United States Environmental Protection Agency | Office of Emergency Response | Directive 9285.7-20FS
Solid Waste andPB94-963314
EPA/540/F-94/031
September 1995

Establishing an Observed Release

Office of Emergency and Remedial Response | Quick Reference Fact Sheet

Abstract

EPA uses the Hazard Ranking System (HRS) (40 CFR Part 300, App. A) to evaluate Superfund sites to be proposed on the National Priorities List (NPL). Based on the HRS criteria, an observed release is established when contaminants have migrated away from a site through environmental media. This fact sheet describes an observed release, the data required, and the process used to document it. Efficient sampling also is emphasized to optimize the use of limited resources, which is especially important in light of conducting integrated assessments under the Superfund Accelerated Cleanup Model (SACM).

Introduction

When planning a Site Inspection, an integrated assessment should be considered as appropriate under the Superfund Accelerated Cleanup Model (SACM). This planning would incorporate a sampling strategy that should maximize remedial and removal resources.

Three categories of sampling generally are performed during a Site Inspection (SI):

- Source sampling to establish the presence of hazardous substances at a site;
- Sampling in the media of concern to establish an observed release, with background sampling corresponding to the source to establish attribution;
- Quality Assurance/Quality Control (QA/QC); sampling (e.g, field blanks) to ensure data integrity.

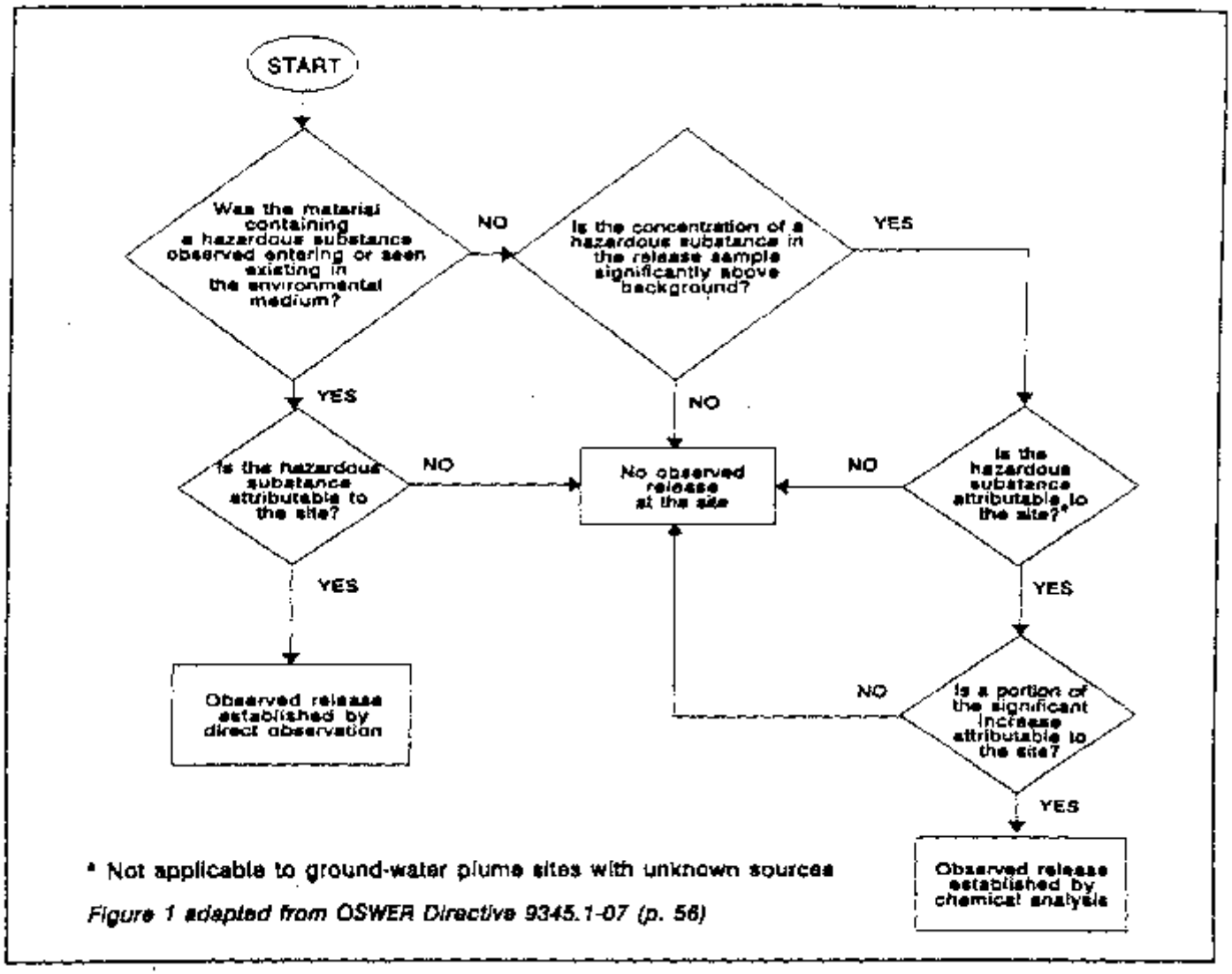
Although all three of these categories are important, this fact sheet pertains to the second category of sampling, and discusses resource conservation by using available data and an integrated sampling approach.

