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**Division of Environmental Science & Assessment**
**Hazardous Waste Support Branch**

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# U.S. EPA REGION 2
# BROWNFIELDS PROJECT PLANNING GUIDANCE

## Volume 1: Brownfields Assessment Overview

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## Volume 1: Brownfields Assessment Overview

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## DISCLAIMER

The ***"U.S. EPA Region 2 Brownfields Project Planning Guidance"*** is a tool for streamlining the planning of a Brownfields Assessment and preparing supporting Quality Assurance (QA) documentation. This guidance presents an overview of the U.S. EPA Region 2 Brownfields Assessment process and a compendium of supplemental reference materials. In addition, it provides U.S. EPA Region 2 Brownfields grant recipients with an approved generic Quality Assurance Project Plan (QAPP) boilerplate, and a template for creating site-specific Sampling, Analysis, and Monitoring Plans (SAMPs). This guidance is ***not*** intended to be used as a project planning tool for performing Superfund National Priority List (NPL) investigations. The technical specifications outlined herein do ***not*** supercede state, local, and site-specific Applicable or Relevant and Appropriate Requirements (ARARs) and/or site-specific To Be Considereds (TBCs) and *New Jersey Technical Requirements for Site Remediation, N.J.A.C. 7:26E* which take precedence for Brownfields sites in New Jersey. The procedures set forth in this document are intended entirely as guidance for U.S. EPA Region 2 Brownfields grant recipients and do not constitute rule-making or policy. These guidelines describe the principles and best practices for establishing Brownfields Assessment Quality Assurance/Quality Control (QA/QC) protocols based upon program experience.

# FOREWORD

When undertaking a Brownfields Assessment, matrices of unknown composition, such as potentially contaminated soil and water, are sampled to determine the need for remediation. This environmental monitoring process focuses on identifying, locating, and characterizing the nature and extent of contamination at a particular site. These sampling efforts are essential for accurately identifying hazardous wastes and contaminated aquifers to protect human health and the environment.

To facilitate this process the U.S. EPA created the Brownfields Economic Redevelopment Initiative in 1993. This initiative provides funding and support to local municipalities to assess and safely clean up Brownfields sites to promote their reuse. 40 CFR 31.45 Subpart C establishes uniform administrative rules for federal grants, cooperative agreements, and sub-awards to state, local, and Indian tribal governments.

***40 CFR 31.45 Quality Assurance***

*If the grantee's project involves environmentally related measurements or data generation, the grantee shall develop and implement quality assurance practices consisting of policies, procedures, specifications, standards, and documentation sufficient to produce data of quality adequate to meet project objectives and to minimize loss of data due to out-of-control conditions or malfunctions. [53 FR8076, Mar. 11, 1988]*

40 CFR 31.45 Subpart C requires U.S. EPA Brownfields grant recipients undertaking environmental monitoring initiatives to develop and implement Quality Assurance (QA) procedures to ensure resulting data are adequate for their intended use. To facilitate these efforts the ***"U.S. EPA Region 2 Brownfields Project Planning Guidance"*** was prepared to assist our stakeholders in planning a Brownfields project and preparing supporting QA documentation. Therefore, we are pleased to provide this publication and believe that it will be of considerable value to any interested party wishing to undertake a Brownfields Assessment.

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## ABSTRACT

The ***"U.S. EPA Region 2 Brownfields Project Planning Guidance"*** is a two volume reference document which defines the Quality Assurance (QA) requirements for U.S. EPA Region 2 Brownfields pilot projects. It is a tool for streamlining the planning of a Targeted Brownfields Assessment and preparing supporting QA documentation. The first volume presents an overview of the U.S. EPA Region 2 Brownfields Assessment process and a compendium of supplemental reference materials. The second volume provides U.S. EPA Region 2 Brownfields grant recipients with an approved generic Quality Assurance Project Plan (QAPP) boilerplate, and a template for creating site-specific Sampling, Analysis, and Monitoring Plans (SAMPs) to document the investigation of individual properties.

This project planning guidance is derived from the ***U.S. EPA Region 2 CERCLA Quality Assurance Manual***, the ***U.S. EPA Quality Assurance Guidance for Conducting Brownfields Site Assessments***, the ***Superfund Program Representative Sampling Guidance***, and the ***Sampler's Guide to the Contract Laboratory Program (CLP)***. The issuance of this QA manual serves as an update of the initial U.S. EPA Region 2 Brownfields Project Planning Guidance issued in 1997. It does not supercede any previously approved generic QAPP currently in place with any local municipality initiating a U.S. EPA Region 2 Brownfields pilot project.

The significance of this project planning guidance is that utilization of the accompanying generic QAPP boilerplate enables U.S. EPA Region 2 Brownfields grantees to comply with the QA provisions set forth in 40 CFR 31.45 Subpart C. It contains all of the pertinent technical information an environmental professional would require to plan and initiate a Brownfields Assessment. In addition, it discusses the development of viable remedial alternatives for the design and implementation of an appropriate cleanup strategy to prepare Brownfields properties for reuse. It is important to understand that there is no single correct way to perform a Brownfields investigation. Rather, this guidance provides the environmental professional with a means to design a Brownfields investigation taking into account the needs of the client, site, and other non-standard factors (community, property marketability, etc.).

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Appendix E: U.S. EPA *Guidance for Conducting Remedial Investigations and Feasibility Studies under CERCLA*

Appendix F: U.S. EPA *Superfund Remedial Design and Remedial Action Guidance*

## INTRODUCTION

The United States Environmental Protection Agency (U.S. EPA) defines Brownfields sites as "abandoned, idled, or under-utilized industrial and commercial facilities where expansion or redevelopment is complicated by real or perceived environmental contamination." To facilitate the revitalization of these properties, the U.S. EPA established its Brownfields Economic Redevelopment Initiative in 1993. This initiative provides funding and support to U.S. EPA Region 2 states, tribes, commonwealths, local communities, and other stakeholders to work together in redeveloping Brownfields properties. To further this process, many states and local jurisdictions are also introducing initiatives to help businesses and communities adapt environmental cleanup programs to the special needs of Brownfields sites.

Preparing a Brownfields site for a productive reuse requires the integration of many diverse elements. The environmental professional must incorporate financial issues, community involvement, liability considerations, and regulatory requirements into site assessment and cleanup decisions. To adequately address these issues necessitates the careful coordination among many groups of stakeholders. Therefore, the success of a Brownfields revitalization project requires the assessment and cleanup of a site be carried out in a manner which integrates all of these critical factors into the overall redevelopment process.

The process of revitalizing abandoned or under utilized commercial facilities where redevelopment is complicated by real or perceived environmental contamination is referred to as a " Brownfields Assessment." This process typically involves the coordination of one or more site investigations and clean up activities. For instance, to determine the likelihood of contamination, a preliminary (Phase I) site assessment consisting of a historical/background review and a site inspection may be initiated. Subsequently, to identify the types and concentrations of contamination, including the areas requiring remediation, may necessitate a full (Phase II) site investigation where sampling activities are performed. In accordance, the establishment of viable clean up options with corresponding cost estimates based on future uses and property redevelopment plans are other factors requiring consideration.

When undertaking a Brownfields revitalization project it is important to recognize that each property may offer a unique set of site-specific characteristics and circumstances which merit consideration. This necessitates the environmental professional to make allowances for property size/topography, prior use, contaminants of concern, matrices of concern, and anticipated reuse. As a result, cleanup strategies are almost always site-specific. At some sites, cleanups may be completed before a property is transferred to its new owners. At other sites, cleanups may take place simultaneously with construction and redevelopment activities. Regardless of when and how a cleanup is accomplished, the challenge to any Brownfields program is to remediate sites quickly and redevelop these properties in ways which benefit both the community and its local economy.

