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Standard Guide for Developing Representative Background Concentrations at Sediment Sites — Framework Overview, Including Conceptual Site Model Considerations[1]

This standard is issued under the fixed designation E3382; 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 (ε) indicates an editorial change since the last revision or reapproval.

1. Scope

1.1 This guide provides an overarching framework for the development of representative sediment background concentrations at contaminated sediment sites. It is intended to inform, complement, and support but not supersede the guidelines established by local, state, tribal, federal, or international agencies.

1.2 Technically defensible representative sediment background concentrations are critical for several purposes (Guide E3242) (**1**)[2]. These include sediment site delineation, establishing remedial goals, remedy selection, assessment of risks posed by representative background concentrations, and establishing appropriate post-remedial monitoring plans.

1.3 As part of the overall framework presented in this guide, Guide E3240 provides a general discussion of how Conceptual Site Model (CSM) development fits into the risk-based corrective action framework for contaminated sediment sites. However, not all elements of a sediment CSM need to be considered when developing representative sediment background concentrations; those that do are discussed in detail in Section 7 of this guide.

1.3.1 As additional data are collected and analyzed, the CSM should be updated as needed.

1.3.2 This guide is related to several other guides. Guide E3344 describes how to select an appropriate background reference area(s). Guide E3164 covers the sampling methodologies used in the field to obtain sediment samples (whether from the sediment site or background reference area[s]), and Guide E3163 discusses appropriate laboratory methodologies to use for the chemical analysis of potential contaminants of concern (PCOCs) in sediment samples. Guide E3242 describes how to evaluate candidate background data to obtain representative background data sets (including statistical, geochemical, and forensic considerations) and then how to use them to calculate representative sediment background concentrations. Relevant content contained in Guides E3163, E3164, E3242, and E3344 is summarized herein, but the individual guides should be consulted for more detailed coverage of these topics.

1.4 Representative sediment background 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 corrective actions performed under local, state, tribal, federal, and international corrective action programs. However, this guide does not provide a detailed description of the requirements or existing background guidance for each jurisdiction.

1.5 This guide would optimally be applied at the start of any sediment corrective action program but can be initiated at other points in the program as well.

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:*[3]

E178 Practice for Dealing With Outlying Observations

E1689 Guide for Developing Conceptual Site Models for Contaminated Sites

[1] 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.

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[2] The boldface numbers in parentheses refer to a list of references at the end of this standard.

[3] 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.

E2993 Guide for Evaluating Potential Hazard as a Result of Methane in the Vadose Zone
E3163 Guide for Selection and Application of Analytical Methods and Procedures Used during Sediment Corrective Action
E3164 Guide for Sediment Corrective Action – Monitoring
E3240 Guide for Risk-Based Corrective Action for Contaminated Sediment Sites
E3242 Guide for Determination of Representative Sediment Background Concentrations
E3248 Guide for NAPL Mobility and Migration in Sediment – Conceptual Models for Emplacement and Advection
E3282 Guide for NAPL Mobility and Migration in Sediments – Evaluation Metrics
E3300 Guide for NAPL Mobility and Migration in Sediment— Evaluating Ebullition and Associated NAPL/Contaminant Transport
E3344 Guide for Selection of Background Reference Areas for Determination of Representative Sediment Background Concentrations

3. Terminology

3.1 *Definitions:*

3.1.1 *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.

3.1.1.1 *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 components. In this guide, the definition of anthropogenic background includes only the human-made component. **(Guide E3344)**

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. **(Guide E3242)**

3.1.3 *background threshold value (BTV), n*—a measure of the upper limit of representative background concentrations. **(Guide E3242)**

3.1.4 *biogenic, adj*—resulting from the activity of living organisms. **(Guide E2993)**

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

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.

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. **(Guide E3242)**

3.1.7 *corrective action, n*—the sequence of actions that may include site assessment and investigation, risk assessment, evaluations of potential remedial action alternatives, interim remedial action, remedial action, operation and maintenance of the remedy, monitoring of progress, making "No Further Action" determinations, and completion of the remedial action. **(Guide E3240)**

3.1.8 *ebullition, n*—a process of gas (primarily methane) generation in sediments where the quantity of gas generated is sufficient for gas bubbles to nucleate, grow, fracture the sediment, and then escape into the overlying water body.