Determining an Observed Release

An *observed release* is based on evidence that contaminants have migrated from a site through a pathway or medium. The Hazard Ranking System (HRS) establishes two general criteria to document an observed release: there must be evidence of a hazardous substance in the medium of concern at a concentration significantly above the background level, and the release of the hazardous substance must be at least partially attributable to the site under investigation (*Hazard Ranking System, Final Rule*, 40 CFR Part 300, App. A). An observed release can be determined either by chemical analysis of samples, or by directly observing the release of the hazardous substance (to be documented) into the medium of concern (see Figure 1). Observed releases can occur through the ground-water, surface water, and air migration pathways. In contrast, the soil exposure pathway is evaluated for *observed contamination* where targets (human populations, resources, and sensitive environments) may come into direct contact with contaminants. (For more information on the soil exposure pathway, refer to the fact sheet *Establishing Areas of Observed Contamination*, September 1995, OSWER Directive 9285.7-18FS.)

The documentation of an observed release by chemical analysis should be accompanied with information on background level and attribution. Attribution requires evidence that the hazardous substance detected in a medium resulted from some portion of the release from the site. Background levels are established by sampling or by using other acceptable information, such as published or existing sample data. Existing data or data from background samples should be generated by sampling and analytical methods similar to those used for the release data (*Hazard Ranking System Guidance*

Figure 1: Flowchart for Establishing an Observed Release Under the HRS



Manual, November 1992, OSWER Directive 9345.1-07). (For more information on establishing background levels, refer to the fact sheet *Establishing Background Levels*, September 1995, OSWER Directive 9285.7-19FS.)

Documenting an observed release is a prerequisite for evaluating actual contamination at targets. Actual contamination at targets indicates a high likelihood of exposure to hazardous substances. Note that the detection of contamination at targets is not in itself sufficient to establish an observed release or actual contamination (OSWER Directive 9345.1-07). The level of actual contamination is determined by comparing the release concentration to health-based or ecological benchmark values, where available. Level I contamination is at or above substance-specific benchmarks; Level II is detection below benchmark values.

Resource Considerations

Generally, the SI is a limited-scope biased sampling event. However, under SACM, traditional remedial SIs should be integrated with traditional removal site assessments. The Data Quality Objective (DQO) process provides a logical framework for planning multiple field investigations, thereby fulfilling the integrated site assessment goal of cross-program response planning and allowing optimal cross-program data usability. (See *Data Quality Objectives Process for Superfund*, September 1993, OSWER Directive 9355.9-01 for further details on the DQO process.)