To gain insight into the many tasks necessary for securing the revitalization and redevelopment of a Brownfields property, it is advantageous to follow an accepted guide when planning these activities. To facilitate these efforts, the ***U.S. EPA Road Map to Understanding Innovative Technology Options for Brownfields Investigation and Cleanup*** [1] and the ***U.S. EPA Tool Kit of Information Resources for Brownfields Investigation and Cleanup*** [2] are provided as appendices to this guidance. These guidance documents discuss Brownfields project planning requirements, historical/background review protocols, site investigation techniques, remedial alternatives, and procedures for evaluating and reporting collected information. In addition, these guides also provide a compendium of information resources which can assist an environmental professional with conducting Brownfields Assessments. For an overview of the U.S. EPA Region 2 Brownfields Assessment process, refer to Figure 1.0 found on page 2 of this guidance which illustrates the sequence of tasks required to revitalize and redevelop a Brownfields property.

# *CHAPTER 1*

## 1.0 PHASE I BROWNFIELDS SITE ASSESSMENT

The purpose of a Phase I Brownfields Site Assessment is to determine the likelihood of contamination at a particular property by collecting and reviewing available information about a site. This "environmental assessment" is an initial investigation performed by conducting a search of historical records. This data collection effort gathers pertinent information about past and current environmental conditions as well as historical uses of the site.

This environmental audit is essentially a systematic process for determining the likelihood of whether a particular property has been affected by actual or potential environmental contamination. There are four principal components for conducting a Phase I Brownfields Site Assessment. These components are: a) Project Planning, b) Historical/Background Review, c) Site Reconnaissance, and d) Evaluation and Reporting of Collected Information.

The information compiled during this initial step of a Brownfields project is extremely important in identifying and evaluating plausible site assessment and cleanup technologies. It is also most useful for determining whether a property can be remediated to a cleanup level necessary for supporting its intended reuse. These assessments prove vital in identifying and addressing community needs. To facilitate these efforts, consideration should always be given to developing social and economic profiles, and identifying acceptable environmental risk.

### 1.1 Project Planning

Project planning is the first step often taken to initiate a Phase I Brownfields Site Assessment. It involves performing those activities integral to the development of an efficient sampling and analysis design which allows for the collection of appropriate data. These activities include forming a project team, conducting a project scoping meeting, and developing project planning deliverables (work plan, health & safety plan, quality assurance project plan, etc.).

Delineating project planning deliverables is essential for documenting the scope of work inherent to undertaking a Brownfields site assessment. This is often accomplished by developing a work plan to outline project objectives, tasks, procedures, resources, schedule, and budget. Work plans are an accepted management technique to assist in directing a consultant retained to perform a comprehensive Brownfields Assessment. Although the development of Brownfields Assessment work plans and health and safety plans are prerequisites of the cooperative agreement, they do not require U.S. EPA approval.

## 1.2 Historical/Background Review

The historical/background records review component of any Phase I Brownfields Site Assessment should always try to encompass information about all previous property usage. Records pertinent for review should include: Sanborn Fire Insurance Maps, aerial photographs, permits and inspection records, title and deed, topographic quadrangles, and federal, state, and local government files. Information that should be obtained is a description of past industrial/commercial usage of the site. This includes all raw materials, finished products, formulations (intermediates and by-products), hazardous substances and wastes. Production processes, discharges and disposal points, and material handling and storage (above and below ground tanks and ground product lines), surface impoundments, landfills, septic systems, and other structures, vessels, conveyances or units are also essential to the site assessment process. Other relevant information, such as demographics, socioeconomic data, water resources data, and soil resource data, can be derived from the Census Bureau, U.S. Geological Survey, Soil Conservation Service, database companies, and the Internet. The collection and review of this information enables the environmental professional to assess the physical setting of a property, site concerns, the nature of current and past operations as well as adjacent property impacts. As a result, these determinations provide valuable insight into the planning of site reconnaissance and subsequent evaluation activities.

## 1.3 Site Reconnaissance

Performing a Brownfields site reconnaissance can prove to be a useful technique for corroborating background information as well as a means for determining the need to collect additional data. This component of a Phase I Brownfields Site Assessment should always be organized in a manner to ensure that any relevant environmental concerns are recognized. Site reconnaissance efforts should always attempt to resolve chemical fate and transport issues including sources, migration pathways, and potential points of entry. This will identify problems with known chemical/fuel storage and handling areas, visible releases to sewers, septic systems or water bodies, building conditions/debris, and underground services/utilities. Therefore, to ensure the validity of a Phase I Brownfields Site Assessment, an inspection of the property should always be performed to evaluate past facility operations and potential effects imparted to the local environment. Consequently, this information is integral to the Brownfields Assessment process because it will form the basis for developing an efficient sampling and analysis design.

## 1.4 Initiating a Brownfields Removal Action

At the conclusion of a Phase I Brownfields Site Assessment, it may become evident that there are hazardous substances on the property which pose an imminent threat to human health and the environment. Such environmental hazards may necessitate that immediate actions be taken to abate contamination of this type. The immediate remediation activities taken to stabilize or clean up acute environmental waste hazards are referred to as “removal actions.” Removal actions typically involve the disposing of tanks or drums containing hazardous substances that are found on the surface of a property and installing drainage controls or security measures, such as fencing at the site. Removal actions are also conducted to mitigate accidental releases of hazardous materials as well. In practice, removal actions should always be initiated whenever an imminent threat to human health and the environment is encountered during this or any phase of a Brownfields Assessment project. When such situations are encountered, contact the designated U.S. EPA Brownfields pilot project On-Scene Coordinator (OSC) or the National Response Center (NRC) at (800) 424-8802 to initiate a removal action.

## 1.5 Evaluation and Reporting of Collected Information

The last component of the Phase I Brownfields Site Assessment process is to evaluate the resulting information and assemble it into a final report. It is essential to evaluate and present this information in a concise manner so that all stakeholders clearly understand the significance of the site assessment findings. The format and content of the Phase I Brownfields Site Assessment report must be all inclusive. For example, the report should include a summary of any data gaps, limiting conditions, maps, figures, photographs, references, and all necessary supporting documentation are essential. Upon completing the site assessment report, a copy should always be provided to the subject state or commonwealth environmental regulatory agency for their information. It is important to understand that this report will form the basis for documenting the Phase I Site Assessment of a Brownfields property. It will also serve as a reference for addressing any subsequent concerns which can arise regarding the environmental condition of the site.

## 1.6 Phase I Brownfields Site Assessment Information Resources

To ensure Phase I Brownfields Site Assessment historical data review reports and supporting topographic information are properly assembled, it is advantageous to follow an accepted guide on conducting a preliminary environmental investigation. Fortunately, there are many guides specific to performing Phase I site assessment activities available (ASTM E 1528 [3], ASTM E 1527 [4], U.S. Postal Service *Facilities Environmental Guide* [5], N.J. DEP *Technical Requirements for Site Remediation* [6], etc.). These guidance documents discuss project planning, historical/background review, site reconnaissance, and the evaluation and reporting of collected information. As such, the ***U.S. EPA Guidance for Performing Preliminary Assessments Under CERCLA*** [7] is the agency's formal site assessment protocol. To facilitate these efforts, the U.S. EPA Preliminary Assessment Guide is included as an appendix to this document. It should be noted that although a variety of accepted protocols exist for conducting a Phase I site assessment, a single guidance should be used exclusively to avoid confusion.