3.1.8.1 *Discussion*—Depending on the composition of a particular sediment, the gas bubbles generated and released by ebullition may strip constituents out of the sediment and transport these into the overlying water. **(Guide E3300)**

3.1.9 *false outlier, n*—measurements that are very large or small relative to the rest of the data but represent true extreme values of a distribution and indicate more variability in the population than was expected. **(Guide E3242)**

3.1.10 *natural background, n*—naturally occurring substances present in the environment in forms (and at concentrations) that have not been influenced by human activity. **(Guide E3344)**

3.1.11 *non-aqueous phase liquid (NAPL), n*—chemicals that are insoluble or only slightly soluble in water that exist as a separate liquid phase in environmental media.

3.1.11.1 *Discussion*—NAPL may be less dense than water (light non-aqueous phase liquid [LNAPL]) or more dense than water (dense non-aqueous phase liquid [DNAPL]). **(Guide E3248)**

3.1.12 *oil-particle aggregate (OPA), n*—a particle formed in a surface water body resulting from the adherence to (or penetration into) an oil droplet by minerals or organic material. **(Guide E3282)**

3.1.13 *outlying observation, n*—an extreme observation in either direction that appears to deviate markedly in value from other members of the sample in which it appears. **(Practice E178)**

3.1.14 *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. **(Guide E3242)**

3.1.15 *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). **(Guide E3242)**

3.1.16 *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 nontidal body of water. **(Guide E3163)**

3.1.17 *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. **(Guide E3240)**

3.1.18 *sheen, n*—a silvery, rainbow, or dark rainbow film on the water surface. **(Guide E3300)**

3.1.19 *sheen blossom, n*—the emergence of NAPL transported by a gas bubble at the water surface followed by spreading of NAPL into a sheen at the air-water interface. **(Guide E3300)**

3.1.20 *tolerable error rate, n*—the specified maximum acceptable error rate set by the decision maker. **(Guide E3242)**

3.1.21 *true outlier, n*—measurements that are very large or small relative to the rest of the data and are a result of transcription errors, data coding errors, or measurement system problems, or it is not representative of the investigated data population as confirmed by other lines of evidence. **(Guide E3242)**

3.1.22 *upper tolerance limit (UTL), n*—the value below which a specified percentage of observed values falls, with a specified confidence level. **(Guide E3242)**

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

3.1.23.1 *Discussion*—Typically, this is stormwater from city streets and adjacent properties that carries contaminants into receiving waters directly, or indirectly via sewer systems. **(Guide E3344)**

3.2 *Definitions of Terms Specific to This Standard:*

3.2.1 *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.

3.2.2 *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.

3.2.2.1 *Discussion*—The candidate background data set must first be evaluated using the steps described in Guide E3242 and Section 6 to obtain a representative background data set, which can then be used to calculate representative background concentrations for the sediment site.

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

3.2.3.1 *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.

3.2.4 *high nondetect, n*—a nondetect concentration with a highly elevated detection limit; for example, a concentration that resides in the upper decile of the analyte's distribution (that is, a detection limit above the 90th percentile of the data set).

3.2.5 *representative background concentrations, n*—chemical concentrations that are inclusive of naturally occurring sources and anthropogenic sources similar to those present at a sediment site but not related to current or historical site releases or activities.

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

3.2.6.1 *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 calculate representative background concentrations for the sediment site using methodologies described in Guide E3242.

4. Significance and Use

4.1 *Intended Use:*

4.1.1 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 *Updates to CSM:*

4.2.1 The CSM should be updated as needed and refined to describe the physical properties, chemical composition and occurrence, biological features, and environmental conditions of the sediment corrective action project (Guide E1689).

4.3 *Reference Material:*

4.3.1 This guide should be used in conjunction with other ASTM guides listed in 2.1 (especially Guides E3163, E3164, E3240, E3242, and E3344), as well as the material in the References section (including (**1**)).

4.4 *Flexible Site-Specific Implementation:*

4.4.1 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:*

4.5.1 This guide is intended to be applicable to a broad range of local, state, tribal, federal, 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:*

4.6.1 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. 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.

4.7 *Other Considerations:*

4.7.1 This guide does not provide a detailed description of all topics of a program to derive representative sediment background concentrations. It is meant to be used in conjunction with other guides (such as Guides E3163, E3164, E3240, E3242, and E3344) to do so.

4.7.2 Sediment sampling and laboratory analyses are not covered in detail in this guide. Guides E3163 and E3164 contain extensive information concerning sediment sampling and laboratory analysis methodologies.

4.7.3 Data quality objectives are not covered in this guide. Data quality objectives are described in (**2**).

4.7.4 The selection of a background reference area(s) is not covered in detail in this guide but is extensively described in Guide E3344.