When possible, available data should be used to meet SI objectives so that resources are conserved (see Exhibit 1). Samples can be strategically collected to establish an observed release and to include one or more targets (i.e.,

Exhibit 1: Considerations when Assessing the Need for Sampling

- *Is there an imminent or current threat to human health or the environment? Is a removal action warranted?* Sample at targets if human or environmental exposure to contaminants is suspected. Always sample for public health concerns.
- *Can sampling meet both removal and remedial site assessment objectives?* If yes, and site conditions warrant, an integrated sampling approach may be used. (For more information, refer to *Integrating Removal and Remedial Site Assessment Investigations*, September 1993, OSWER Directive 9345.1-16FS.)
- *What are the objectives of the SI?* Table 4-7 in *Guidance for Performing Site Inspections Under CERCLA*, 1992, OSWER Directive 9345.1-05, provides guidelines on the number of samples recommended for a focused, expanded, or single SI as part of an observed release sampling strategy.
- *Could the pathway critically affect the site Hazard Ranking System (HRS) score ($ 28.50)? If yes, must an observed release be documented for that pathway to achieve that site score?* If no, evaluating the pathway for potential contamination may be sufficient (particularly for less critical pathways).
- *What are the pathway criteria? Are targets nearby?* Each HRS pathway has certain criteria for determining and limiting target distance with respect to contaminants. For example, for the soil exposure pathway, contamination must be documented within a zero to two feet depth from the surface, and contamination must be on the property and within 200 feet of targets. For the surface water pathway, the surface water body must be within two overland miles of the site or source. Sample collection should be avoided if sampling cannot meet the pathway criteria.

dual purpose sampling). Analytical data with appropriate and adequate quality assurance/quality control (QA/QC) are needed, since benchmarks are expressed in concentration units.

The Agency for Toxic Substances and Disease Registry (ATSDR) should be consulted when there is the potential for human exposure to toxic substances. The sampling approach for these sites should include data collection for the human exposure information that ATSDR uses to determine if a health advisory is needed. ATSDR also uses this data in the preparation of a public health assessment, which is required within 12 months of proposal to the National Priorities List.

Observed Release by Direct Observation

To establish an observed release by direct observation, a hazardous substance must be observed or known to have been released into the medium of concern. Existing analytical data or other references, such as manifests, should be used to document that the hazardous substance is present or known to have been released (OSWER Directive 9345.1-07. See Exhibit 2 for examples of an observed release by direct observation.

For the ground-water pathway, an observed release by direct observation may be documented with information that hazardous materials have come to be located or deposited in the aquifer of concern (OSWER Directive 9345.1-07).
For the surface water pathway, direct observation to establish an observed release can be documented by:

- Seeing hazardous substances entering the water body through migration or knowing they have entered through direct deposition;
- Natural flooding of a source area so that hazardous substances come in direct contact with the water: in this case, the presence of a hazardous substance sigaificantly above background prior to flooding must be demonstrated (OSWER Directive 9345.1-07). Historical data may be sufficient to document flood levels, the presence of a hazardous substance, and its direct contact with flooded waters;
- Adverse effects (e.g., fish kill) associated with the release of a hazardous substance to surface water. Note that inference requires extensive documentation and verified attribution (OSWER Directive 9345.1-07).

For the air pathway, direct observation may be established by demonstrating adverse effects from a release (OSWER Directive 9345.1-07).

Observed Release by Chemical Analysis

An observed release can be documented when samples from the media of concern exhibit contamination significantly above background levels, and the contaminants are attributable to the source. Since concentrations of contaminants usually decrease with

Exhibit 2: **Examples of an Observed Release by Direct Observation For Different Media**

- Ground-water pathway--Hazardous substances placed into an old quarry where the water table has risen above the level of the deposited materials.
- Surface water pathway--An impoundment leachate seep seen entering a stream. (Collect a sample from the leachate to document hazardous substances.) Also, effluent known to contain hazardous substances (through manifests) seen entering a surface water body.
- Air pathway--A field logbook entry and photodocumentation of a dust cloud originating from a tailings pile. A sample of the fine particulate matter from the pile showing the presence of hazardous substances will verify the release (OSWER Directives 9345.1-05 and 9345.1-07).

distance from a source, sampling near sources will better establish an observed release and attribution (*Guidance for Performing Site Inspections Under CERCLA*, September 1992, OSWER Directive 9345.1-05). At a minimum, one validated sample and a background level are required to document a release, even if earlier or later sampling fails to show a release. Varying results could be due in part to intermittent releases (OSWER Directive 9345.1-07).