# *CHAPTER 2*

## 2.0 PHASE II BROWNFIELDS SITE INVESTIGATION

The revitalization of a Brownfields property is an iterative process which requires the coordination of many connected activities. In accordance, the second step in the assessment process is to conduct a Phase II Brownfields Site Investigation. This phase of the Brownfields Assessment process focuses on identifying, locating, and characterizing the nature and extent of contamination (if present) inherent to a property. It often involves sampling and analyzing matrices of unknown composition, such as potentially contaminated soil and water, to determine the need for remediation.

A Phase II Brownfields Site Investigation is typically carried out in a staged manner to encourage a continual derivation of the site characterization effort. The conceptual model for undertaking a site investigation will focus on designing an environmental monitoring network which will minimize the collection of unnecessary samples and establish contingencies to maximize data quality. The work breakdown structure comprising this site investigation model will involve: a) Project Planning/Scoping, b) Site Characterization, c) Sample Analysis, d) Data Management, Validation and Evaluation, e) Preliminary Risk Assessment, and f) Data Summation and Evaluation of Information Needs.

To construct a comprehensive site investigation effort, the information gathered from a Phase I Brownfields Site Assessment should be used to design a plausible environmental monitoring network. This information will assist in determining the environmental matrices of concern, sampling locations, analytical parameters, and their frequency for collection. The Phase II Brownfields Site Investigation will essentially focus on collecting environmental data which are of an appropriate quality to determine the nature and extent of contamination inherent to a property. In addition, this data collection effort can also be undertaken to assess contaminant migration pathways or to conduct a preliminary risk assessment for ascertaining any potential threats to human health and the environment.

It is important to note that one should only initiate a Phase II Brownfields Site Investigation when the preliminary site assessment results indicate the actual or potential existence of hazardous materials. Likewise, it would also be prudent to perform Phase II monitoring in order to complete data gaps essential for determining the overall condition of a site. Nonetheless, it provides the necessary information needed to characterize a property, define site dynamics, delineate risks, and develop programs to mitigate or eliminate potential adverse human health and environmental impacts. These results are integral because they will ultimately form the basis for establishing practical cleanup goals to enable the redevelopment and reuse of a Brownfields property.

### 2.1 Project Planning/Scoping

Project planning/scoping are the initial series of activities often taken to begin a Phase II Brownfields Site Investigation. These activities will involve assembling a project team, holding a project scoping meeting, and developing project planning deliverables. Due to the complexity and cost of a site investigation, developing an efficient sampling and analytical scheme in this manner will assist in the collection of appropriate data.

Upon the formation of a project team, it is customary to plan a Phase II Brownfields Site investigation by holding a series of “scoping” or “kick-off” meetings. These meetings should include all of the pertinent

Brownfields stakeholders and environmental professionals needed to define the objectives for undertaking a site investigation. Typically, project scoping sub-tasks will involve:

- Evaluating existing historical data.
- Performing a site visit to compare current site conditions with those reported in the site assessment report, and to identify site boundaries, including potential on-site and off-site migration pathways.
- Developing a hypothesis to depict the nature and extent of contamination through the use of a conceptual site model to promote the completion of a site-specific Sampling, Analysis, and Monitoring Plan (SAMP).
- Identifying potential Applicable or Relevant and Appropriate Requirements (ARARs) and To Be Considereds (TBCs) as cleanup criteria.
- Discussing the findings of the previous sub-tasks with Brownfields stakeholders at an external scoping meeting to determine if the preliminary understanding of site conditions and requirements are realistic.
- Designing a data collection program which delineates data requirements and data quality objectives.
- Defining Preliminary Remediation Goals (PRGs).
- Defining preliminary response actions to implement the PRGs.
- Delineating the "final" scope of work, project planning deliverables, schedule, and budget.
- Establishing project planning deliverables [Health and Safety Plan (HASP), generic Quality Assurance Project Plan (QAPP), and site-specific Sampling, Analysis, and Monitoring Plan (SAMP)].

The establishment of project planning deliverables is an important component because it provides a mechanism for documenting the scope of work inherent to the undertaking of a site investigation. This is often performed by developing a work plan to delineate project objectives, tasks, procedures, resources, schedule, and budget. As previously stated, work plans are an accepted management technique to assist in directing a consultant retained to perform a comprehensive Brownfields Assessment. Although the development of Brownfields Assessment work plans and health and safety plans are prerequisites of the cooperative agreement, they do not require U.S. EPA approval.

In practice, it can be most difficult to separate important Quality Assurance/Quality Control (QA/QC) activities from technical performance functions when planning a Phase II Brownfields Site Investigation. Hence, QAPPs and site-specific SAMPs are integral components typically comprising a site investigation work plan. 40 CFR 31.45 Subpart C requires U.S. EPA Brownfields grant recipients performing environmental related measurements to develop and implement quality assurance procedures to produce data adequate for their intended use.

***40 CFR 31.45 Quality Assurance***

*If the grantee's project involves environmentally related measurements or data generation, the grantee shall develop and implement quality assurance practices consisting of policies, procedures, specifications, standards, and documentation sufficient to produce data of quality adequate to meet project objectives and to minimize loss of data due to out-of-control conditions or malfunctions. [53 FR8076, Mar. 11, 1988]*

To ensure compliance with the quality assurance requirements set forth in 40 CFR 31.45 Subpart C, Brownfields QAPPs and resulting site-specific SAMPs require U.S. EPA approval and possible subject state regulatory agency concurrence. Volume 2 of this guidance provides U.S. EPA Region 2 Brownfields grant recipients with an agency approved generic QAPP boilerplate and supplemental reference materials to facilitate project plan preparation and approval. It also includes a template for creating site-specific SAMPs for documenting the investigation of individual Brownfields properties within a municipality.

The U.S. EPA Region 2 generic Brownfields QAPP boilerplate delineates project organizational and procedural standards for assuring the quality of site investigation environmental measurement data. In this manner it serves to document the Brownfields site investigation project planning process for formulating "Acceptance or Performance Criteria" to enhance the credibility of sampling results. Consequently, following the U.S. EPA Region 2 generic Brownfields QAPP boilerplate will promote the acquisition of data which are of a known quality while reducing errors and the expending of resources to correct them.

The technical specifications inherent to the U.S. EPA Region 2 generic Brownfields QAPP boilerplate focus on depicting the QA/QC and sampling criteria necessary to performing a site investigation for our grant recipients. It delineates a sampling and analytical scheme which recommends that a portion of the applicable samples collected during a Brownfields site investigation undergo fixed laboratory confirmatory analyses. In accordance, the elements which comprise the QA/QC program outlined in the U.S. EPA Region 2 generic Brownfields QAPP boilerplate are as follows:

- Staff Organization and Responsibility (Form B).
- Standard Operating Procedures (SOPs) for Sampling and Analytical Methods (Form F-1).
- Field and Laboratory Calibration Procedures (Forms H and J).
- Field Quality Control Requirements (Form M).
- Data Assessment Procedures (Form O).
- Data Reduction, Validation, and Reporting Procedures (Forms P, Q-1, Q-2, and R).

In conjunction, the elements which form the basis of the sampling specifications delineated within the generic QAPP boilerplate are as follows:

- Sampling Design (Form E).
- Sampling Methods (Form F-1).
- Sample Handling and Custody (Form K).
- Analytical Methods (Form F-1 and F-2).
- Field Quality Control Requirements (Form M).
- Instrument/Equipment Testing, Inspection, and Maintenance (Forms G and I).
- Instrument Calibration Frequency (Form J).
- Data Management (Form N).