4.7.5 Background study design considerations are not covered in detail in this guide, but are extensively described in other references, including Guide E3164 and (**3**).

4.7.6 The use of data evaluation methodologies to obtain representative background data sets from candidate background data sets is not covered in detail in this guide but is discussed in more depth in Guide E3242.

4.7.6.1 Identification and removal of high nondetect values from candidate background data sets are discussed in detail in Guide E3242.

4.7.6.2 Identification and removal of outliers from candidate background data sets are discussed in detail in Practice E178, as well as Guide E3242.

4.7.6.3 Geochemical methodologies used in evaluating candidate background data sets to obtain representative background data sets are discussed in detail in Guide E3242; their applications during reference-area selection are discussed in Guide E3344.

4.7.6.4 Chemical forensics methodologies used in evaluating candidate background data sets to obtain representative background data sets are discussed in detail in Guide E3242; their applications during reference-area selection are discussed in Guide E3344.

4.7.7 The use of statistical methods to calculate BTVs from representative background data sets and to compare such data sets to the site data sets are discussed in detail in Guide E3242.

4.7.8 Geospatial analysis considerations are not thoroughly discussed in this guidance but are discussed in more depth relative to environmental evaluations in (**4**), which focuses on quality assurance concerns relative to geospatial analyses.

4.7.9 In this guide, "sediment" (3.1.16) is defined as a matrix being found at the bottom of a water body. Upland soils of sedimentary origin are excluded from consideration as sediment in this guide.

4.7.10 In this guide, only COC concentrations are considered. Residual background radioactivity is out of scope for this guide.

4.8 *Structure and Components of This Guide:* The user of this guide should review the overall structure and components of this guide before proceeding with use, including:

- Section 1 Scope
- Section 2 Referenced Documents
- Section 3 Terminology
- Section 4 Significance and Use
- Section 5 Overview of Representative Background Concentrations
- Section 6 Framework for Developing Representative Background Concentrations for Sediment Sites
- Section 7 Conceptual Site Model Considerations When Developing Representative Background Concentrations for Sediment Sites
- Section 8 Keywords
- References

5. Overview of Representative Background Concentrations

5.1 *Importance of Representative Background Concentrations:*

5.1.1 It has been recognized for more than three decades that establishing a reliable representation of background is of key importance at contaminated sediment sites (**1, 5, 6**). This guide has been prepared to provide an overarching framework for the development of representative background concentrations at such sites. Technically defensible, representative background concentrations are critical in establishing an appropriate remedial response and providing realistic cleanup levels.

5.2 *Representative Background Concentrations—Anthropogenic and Natural Contributions:*

5.2.1 Anthropogenic background is defined in 3.1.1 and natural background is defined in 3.1.10.

5.2.2 For certain constituents, such as metals, the representative background concentrations contain contributions from both naturally occurring and anthropogenic background sources. For others, such as synthetic chemicals, the representative background concentrations contain contributions from only anthropogenic background sources.

5.2.3 This guide recognizes ongoing background chemical inputs to a sediment site (that are not from current or historical site releases or activities) from point sources (such as discharges from municipal and industrial outfalls) and from non-point and diffuse watershed-wide sources (such as sediment transported from off-site, urban runoff, and atmospheric deposition).

5.3 *Determination of Representative Background Concentrations:*

5.3.1 For sediment sites, the goal is to derive representative background concentrations, which are equivalent to anthropogenic background for man-made chemicals and the combination of naturally occurring and anthropogenic backgrounds for naturally occurring chemicals (such as metals). Technically defensible representative sediment background concentrations

are typically derived using data collected from a site's background reference area(s), which is an area(s) similar to the sediment site but not affected by current or historical site releases or activities. Representative sediment background concentrations can also be extracted from the sediment site data set. Derivation of these representative sediment background concentrations is performed using appropriate statistical and geochemical evaluation methods (refer to Section 6).

5.3.2 At many sediment sites, multiple sources may contribute to the nature and extent of contamination. The largest contributor of contamination at sediment sites is typically current or historical site releases or activities. However, contamination can also result from natural and ongoing anthropogenic sources not related to current or historical site releases or activities.

5.3.3 Off-site contamination not associated with current or historical sediment site releases or activities is considered a component of representative background concentrations and will continue to be a source of contamination to the sediment site unless all transport pathways onto the sediment site are eliminated. Technically defensible representative background concentrations account for any background chemical input (both natural and anthropogenic) that is expected to continue migrating onto the sediment site after the completion of corrective actions.