To document an observed release by chemical analysis, the following criteria must be met (except for radionuclides, which are discussed later in this fact sheet):

- The release of a hazardous substance must be at least partially attributable to a source at the site. (Note: This does not apply to ground-water plume sites with unknown sources.)
- The sample concentration must be greater than or equal to the appropriate detection limit (40 CFR Part 300, App. A).
- If the background level is below its detection limit, the sample concentration must be greater than or equal to the background detection limit.
- If the background level is greater than or equal to its detection limit, the sample concentration must be at least three times the background concentration (OSWER Directive 9345.1-07).
- The detection limits must be calculated or determined properly. The detection limit used for comparison often depends on the source of the analytical data. Detection limits may be different for release and background samples. Detection limits such as those provided by the Contract Laboratory Program (CLP) may be used (OSWER Directive 9345.1-07).

Observed release sampling variables differ according to the medium, or pathway. These variables include temporal and spatial variation, hazardous substances present, and documentation of location and collection conditions.

Ground-water Pathway

For the ground-water pathway, certain types of wells, including monitoring, irrigation, or drinking water wells, may be used to establish an observed release. To establish an observed release, the well(s) closest to the contamination source should be sampled. It is preferable to select background well(s) outside the influence of a source and in the same zone of the same aquifer being evaluated. Cross-gradient or upgradient background sample locations are used when flow gradient information is available. (Ground-water flow gradient information is not required for HRS scoring purposes.) Establishing an observed release in the ground-water pathway could be further complicated by uncertainties about ground-water flow direction, and any resultant uncertainty about background and attribution. Caution should be exercised regarding the use of wells that are close to the site to determine background levels. For example, landfills and impoundments could interfere with natural ground-water flow. Pumping also may affect ground-water direction and plume movement. If available, pumping rates of nearby wells (including those sampled) may serve as a useful source of information for addressing both sample comparability and contaminant effect. Note: The same well may not necessarily be used to document actual contamination of targets. For a target population, actual contamination should be documented using a drinking water well.

The characteristics of suspected contaminants in ground water should be considered when selecting sample locations and depths. Contaminants in ground water may not be evenly dispersed. For example, oils and organic substances lighter than water (light non-aqueous phase liquids [LNAPLs]) tend to float on top of the water table. Contaminants heavier than water (dense non-aqueous phase liquids [DNAPLs]) sink to the bottom of the water column (OSWER Directive 9345.147).

Surface Water Pathway

Aqueous effluent, sediment, and tissue samples from sessile, benthic organisms are used to document an observed release to the surface water pathway. Generally, at least two samples (aqueous or sediment) are required for documenting an observed release in the surface water pathway. They are: a background sample slightly upstream of the Probable Point of Entry (PPE) for contaminants from the site or source; and a sample act or slightly downstream of the PPE. Exceptions to this two sample minimum requirement are when: 1) the surface water body originates at the site (no upstream background exists), 2) multiple PPEs exist, or 3) tidal flow exists. In the first case, one sample may be sufficient to document a release. In the second case, it may be advisable to sample upstream of each PPE. In this case, sampling is necessary at the PPE or downstream of each PPE to establish an observed release. In the third case, background data may need to be collected inside and outside the tidal area.

Aqueous samples may be used to document current releases to a surface water body. A preferred way is to collect the downstream sample first, and to collect aqueous samples before sediments to avoid the introduction of any contaminants not associated with the site or medium. Aeration of a sample should be minimized to prevent reducing the concentration of contaminants such as volatile organic chemicals.