Utilization of the U.S. EPA Region 2 generic Brownfields QAPP boilerplate is appropriate when a grant recipient will perform similar activities at multiple sites and/or conduct minimal sampling activities. However, there may be instances where the envisioned scope of work may involve undertaking a site-specific comprehensive Brownfields Assessment. Unfortunately, the exclusive utilization of the U.S. EPA Region 2 generic Brownfields QAPP boilerplate will not be sufficient in these situations. Consequently, to delineate the technical specifications explicit to undertaking the investigation of an individual Brownfields property requires

the development of a site-specific SAMP supplement.

To fulfill this need, the companion document to the U.S. EPA Region 2 generic Brownfields QAPP boilerplate is an accompanying site-specific SAMP template. The SAMP template is a supplement to be used by U.S. EPA Region 2 Brownfields grant recipients to describe in detail how they will go about performing a site-specific comprehensive Brownfields Assessment. It is to be used for summarizing previous results, subsequent field activities, pertinent field methodologies for implementation, and data reporting requirements. In many instances the management of most Brownfields sites will be subject to state or commonwealth environmental regulatory authority. Therefore, site-specific SAMPs should always be submitted to the subject state or commonwealth environmental regulatory agency for approval prior to such sampling taking place.

Following the U.S. EPA Region 2 generic Brownfields QAPP boilerplate will ensure that the environmental measurement data generated in accordance with this guide will be precise, accurate, representative, comparable, and complete. Likewise, it will provide the environmental professional with data which are scientifically valid and legally defensible to make appropriate decisions concerning the site. Therefore, this project planning guidance establishes the necessary technical specifications for conducting site-specific comprehensive Brownfields Assessments to facilitate the revitalization of these properties.

## 2.2 Site Characterization

To identify the type and concentration of contaminants which may exist at a Brownfields site, sampling activities are typically undertaken to determine the need for remediation. The implementation of field characterization activities will typically begin upon finalization of the specified project planning deliverables (Work Plan, Health & Safety Plan, generic QAPP, and site-specific SAMP). This will involve implementing the technical specifications delineated in the site-specific SAMP for collecting, analyzing, validating and evaluating all pertinent environmental measurement data.

The site characterization process encompasses the collection, analysis, and assessment of field sampling data to determine if a Brownfields property may pose a threat to human health and/or the environment. The activities for performing a site characterization will consist of undertaking field operations traditionally involving mobilization, sample/data collection, and demobilization. These efforts are essential because they provide the means for enabling subsequent supplementary data acquisition and compilation activities which are necessary to complete a Phase II Brownfields Site Investigation project.

### 2.2.1 Mobilization

To perform environmental sampling and data collection efforts, a number of critical support activities must be undertaken to initiate field operations. The support activities which are commonly performed in preparation of field operations are referred to as “mobilization” efforts. Mobilization activities will typically involve the logistical planning and deployment of equipment, services, and staff essential to support field operations. For instance, logistical planning activities may include obtaining the necessary agreements to detail site access/egress restrictions to those areas of the property undergoing investigation (including upgradient and/or background locations). Similar efforts may include obtaining the appropriate permits to enable activities such as monitoring well installation, as well as, laying out and constructing on-site support/safety zones.

In addition to logistical planning, the assembling of equipment, services and staff are corresponding mobilization

activities essential to enable the commencement of field operations. This involves providing on-site support facilities and services such as command post trailers, utilities, equipment and supplies, portable restrooms and storage accommodations for the testing and/or disposal of Investigation Derived Wastes (IDWs). When necessary, these efforts may also include the procurement of pertinent subcontractors such as analytical laboratory services to perform designated environmental sample analyses. It should be noted that a thorough mobilization will always include developing and providing an initial health and safety debriefing for all project team members who will be performing field operations.

### 2.2.2 Sample/Data collection

The focus of site characterization field operations will always primarily center upon the initiation of environmental sample and data collection activities. These activities are typically undertaken in accordance with the technical specifications delineated in the associated site-specific SAMP to ensure sampling operations are relevant and appropriate. In this endeavor, the field team will concentrate its efforts to acquire the necessary environmental measurement data required to satisfy the envisioned project objectives. For a Brownfields site characterization effort, typical project objectives may include:

- Confirmation of the conceptual facility model.
- Verification of previous field screening and/or site characterization results.
- Characterization of the vertical and horizontal extent of contamination inherent to a property.
- Characterization of the potential contaminant transport pathways inherent to a property.
- Delineation of potential impacts and effects on receiving media.
- Collection of engineering data to formulate pertinent response/corrective actions.
- Evaluation of probable remediation technologies appropriate for the envisioned re-use of a property.

When undertaking a Brownfields site characterization project, the sampling of potentially contaminated matrices may be required to collect the necessary measurement data to assess the need for remediation. Conventional environmental sample matrices commonly designated for collection include soil, sediment, groundwater, surface water, tissue, biota and air. In conjunction, the sampling of wastes such as process wastes, drum and tank contents or other anthropogenic wastes may also be warranted to characterize a property. However, it is important to note that field operations may require other data collection efforts in addition to the sampling of potentially contaminated matrices. This data may include, but not be limited to, surveying surface features (natural and manmade), geology, hydrology, meteorology, demographics (human populations), land usages, habitats, and identification of endangered and/or threatened species to complete a site characterization project.

The conclusion of any site characterization project should always result in the acquisition of environmental measurement data adequate to promote correct decision making when revitalizing a Brownfields property. To ensure data are of an appropriate quality for decision making, QA/QC parameters are traditionally delineated for assessing measurement error. Often the number and type of QC sample audits will differ for each site-specific Brownfields investigation. This is attributed to the fact that project objectives and "Acceptance or Performance Criteria" will inherently vary between Brownfields properties. As a result, QA/QC criteria comprising a Brownfields data collection program are to be outlined in a site-specific SAMP for the purpose of planning and documenting the dynamics for evaluating data quality.

In practice, a comprehensive QA/QC program will specify QC checks for both field and laboratory activities. Typical field QC audits will usually consist of field blank (deionized water blank), trip blank, equipment rinsate

blank, and collocated/replicate samples. Alternately, laboratory QC audits will consist of method blank, matrix spike/matrix spike duplicate, surrogate spike, continuing calibration verification, continuing calibration blank, and performance evaluation samples. The U.S. EPA Region 2 generic Brownfields QAPP boilerplate puts forward a scheme for QC check analyses to occur at a 5% minimum frequency of the total number of samples collected during a site investigation. With regard to equipment rinsate blanks, one sample should be collected for each type of equipment used each day a decontamination event is carried out.

To enhance the overall site characterization process, a number of in-situ analytical support tools can be employed in the field to facilitate the environmental measurement process. These in-situ analytical support tools such as direct reading instruments (XRF, FIDs, PIDs), test kits (immunoassay kits), and geophysical instruments (Geoprobe, Ground Penetrating Radar) can prove most useful in identifying grossly contaminated areas. In conjunction, there are also analytical tools which can be used to expedite the acquisition of confirmatory site investigation data. These options involve the utilization of the U.S. EPA Contract Laboratory Program (CLP), and mobile (on-site) laboratories. It should be noted that utilization of the analytical support tools for augmenting the design of a site characterization project should always be dealt with on a case-by-case basis. To ensure these techniques are relevant and appropriate, it is essential to consult your subject state or commonwealth Project Manager prior to utilization.