5.3.4 An important principle for management of contaminated sediment sites is control of background sources of contamination, to the greatest extent practicable, prior to initiating corrective actions. However, it is rarely practicable to control all background sources before corrective action initiation.

5.4 *Use of Representative Background Concentrations:*

5.4.1 Once established, representative background concentrations may be applied as cleanup levels at sites where these derived concentrations are greater than risk-based cleanup levels, thereby setting the scope and scale of the sediment site corrective actions. "The reasons for this approach include cost-effectiveness, technical practicability, and the potential for recontamination of remediated areas by surrounding areas with elevated background concentrations" (**7**). This approach (developed by USEPA) highlights the importance of deriving representative background concentrations that are technically defensible.

5.4.2 Additionally, representative background concentrations can assist in determining sediment site boundaries, understanding risks at a site due to background concentrations, establishing and optimizing realistic long-term monitoring plans, and assessing the performance of corrective actions (Guide E3242).

5.5 *Corrective Action Sustainability:*

5.5.1 In the absence of technically defensible representative background concentrations, risk-based cleanup levels may be used inappropriately at sediment sites where representative background concentrations would actually be greater than the risk-based cleanup levels. Similarly, if the representative background concentrations have been erroneously calculated, inappropriately low cleanup goals could be used in the corrective action evaluation process. Under both circumstances, surface sediments may initially meet all chemical concentration-based remedial objectives (such as cleanup levels) upon corrective action completion, but they will eventually return to representative background concentrations at some time after completion, and the cleanup levels will again be exceeded.

5.5.1.1 Due to inappropriate cleanup levels based (in part) on the selection of unrepresentative background concentrations, perceived failure of the corrective action has been observed at numerous sediment sites throughout the United States, under both federal and state jurisdiction (**8**). The framework outlined in this guide is intended to avoid costly perceived remedy failures due to recontamination (that is, equilibration to representative background sediment concentrations) by highlighting approaches to obtain technically defensible, representative background concentrations.

5.5.2 Attempting to implement corrective actions to achieve concentrations less than representative background is not sustainable over the long term and can require considerable expenditures that serve no environmental or public health purpose. The framework described in this guide, as well as components of this framework described in more detail in Guides E3163, E3164, E3240, E3242, and E3344, is intended to help promote a scientifically sound approach for establishing representative background concentrations, leading to corrective action decisions that avoid costly perceived corrective action failures at sediment sites. Once derived, these representative background concentrations should ideally remain fixed for the duration of the remedial investigation and remedial response processes. This will help to ensure long-term remedy success, a goal shared by all stakeholders.

5.5.3 Long-term remedy success depends on the degree of site understanding. This guide highlights CSM elements (which are not discussed in Guides E3163, E3164, E3242, and E3344) whose consideration is necessary to achieve a more complete understanding of the historical and current inputs to the sediment site for derivation of representative background values.

5.6 *Status of Regulations, Standards, and Guidance:*

5.6.1 Local, tribal, and individual state regulatory agencies may have background guidance documents for different matrices such as soil, groundwater, or sediments. However, a comprehensive review of these background documents is out of scope for this guidance. As stated in 4.5.1, the users of this guide need to be aware of the regulatory requirements and guidance applicable in the jurisdiction where the work is being performed.

5.6.2 In the United States, the Interstate Technology and Regulatory Council (ITRC) has published guidance on determining representative soil background concentrations at upland sites (**9**). However, ITRC has not published guidance specifically targeting background at sediment sites.

5.6.3 At the federal level in the United States, the U.S. Environmental Protection Agency (USEPA) discusses background in a number of documents (**1**, **3**, **5**, **10**, **11**, **12**, **13**, **14**, **15**, **16**, **17**, **18**), but technical guidance specific to background at sediment sites (as opposed to soil and groundwater at upland sites, which are the topic for these referenced USEPA documents) has not been issued by USEPA. However, technical

guidance for background at sediment sites has been issued by the U.S. Department of Navy (**19**).

5.6.4 Internationally, guidance documents regarding the derivation of representative background concentrations have also been published (**20**, **21**, **22**, **23**, **24**); these are examples of international guidance and not a comprehensive list, which is out of scope for this guidance. Again, this guidance is focused on soil and groundwater at upland sites; no sediment-specific background guidance has been published (other than Guides E3242 and E3344).