Seasonal and other potential variations such as irrigation and flooding should be considered when sampling in this pathway. Deep, slow-moving surface water bodies often exhibit some chemical or thermal stratification. Stratification can occur where two streams converge. Additionally, the absorption or dilution of substances is affected by stream movement, and depositional conditions vary within the riffles or close to stream edges (OSWER Directive 9345.1-07).

Sediment samples may be used to document historical releases to a surface water body. Ideally, the characteristics of the suspected contaminant(s) should be known in order to select the best sample medium, location, and sampling method. Often, sediments are scoured and deposited in bends of streams and other flowing surface water bodies. Sample from like areas (e.g., inside bend deposition areas) for comparability. Grain size, organic content, and structure can affect adsorbance of substances to sediments, possibly introducing bias to the samples. For example, trichloroethylene (TCE) could adsorb to certain particles (OSWER Directive 9345.1-07).When possible, differentiate sediments from soils, especially when sampling along the edge of a water body. Note that in arid or semiarid locations (less than 20 inches mean annual precipitation), "sediments" include areas with intermittently flowing waters as well as contiguous intermittently flowing ditches. Contamination in these areas should be evaluated in the surface water pathway (40 CFR Part 300, App. A).

Tissue sampling can pose challenges for comparability because of differences between members of the same species, differences between species, variations within a study population, species mobility, and tissue differentiation. The target sample species should be examined for type of organism, approximate age, gender, size of population, migratory nature, and seasonal, feeding, spawning, or other periodic activities that influence concentration of substances within the organism (OSWER Directive 9345.1-07). Due to the potential difficulty of collecting comparable samples, tissue samples are more readily used to document actual contamination instead of an observed release. It is prudent to collect tissue samples in concert with other sampling activities when documenting an observed release.

For tissue sampling, both the rationale for the tissue selection and the accuracy of measurement should be established. Edible tissues from sessile, benthic organisms are preferred for HRS evaluation. (Generally, non-sessile benthic organisms, finfish, amphibians, and reptiles should not be used.)

Note that the surface water pathway requires sampling at or beyond the target to establish actual contamination; in contrast, the ground-water pathway requires sampling at the target.

Air Pathway

It is important to consider temporal variability in air sampling because large variations in substance concentration can occur over a very short time. Emissions characteristics depend upon topography and changeable atmospheric conditions, including temperature, pressure, wind speed and direction, precipitation, and atmospheric stability.

Monitoring wind direction is important in documenting migration of hazardous substances from the source. Wind roses, which detail the percentage of predominant wind direction, should be developed for the sampling period to document shifts in wind direction (OSWER Directive 9345.1-07).

For the air pathway, an air sample may be used to document both an observed release and actual contamination of targets within a certain radius from the source. An observed release by chemical analysis can be difficult to establish for the air pathway because of the challenge of obtaining comparable and verifiable samples. Under the HRS, EPA evaluates outdoor ambient air conditions only, indoor air samples are not evaluated for this pathway (OSWER Directive 9345.1-07).

Partial Attribution and Multiple Source Sites

Sources of contamination other than those from the site are often present. For example, substances may originate from non-point sources such as pesticide application, and from products containing lead.

Establishing background levels is especially important when attributing hazardous substances to varied sources. Background and site sample data should be from the same medium using similar sampling and analytical methods. Background samples should be collected from outside the influence of contamination from the site under investigation, but do not have to be free of contamination for purposes of attribution. The data need only support that the sample concentration is beyond an established background level. The location of other potential sources should be thoroughly reviewed and documented so that the appropriate background sampling locations can be selected. Background levels for ubiquitous substances should account for local variability; several samples may be required to establish the background levels (OSWER Directive 9345.1-07).

Where attribution is questionable, sampling should be done to gather analytical data demonstrating that the contamination is at least partially attributable to the site. Contamination from sites sometimes can be isolated by identifying hazardous substance unique to the site under investigation. Special analytical services and close evaluation of data may be required to identify these hazardous substances. Information about the disposal practices and waste products of nearby facilities may help identify target compounds associated with the site (OSWER Directive 9345.1-05).