### 2.2.3 Demobilization

Upon completion of environmental sampling and data collection activities, the disbanding of field operations (removal of personnel and equipment from site) is referred to as "demobilization." The most significant component of the site demobilization process will be the overall management and disposal of Investigation Derived Waste (IDW). IDW will typically be comprised of used personnel protective equipment (PPE), contaminated sampling equipment, monitoring well purge water, and/or drill cuttings from monitoring wells and soil borings. Due to the fact that these materials may be potentially hazardous, it is essential to store, test, and dispose of IDWs in a proper manner. This will ensure that there are no exposures to these materials and will limit any potential liabilities from the mishandling of these materials.

## 2.3 Sample Analysis

To specify the appropriate analyses for characterizing Brownfields properties, it is important to understand the basic groupings of analytes which are measured by a particular analytical method. In addition, it is important to have knowledge of analytical detection limits and capability of achieving specified levels of quantitation. This is critical since environmental sample analyses are made using specific analytical methodologies geared for the matrices of concern to achieve designated levels of detection. To ensure Brownfields site characterization analyses are relevant and appropriate, it is customary to plan and delineate the necessary analytical determinations in a site-specific SAMP. In practice, the most effective use of a Brownfields sampling budget is to incorporate in-situ field analytical techniques into the overall data collection process. This will typically involve specifying the proper combination of screening techniques with confirmatory fixed laboratory analyses. The analytical scheme put forward in the U.S. EPA Region 2 generic Brownfields QAPP boilerplate encourages the design of a monitoring network which blends in-situ field analytical techniques with confirmatory fixed laboratory analyses. It specifies that a minimum of 20% of all samples collected during a Brownfields site investigation undergo fixed laboratory U.S. EPA CLP Target Analyte list (TAL) and Target Compound List (TCL) confirmatory analyses. In conjunction, it specifies that approximately 50% of all background or "presumed clean" reference samples should likewise undergo fixed laboratory U.S. EPA CLP TAL and TCL

confirmatory analyses to limit false negative and sampling errors.

## 2.4 Data Management, Validation , and Evaluation

To accurately characterize a Brownfields property, extensive amounts of physical and chemical data are often compiled to determine if a site may pose a threat to human health and/or the environment. This information will typically form the basis for determining the presence and extent of specific contaminants at a site. To make certain that Brownfields site characterization decisions are correct, environmental data measurement reporting, review, and assessment efforts must be complete and comprehensive. As a result, it is essential that a data reporting and assessment scheme be developed that addresses the complete spectrum of environmental measurement data generated by a Phase II Brownfields Site Investigation project. Typically, an appropriate scheme will consist of performing activities involving data management, validation, and evaluation tasks. These efforts will assure Phase II Brownfields Site Investigation results are scientifically valid and legally defensible by promoting data integrity.

### 2.4.1 Data management

The initial processes undertaken to maintain the integrity of environmental measurement data are most essential to ensure the validity of the Brownfields site characterization decisions being made. The functions which are routinely performed to maintain the integrity of environmental monitoring results are referred to as "data management" activities. These efforts are taken to facilitate the likelihood that resulting site characterization data are genuinely representative of the conditions inherent to a Brownfields property. The techniques for administering a competent data management program are fundamental and well proven. They usually only involve the completion of formal paperwork to track field sample collection and data acquisition activities. Traditional data management documentation will include:

- Sample tags
- Traffic reports/Chain-of-Custody (COC) forms
- Notice of transmittals
- Shipping air bills
- Custody seals
- Analytical services tracking forms
- Data package Chain-of-Custody (COC) forms
- Analyst logbooks
- Analytical bench sheets
- Chromatographic charts, instrument/computer printouts and raw data summaries
- Instrument logbooks
- Correspondence and documentation inventories

To assist in the design of an appropriate data management program, the ***U.S. EPA Sampler's Guide to the Contract Laboratory Program*** [8] is an accepted guidance which should be consulted to plan and document these efforts. The U.S. EPA Sampler's Guide provides a comprehensive overview to assist samplers in clarifying the procedures and paperwork necessary for submitting environmental samples for CLP analyses. To facilitate these efforts, it is included as an attachment to the generic QAPP supplement of this guidance.

### 2.4.2 Data validation

When performing a Brownfields site characterization project it is important to understand that there is an

appreciable amount of uncertainty in all chemical data. In addition to lab error, there are matrix effect errors as well as field sampling errors such as improper decontamination of field equipment, loss of samples, and failure to ship samples in a timely manner after collection. The significance of these errors can and will impact the degree of uncertainty inherent to a given set of environmental measurement data.

To ensure that Brownfields environmental measurement data are of an appropriate quality, it is essential to verify if the contaminant concentrations reported by a laboratory genuinely represent contaminant concentrations in a sample. The technique for assessing bias inherent to a set of environmental measurement results is referred to as "data validation." Data validation is a systematic process for reviewing a body of data against a set of criteria to provide assurance that the data are adequate for their intended use. Data validation consists of data editing, screening, checking, auditing, verifying, certifying, and reviewing. The typical data validation effort will often involve evaluating:

- Holding times
- Instrument tuning
- Calibration and retention time windows
- Blank contaminants
- Surrogate recovery (a measure of extraction efficiency)
- Chromatographic performance (baseline, interference, retention time shift, and peak resolution)
- Emission interferences or spectral interference from other elements when reviewing metals data
- Calculations and transcription of numerical values to the required forms in the data package
- Matrix effect errors (interference from the sample itself)
- Degradation of compounds during analysis

When a data user has a very limited knowledge of the environmental condition of a Brownfields property, decisions based on site characterization measurement data will be used to form the basis of a plausible redevelopment plan. It is prudent for Brownfields stakeholders to validate pertinent environmental measurement data to identify results with questionable quantitative value. In doing so, the addition of "data qualifiers" will be noted on the results to provide an indication of data quality. This is most important because it provides Brownfields stakeholders with an evaluation of Precision, Accuracy, Representativeness, Comparability, and Completeness (PARCC) which collectively form the characteristic determinants of data quality.

This Brownfields project planning guidance prescribes the use of our U.S. EPA CLP analytical Statements of Work (SOWs) for the acquisition of all confirmatory data. The U.S. EPA CLP SOWs delineate the analytical determinations and data deliverables for carrying out these analyses. In accordance, U.S. EPA Region 2 has developed standardized protocols for validating CLP analyses. As a result, the corresponding U.S. EPA Region 2 data validation protocols are appropriate for validating confirmatory Brownfields site characterization data generated in this manner. To expedite these efforts, the following U.S. EPA Region 2 data validation protocols (***SOP No. HW-6: CLP Organics Data Review and Preliminary Review*** [9] and ***SOP No. HW-2: Evaluation of Metals Data for the Contract Laboratory Program*** [10]) are included as appendices to the generic QAPP supplement of this project planning guidance.

### 2.4.3 <u>Data evaluation</u>

When performing a Brownfields site characterization, all relevant validated environmental measurement data

should be reconciled with the "Acceptance or Performance Criteria" specified for the project. This determination is integral because it provides an indication of whether the environmental measurement data are of the right type, quality, and quantity to support environmental decision making efforts.

To perform this activity, scientific and statistical procedures are typically employed to provide an assessment. This evaluation will focus on several key data review considerations concerning the site characterization effort. This will consist of determining if sampling protocols were appropriate, reviewing sampling program design for media variability, correlating in-situ field measurement data with fixed laboratory confirmatory results, and evaluating background concentrations to help identify site-specific contamination.