5.6.5 Practitioners should be aware of background guidance documents that are applicable to the jurisdiction in which the sediment site is located. Even if the background guidance is not specifically for sediments, but is for soil or groundwater at upland sites, regulators may attempt to utilize concepts and methodologies from their upland guidance at sediment sites under their jurisdiction.

5.6.6 Application of background guidance for soil and groundwater at upland sites may not be appropriate at sediment sites. Sediment sites have many different characteristics that are not present at upland sites (Guide E3248), including physical characteristics, geochemical characteristics, biological characteristics, and different contaminant emplacement and transport.

5.6.7 This guide and its associated guides (Guides E3163, E3164, E3240, E3242, and E3344) have been developed (in part) to fill a gap due to the absence of existing guidance from various regulatory agencies for the derivation of representative background concentrations for contaminated sediment sites.

6. Framework for Developing Representative Background Concentrations for Sediment Sites

6.1 *Framework Overview:*

6.1.1 Fig. 1 presents the overall framework to calculate representative background concentrations at a sediment site. This guide (refer to Section 7) provides a detailed discussion of the first step in the process. The other steps in the process are described in detail in other guides. However, brief descriptions of all the other steps in this framework are provided in this section, along with references to other guides where more a detailed discussion of each step is offered (if applicable).

6.2 *Sediment Site Preliminary CSM Development and Identification of Elements Needed to Develop Representative Background Concentrations (refer to Guide E3240):*

6.2.1 As a first step in this framework (Fig. 1), a thorough understanding of the sediment site is necessary. This can be accomplished by developing a preliminary CSM for the sediment site (Guide E3240), which includes the initial identification of contaminant sources (and PCOCs associated with them), exposure pathways, and receptors. Refer to Section 7 for a detailed discussion of the elements of the CSM needed to develop representative background concentrations.

6.2.1.1 As part of this CSM, the sediment site PCOCs must be identified. Guide E3240 describes the process of performing a tiered evaluation to first screen sediment site PCOC concentrations against generic sediment criteria developed using conservative exposure and toxicity assumptions. The sediment site data are then further screened against sediment criteria developed using site-specific information, with the concept being that screening criteria can be made less stringent by the incorporation of site-specific information. Application of this tiered screening process leads to identification of a COC list (that is, any PCOC whose concentration in the sediment at the sediment site exceeds the risk-based criteria) for the sediment site.

6.2.1.2 Only a subset of the elements required for a preliminary sediment site CSM (that is, the contaminant sources and associated PCOCs) are needed for the development of representative background concentrations for the sediment site.

6.3 *Selection of Background Reference Areas for Determination of Representative Sediment Background Concentrations (refer to Guide E3344):*

6.3.1 Once the preliminary CSM has been developed for the sediment site, a suitable background reference area(s) can be identified for sampling. Considerations and methodologies for identifying an appropriate background reference area(s) are described in detail in Guide E3344.

6.3.2 In general, determination of representative background concentrations requires additional sampling away from the area(s) where current or historical site releases or activities have contaminated the sediment site. This process typically involves identifying a suitable background reference area(s), which should have physical, chemical, geological, biological, and anthropogenic characteristics as similar as possible to the sediment site being investigated but should not have been affected by current or historical sediment site activities or releases. This background reference area(s) should include ongoing and uncontrolled sources similar to those (or the same, if an unimpacted area of the sediment site is being used as the background reference area[s]) that will continue to contribute contaminant concentrations to the sediment site (Guide E3344) (**7**, **19**).

6.3.2.1 In addition, the background reference area(s) should have a similar land use to the subject site (for example, if the subject site is in an industrial area, the background reference area(s) should be in an industrial area). As described in Guide E3344, the background reference area(s) should be as similar to the site as possible, but it is recognized that there will always be differences between the two. USEPA notes that for soils, "the ideal background reference area would have the same distribution of concentrations of the chemicals of concern as those which would be expected on the site, if the site had never been impacted" (**3**).

6.3.3 If a suitable off-site background reference area(s) cannot be identified, nonimpacted site data may be extracted to obtain a candidate background data set (Guide E3242) (**7**, **9**).

6.3.3.1 All samples of suitable quality and usability collected within the background reference area(s) are included as part of the candidate background reference area data set.