Attribution may be established through the use of manifests, labels, records, oral or written statements, or other information regarding hazardous substances present at the site or at alternative sources. If these references confirm the presence of a hazardous substance at the site, attribution generally can be established even if specific sources where the substance was deposited cannot be documented (OSWER Directive 9345.1-07).

Sufficient samples from the site under investigation and from other known potential sources (or other adjacent areas) should be obtained to demonstrate that an increase in contaminant levels is attributable to the site. Additional information beyond analytical samples may be required if the other sites release intermittently. To attribute contamination sufficiently, collect the following data:

- Concentration gradients (e.g., samples from multiple wells or a series of samples between the site and alternative sources)
- Flow gradients and other information about the media of concern
- Data that associate the site with a unique substance or unique ratios of different substances (OSWER Directive 9345.1-07).

Complex factors affecting attribution (e.g., soil contamination in an industrial area) may require conducting an Expanded Site Inspection (ESI). In many cases, attribution concerns may be addressed by characterizing other sources at a site and those of neighboring sites (OSWER Directive 9345.1-05).

To establish attribution for the ground-water pathway, it is preferable to sample wells located between site sources and other sources. Three wells generally are needed to define flow direction and to verify the source versus another source. For surface water, a sample may be collected downstream of or at the confluence. It may be necessary to sample background and attribution along each tributary if multiple sources are located upstream (OSWER Directive 9345.1-07).

Transformation Products

It is possible to establish an observed release based on documenting the existence of a transformation product, if the transformation product is itself a hazardous substance. In these cases, the observed release must be documented by chemical analysis (OSWER Directive 9345.1-07).

Transformation products are substances found when a hazardous substance is changed in the environment by physical, chemical, or biological processes. Most transformation products at hazardous waste sites are the result of degradation (OSWER Directive 9345.1-07).

In order to attribute the parent substances and the transformation product to the site, the presence of a transformation product in a sample at a level significantly above the background level(s) should be documented.

The following references may be useful for documenting parent substances and transformation products:

- Site-specific studies on the transformation process by qualified research organizations (e.g., U.S. Government agencies, universities)
- Technical reports on transformation from EPA's Office of Research and Development
- Databases containing EPA-reviewed information Articles from peer-reviewed journals
- Textbooks on soil, environmental microbiology, biotechnology, and biotreatment processes and their effectiveness (OSWER Directive 9345.1-07).

For determining an observed release, conditions at the site must be conducive to, or must not impede, transformation, and at least one source must be able to release the substance to a pathway (OSWER Directive 9345.1-07).

Radionuclide Sites

The criteria for documenting an observed release by direct observation apply to radionuclides. Table 7-1 in the *Hazard Ranking System, Final Rule* provides the HRS factor categories that are evaluated differently when radionuclides are present (40 CFR Part 300, App. A).

Radionuclide sites are divided into three groups for documenting an observed release by chemical analysis:

- Radionuclides that exist naturally and ubiquitous radionuclides
- Man-made radionuclides which are not ubiquitous
- External gamma radiation (for the soil exposure pathway only). For gamma radiation, measure the exposure rate at one meter above ground. (For more information, refer to the fact sheet *Establishing Background Levels*, September 1995, OSWER Directive 9285.7-19FS.)

Observed releases from a combination of radionuclides and hazardous wastes (mixed waste) should be documented separately. Establishing an observed release requires:

- Identification of the radionuclide of concern and the physical and chemical properties of the radionuclide;
- On-site and background levels for that radionuclide; and
- Detection limit for the radionuclide.

Specific requirements for establishing an observed release for each of the three groups of radionuclides can be found in Section 7.1.1 of the *Hazard Ranking System, Final Rule* (40 CFR Part 300, App. A).

Summary

Documenting an observed release requires evidence that the concentration of the hazardous substance of concern significantly exceeds the background level. The hazardous substance must be attributable at least in part to the site under investigation (except for sites with ground-water contamination from unknown sources). Establishing an observed release requires thorough documentation. The sampling design of the Sl should attempt to meet multiple HRS data needs with a limited number of samples.