This evaluation process will enable the environmental professional to delete unusable data and explain the limitations of qualified data. This is crucial because it provides the information a decision maker will need to draw conclusions about the strength of evidence depicted by the collected measurement data. For instance, if it is found that sufficient data were not collected during the initial sampling effort, or if the objectives of the site investigation were modified mid-way through the project, additional data collection efforts may be required.

## 2.5 Preliminary Risk Assessment

The culmination of the Brownfields site characterization process leads to an evaluation which identifies, locates and characterizes the nature and extent of contamination at a particular site. The accurate identification and characterization of hazardous waste contamination is crucial to protect public health and the environment at Brownfields sites. Therefore, site investigation results should always be compared to applicable regulatory thresholds and/or action levels (i.e., ARARs and TBCs).

The formal process for identifying potential threats to human health and the environment is referred to as a "risk assessment." It generally involves performing data collection and evaluation, an exposure assessment, a toxicity assessment, and a risk characterization. This structured process is a means for estimating the increased risk associated with exposure to toxic agents at a particular site over a specific period of time. These estimates can be made for either human and/or ecological receptors. Typically, a response action will be required if the excess carcinogenic and/or non-carcinogenic risks caused by current or potential future site conditions exceed $1 \times 10^{-4}$ to $1 \times 10^{-6}$ for carcinogenic risk or a hazard index exceeding 1.0 for a non-carcinogenic risk.

## 2.6 Data Summation and Evaluation of Additional Information Needs

The final component of any Brownfields site characterization project is to summarize the resulting environmental monitoring information. The intent of this effort is to inform Brownfields stakeholders of the site characterization findings by providing a summation of pertinent environmental measurement results and data quality assessments. In conjunction, it should also serve as a forum for recommending subsequent actions such as collecting additional data, undertaking remediation, or designating no further action required. Customarily, the consulting environmental professional retained by the Brownfields grant recipient will draft this report and forward it to the managing municipality for review. Following this review, a meeting should then be held with the Brownfields stakeholders to discuss the site characterization findings and resolve any comments. This summation is an integral element in the Brownfields revitalization process since it serves as the means for indicating the attainment of site characterization goals and strategies for future phases of the project.

## 2.7 Phase II Brownfields Site Investigation Information Resources

To assist in the design of an appropriate Phase II Brownfields environmental monitoring program, it is advantageous to follow an accepted site investigation guidance. As such, the ***U.S. EPA Guidance for Performing Site Inspections Under CERCLA*** [11] is included as an appendix to this document. This guide is the agency's formal site investigation protocol which delineates the U.S. EPA approach for planning an effective sampling and analytical scheme to evaluate CERCLA sites. It discusses project planning/scoping, site characterization, sample analysis, data management, validation and evaluation, risk assessment, and data summation and evaluation of information needs. Hence, this guide can facilitate the development of a relevant and appropriate environmental monitoring network for verifying the findings of a preceding Phase I Brownfields Site Assessment. Although the U.S. EPA site inspection guidance also depicts the U.S. EPA Hazard Ranking System (HRS) process for scoring CERCLA sites, this guide should only be relied upon to assist an environmental professional in planning a Phase II Brownfields Site Investigation involving intrusive sampling of a limited extent.

# *CHAPTER 3*

## 3.0 REMEDIAL ALTERNATIVES FOR BROWNFIELDS REDEVELOPMENT

At the conclusion of a Phase II Brownfields Site Investigation, it is customary to consider the establishment and implementation of a plan to prepare a property for redevelopment and reuse. These efforts will focus on developing options to mitigate any direct health/environmental threats and alternatives to support revitalization. It is essential that these recommendations be appropriate, cost effective, and farsighted to spur further beneficial activity in the surrounding area. To ensure revitalization alternatives are relevant, it is prudent to perform an analysis of both the technical and cost impacts, including the benefits, of the recommended actions.

Site characterization information is vital in supporting the redevelopment and reuse of a Brownfields property. Appropriate information permits consideration of site contamination and remediation costs when evaluating redevelopment and the potential tangible benefits to the community. This stage of the process will involve interpreting the Phase II Brownfields Site Investigation results to render these determinations. These findings will provide a summation of pertinent environmental measurement results and data quality assessments. This will enable Brownfields stakeholders to ascertain the need to collect additional data, undertake remediation, or designate no further action required.

### 3.1 Implementing an Expanded Brownfields Site Investigation

A Phase II Brownfields Site Investigation is usually undertaken to identify, locate, and characterize the nature and extent of contamination (if present) inherent to a particular property. To accomplish these objectives an appropriately detailed study must be performed to accurately identify hazardous wastes and contaminated aquifers in order to protect human health and the environment. This process will ultimately result in the acquisition of extensive amounts of physical and chemical data which will form the basis for characterizing a Brownfields property.

To enable Brownfields stakeholders to render environmental decisions concerning the condition of a property, they will need to draw their conclusions from the strength of the evidence depicted by the collected measurement data. As a result, Phase II Brownfields Site Investigation data must be of an appropriate quality to be adequate for their intended use. Unfortunately, there may be instances when Brownfields site investigation environmental measurement data are inconclusive. For instance, data errors resulting from limitations in sampling design, sampling methodology, handling procedures, sample heterogeneity, and the analytical protocols may be apparent. Alternately, the resulting site investigation data may be limited in the ability to determine horizontal and/or vertical extents of contamination.

In the instances where initial characterization results prove to be inconclusive, the implementation of an Expanded Brownfields Site Investigation should be considered. This effort is typically undertaken when the need to collect additional data are warranted to ascertain the environmental condition of a Brownfields property. Hence, the activities for performing an Expanded Brownfields Site Investigation will again consist of undertaking field operations involving environmental sample and data collection. The approach for conducting this environmental monitoring effort will likewise follow the work breakdown structure of a Phase II Brownfields Site Investigation. Therefore, to facilitate the planning and completion of an Expanded Brownfields Site Investigation refer to the site investigation model presented in the previous chapter of this guidance.

### 3.1.1 Reevaluating applicable clean up and response criteria

Brownfields site investigation projects are commonly undertaken to yield a baseline for evaluating environmental contamination and/or to complete data gaps. As a result, additional sampling efforts may be required to properly characterize a Brownfields property. In these instances, it is prudent for a Brownfields project team to perform a comprehensive review of identified regulatory requirements (ARARs & TBCs) whenever new site-specific data are acquired. These efforts are beneficial in determining if additional environmental sample collection efforts are required or to determine if new requirements apply to the site. Therefore, this continual derivation of the site investigation effort will assist in minimizing the collection of unnecessary samples and establishing contingencies for maximizing data quality.

## 3.2 Developing Brownfields Clean Up Options

The culmination of the Brownfields Assessment process is to design and implement an appropriate clean up plan to prepare a property for redevelopment and reuse. The design of any clean up plan and the subsequent implementation of a selected remedy will require careful coordination with the other redevelopment efforts in the immediate vicinity of a site. In many instances, securing an assessment of the environmental condition of a Brownfields property could be sufficient in spurring the reuse of a site. Nonetheless, the determination of an appropriate clean up strategy and corresponding cost estimate must be based on the envisioned reuse of a property. In doing so, Brownfields revitalization efforts will invariably result in promoting the sustainable reuse of a property.

When undertaking a Brownfields Assessment, it is important to understand that there will be instances where site characterization data may indicate the presence of environmental contamination and the need for remediation. It is important to understand the applicable regulatory guidelines to select the appropriate technologies for remediating a Brownfields property. In many instances, the management of most Brownfields sites will be subject to state or commonwealth environmental regulatory authority. Therefore, the subject state or commonwealth environmental regulatory authority will specify the applicable guidelines for the selection of remedial options, and the design and implementation of a clean up strategy.