6.3.4 Typical components of a background reference area sampling design include media type (that is, bulk sediment samples); the number and type of samples; sampling depth; sampling methodology; and laboratory/chemical analyses (including quality assurance, quality control, and data validation requirements). Design components of sampling procedures,

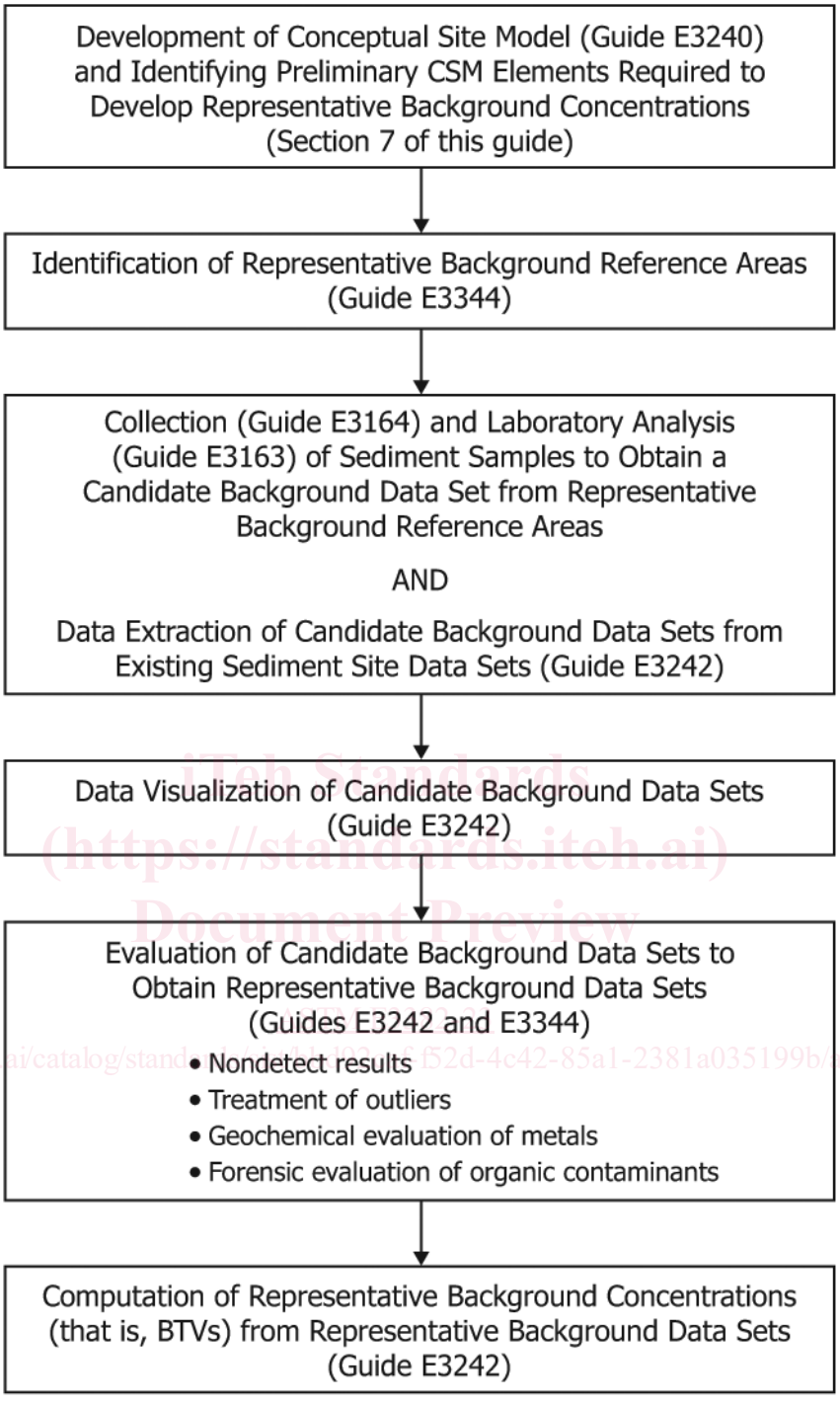

FIG. 1 Framework to Determine Representative Sediment Background Concentrations

including determination of the number of samples based on statistical methodologies, are described in (**19**, **25**, **26**, **27**).

6.3.5 Selection of an off-site background reference area(s) analogous to the sediment site is complicated by the fact that sediment background often represents mixtures of naturally occurring and anthropogenic influences. In some cases, these mixtures yield geographically distinct background populations (that is, background reference subareas with varying degrees of anthropogenic influences in different parts of the background reference area[s]). Under such situations, the part of the targeted background reference area(s) (or subareas) that is most analogous to the sediment site must be selected as the background reference area(s). Any other choice would result in nonrepresentative candidate background data sets.