Considering these factors, it is important to consult the subject state or commonwealth environmental regulatory authority to determine what, if any, site-specific requirements may apply. The process for revitalizing a Brownfields property can involve the restoration of a natural environment, such as an ecosystem, or a man-made environment, such as a building. In most cases, these efforts will be primarily driven by the envisioned reuse of the Brownfields property. Site-specific ARARs and/or TBCs which establish remedial standards can also vary depending upon if the redevelopment of a Brownfields property will be for “industrial” or “residential” reuse. Fortunately, the subject state or commonwealth environmental regulatory authorities can assist Brownfields stakeholders in identifying the requirements which may affect the site. For these reasons, it is essential to decide upon a viable reuse for a site before beginning remediation and to remain in close contact with the appropriate subject environmental regulatory agency throughout the clean up process.

When initiating a Brownfields remediation, the review and analysis of clean up alternatives will invariably rely on the data collected during the site assessment and investigation phases of a project. The purpose of screening various remediation technologies will be to evaluate each alternative for its capability to meet specific clean up and redevelopment objectives. In addition, it is also important to consider budget requirements and a work schedule to ensure a Brownfields redevelopment project remains viable. At this time, consideration should be

given to the role of institutional controls, such as zoning and deed restrictions, posting safety signs, and efforts to increase community awareness of the environmental condition of a site undergoing clean up activities.

The evaluation and selection of appropriate treatment technologies or pollution control technologies are important to ensure the remediation of a Brownfields property is undertaken in a correct and cost-effective manner. This evaluation process typically includes a treatability study, feasibility analysis, and the development of a final recommendation. The process analyzes both the technical considerations and cost-benefit remediation alternative based upon the following criteria:

- Protection of human health and the environment.
- Compliance with site-specific ARARs and/or TBCs.
- Long-term effectiveness and permanence.
- Reduction of contaminant toxicity, mobility or volume.
- Short-term effectiveness.
- Implementability.
- Cost.
- Community acceptance.
- Subject state or commonwealth regulatory approval.

## 3.3 Implementing Brownfields Treatability Studies

At the conclusion of the site investigation process, identified potential threats to human health and the environment must be remediated to enable the redevelopment and reuse of a Brownfields property. To ensure a Brownfields remediation project is undertaken in a correct and cost-effective manner, it is essential to determine which treatment technology is the most appropriate to employ. This remedial assessment activity typically performed in support of an environmental clean up effort is referred to as a "treatability study." A treatability study is a short-term scientific investigation to determine if a response action technology is an appropriate and cost-effective solution to mitigate contaminants of concern found in particular site-specific environmental media.

Traditionally, there are three types of treatability studies for evaluating remediation technologies. They are: a) remedy screening which involve laboratory-scale studies, b) remedy selection which consist of bench-scale studies, and c) remedy design which carry out pilot-scale studies. Consequently, it is important to scope treatability studies early in the project planning phase. This involves delineating the applicable sampling and data quality objective requirements, the selection of technologies, waste disposal requirements, and estimates for study time frames and budgeting. Alternately, the development of a separate work plan, health and safety plan, and QAPP should be considered if these items were not initially addressed within the scope of the Phase II Brownfields Site Investigation. Therefore, to assist in planning a Brownfields treatability study, refer to the work breakdown structure comprising the site investigation model presented in the previous chapter.

### 3.3.1 Evaluating response action technology limiting characteristics

The process for undertaking a Brownfields treatability study will often involve the identification, screening, and analysis of remedial alternatives for abating a contaminated property. An important aspect throughout this process is to consider any affects the composition of a contaminated environmental media may have on the effectiveness of a treatment technology. The impacts site-specific environmental media conditions can impart

on the performance of a remedial alternative are referred to as “process limiting characteristics.”

To assess these effects, decision values for process limiting characteristics are assigned to each remedial alternative during a treatability study and compared to the site-specific values for those same characteristics. This assessment provides a site-specific means for indicating the most appropriate treatment technology. For instance, if site-specific values are outside the range required for the effective use of a remedial alternative, that treatment technology is less likely to be selected.

Process limiting characteristics are site-specific data types integral for evaluating the effectiveness and ability for the implementation of a remedial treatment alternative. Typically, process limiting characteristics are depicted as descriptors of rate limiting steps in the overall remedial process. In some instances, the effects brought about by process limiting characteristics can be overcome by adjusting the condition of the contaminated environmental media (pH, temperature, conductivity, oxidation-reduction potential, nutrient content, etc.). However, it is important to note that the level of effort needed to overcome some of these limitations can often preclude the use of a remedial process.

Decision values for process limiting characteristics are becoming more readily available through related scientific publications. This allows for the environmental professional to directly calculate these factors for processes with known design equations. Traditionally, process limiting characteristics for waste/site characterization are categorized according to: a) mass transport characteristics, b) reaction characteristics, c) contaminant properties, and d) engineering characteristics. In practice, most remedial alternatives will have process limiting characteristics in more than one category. Therefore, a thorough characterization of the affected environmental media is required to determine accurate site-specific values for process limiting characteristics.

## 3.4 Implementing Brownfields Feasibility Analyses

Whenever new site-specific Brownfields characterization data are collected, analyzed, validated, and evaluated, it is customary to utilize these results to develop remedial objectives. Once Brownfields remediation goals are finalized it is essential to begin the evaluation of feasible treatment options to address the environmental challenges impacting a property. This remedial assessment activity typically performed in support of an environmental clean up effort is referred to as a "feasibility analysis." The feasibility analysis is a technique for providing cost and technical practicability estimates for specific remediation technologies using the data acquired from a treatability study. The approach for performing a feasibility analysis involves: a) refining preliminary remediation goals, b) developing general response actions, c) identifying/screening appropriate technologies, d) performing a detailed analysis of treatment/response alternatives and e) recommend the most appropriate technologies. To ensure that a Brownfields feasibility study is undertaken in an appropriate manner, it is essential to follow an accepted guidance for conducting remediation technology practical assessments.

### 3.4.1 Refining of preliminary remediation goals

Once treatability studies have been completed, the resulting data are introduced into the technology or response action screening phase of the feasibility analysis. It is important that these studies utilize site-specific data to ensure the practicability of the final results. They are typically undertaken to refine the preliminary remediation goals developed during the project planning phase of the Brownfields remediation effort. Establishing remediation goals are integral because they are indicative of the contaminants of concern, media of concern, exposure routes, receptors of contamination, and remediation levels for each contaminant in a given media (ARARs and/or TBCs).

### 3.4.2 Developing general response actions

After remediation goals are finalized, it is customary to begin developing treatment options for addressing the environmental challenges impacting a Brownfields property. The remedial options for mitigating environmental contamination are typically referred to as "response actions." Response actions are practical methods of protection which are viable in abating site-specific environmental contaminants of concern. Traditional environmental response actions include landfill capping, contaminated groundwater pumping and treatment systems, and contaminated soil incineration. To facilitate the development of response actions it is important to consider such applications with the establishment of remediation goals during the project planning phase of a Brownfields site investigation. In conjunction, it is important to refine the universe of response actions using the data acquired through site investigation and treatability study efforts to ensure the various alternatives are appropriate.

### 3.4.3 Identifying/Screening appropriate technologies

To determine which treatment technologies are appropriate for a particular Brownfields property, it is customary at this stage of a feasibility analysis to identify and screen each viable remedial alternative. This involves preparing and evaluating a list of potentially applicable technologies and/or technological process options. Subsequently, each option is evaluated and the list is then reduced by determining which remedial alternatives are not practical based upon technical merit. In doing so, a determination is made as to whether the individual technology and/or series of treatment technologies (treatment trains) will or will not work under current site conditions.

### 3.4.4 Analyzing treatment/response alternatives

During this stage of a feasibility analysis, a number of activities must be undertaken to render a detailed evaluation of the proposed treatment/response alternatives. The first step in this effort is to select representative process options for abating each environmental media or waste of concern. At this time it is important to re-evaluate information needs to ensure that the necessary supporting data are adequate for rendering decisions on treatment technology selection. Following these pre-selection procedures, the technologies are assembled into process alternatives for the purpose of combining general response actions into specific remedial strategies capable of meeting remediation goals. Finally, to complete the feasibility analysis, the process alternatives are screened by assessing the number of associated response actions to ensure that only the most viable remedial strategies will undergo detailed evaluation by the Brownfields stakeholders.

### 3.4.5 Recommending the most appropriate technologies

To conclude a feasibility analysis, it is crucial to develop a final recommendation of the most appropriate treatment technology and/or pollution control technology resulting from this evaluation. Consequently, the U.S. EPA currently relies upon nine separate evaluation criteria to provide a comprehensive analysis of remedial alternatives. These evaluation criteria are delineated in section 3.2 of this guidance. Therefore, utilizing this framework will facilitate the selection of a correct and cost effective remedial strategy capable of meeting Brownfields remediation goals.

## 3.5 Developing a Final Recommendation

Once a response action has been selected, the process used to select a remedial strategy should always be clearly described in a separate report to document the development of a final recommendation. It is essential that this report present an analysis of both the technical and cost impacts as well as the benefits of the recommended remedial strategy. This information should be presented in such a manner so that it will assist both the Brownfields stakeholders and the subject state or commonwealth environmental regulatory agency in understanding the significance of the findings.

It is important to note that this report serves as the primary means for communicating the conclusion of a Brownfields remedial assessment. It also serves as the principle reference document should questions concerning the environmental condition of a property arise in the future. As a result, the format and content of this report are central to understanding the conclusions which are rendered. To verify the exact requirements to format a report, consult the subject state or commonwealth environmental regulatory agency case manager for specific details. Upon its completion, the final report should always be submitted to the subject state or commonwealth environmental regulatory agency for their review and concurrence.

## 3.6 Brownfields Remedial Information Resources

To evaluate and select appropriate remedial alternatives for Brownfields redevelopment, it is advantageous to follow an accepted guidance to facilitate these efforts. As such, there are many protocols which detail the processes to characterize the extent of uncontrolled hazardous waste in the environment and evaluate potential treatment options to remediate contaminated sites. These guides include ASTM D 5730 [12], ASTM E 1739 [13], ASTM PS 3 [14], and the U.S. Army Corps of Engineers Engineer Manual EM 1110-1-502 [15]. The ***U.S. EPA Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA*** [16] delineates the agency's approach for conducting an expanded site investigation and evaluating practical remedial alternatives. It discusses project planning, community relations programs, field investigation activities, sample analysis/validation, data evaluation, risk assessment, treatability studies, final reporting, developing and screening of alternatives, and analyzing practical treatment alternatives for selecting a final remedy. Therefore, this guide is included as an appendix to this document to assist the environmental professional with implementing a correct and cost effective Brownfields Remedial Investigation/Feasibility Study.

# *CHAPTER 4*

## 4.0 BROWNFIELDS POST TREATMENT REMEDY CLOSURE

When performing Brownfields Assessments, there will be instances where resulting site investigation data will indicate the presence of environmental contamination and the need for remediation. To prepare a Brownfields property affected with environmental contamination for redevelopment and reuse, an appropriate cleanup plan must be designed and a remediation action implemented. It is important to gain state or commonwealth environmental regulatory authority approval for the selected remediation, and to coordinate remediation activity with other redevelopment efforts involving the site. Site closeout activities can begin on completion of all appropriate response actions. Typically, this will involve undertaking a predetermined site monitoring effort to ensure that the selected treatment remedy meets all anticipated performance criteria (site-specific ARARs and/or TBCs).

### 4.1 Site Closure Monitoring Operations

To perform post treatment confirmatory monitoring, field operations involving environmental sample and data collection efforts will have to be initiated. It is important to consult the subject state or commonwealth environmental regulatory authority to determine the applicable requirements for conducting these activities. When undertaking Brownfields site closure monitoring operations, it is advantageous to follow an accepted guidance to facilitate these efforts. As such, the ***U.S. EPA Superfund Remedial Design and Remedial Action Guidance*** [17] delineates the agency's approach for managing remedial activities at CERCLA sites. It discusses Remedial Design/Remedial Action (RD/RA) project planning and tasks, community relations programs, monitoring and oversight activities, sample analysis/validation, data evaluation, site closure activities, and final reporting. Therefore, this guide is included as an appendix to this document to assist the environmental professional with implementing a relevant and appropriate Brownfields site closure RD/RA program.

### 4.2 Designating No Further Action

The conclusion of a comprehensive Brownfields Assessment is to secure the revitalization of an abandoned, idled, or under-utilized commercial property where redevelopment has been complicated by real or perceived environmental contamination. To achieve this goal, there must be a reasonable assurance that there are no potential threats to human health and the environment inherent to the property. These assurances should include a determination that no acute risks are evident, and an evaluation of potential human exposure pathways. In conjunction, this may also involve securing a verification that any contaminants remaining on-site will not migrate during the time frame when they may pose any significant risk.

In some instances, initial Phase I site assessment results can be sufficient to designate that "no further action" be undertaken if they indicate a Brownfields property has no actual or potential existence of contamination. However, this information will usually be acquired through a Phase II site investigation to identify, locate, and characterize the nature and extent of contamination (if it is present) inherent to a Brownfields property. This data will typically form the basis for recommending subsequent actions such as collecting additional data, undertaking remediation, or designating "no further action" required. If it is determined at this stage of the process that there is no need for remediation, efforts should be undertaken to designate that "no further action" be required. Alternately, there will be instances where site investigation results indicate the presence of

environmental contamination and the need for remediation. Subsequently, post-treatment confirmatory analyses will provide the assurance for communicating the conclusion of a Brownfields clean up effort to determine if "no further action" to remediate the site is needed.

To indicate the sufficiency of clean-up standards for all planned remedial activities, the use of "no further action" letters and similar legal or quasi-legal documents should be considered to denote the completion of a Brownfields Assessment project. The use of such memorandums are encouraged for indicating that a given Brownfields site is sufficiently clean to support the sustainable envisioned reuse of the property. In most cases the management of Brownfields sites will be subject to state or commonwealth environmental regulatory authority. To verify the exact requirements and documentation (data, property restrictions and/or covenant not-to-sue letters, zoning variances, maintenance operations, etc.) for designating no further action, consult the subject state or commonwealth environmental regulatory agency case manager for specific details.

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**APPENDIX A**

***U.S. EPA Road Map to Understanding Innovative Technology Options for Brownfields Investigation and Cleanup***

# APPENDIX B

***U.S. EPA Tool Kit of Information Resources for Brownfields Investigation and Cleanup***

# APPENDIX C

***U.S. EPA Guidance for Performing Preliminary Assessments Under CERCLA***

# APPENDIX D

***U.S. EPA Guidance for Performing Site Inspections Under CERCLA***

# APPENDIX E

***U.S. EPA Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA***

# APPENDIX F

***U.S. EPA Superfund Remedial Design and Remedial Action Guidance***