



# Evaluating Ground Water Plumes Under the Hazard Ranking System

Office of Emergency and Remedial Response  
State, Tribal, and Site Identification Center (5204G)

Quick Reference Fact Sheet

This fact sheet provides information on when a potential National Priorities List (NPL) site can be evaluated as a contaminated ground water plume with no identified source and how such a site is evaluated under the Hazard Ranking System (HRS). It defines the steps that should generally be taken before a ground water plume can be evaluated as a source; summarizes scoring considerations for sites that consist solely of a ground water plume; and discusses other considerations for evaluating sites where ground water plumes are present as the sole source. Responses to commonly asked questions about evaluating contaminated ground water plumes at potential NPL sites are also presented. This fact sheet is intended to provide general guidance on ground water plumes for people who are performing evaluations of sites under the HRS and may be amended by EPA on a site-specific basis.

## BACKGROUND

The HRS is the primary tool that EPA uses to place hazardous waste sites on the NPL under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA). NPL sites are releases and potential releases of hazardous substances and include all areas where substances have been deposited, stored, disposed, or placed, or have otherwise come to be located. In some instances, ground water has become contaminated, and the source of the contamination has not clearly been identified. These sites are referred to as ground water plume sites. When evaluating these releases for possible proposal to the NPL, the HRS scorer should take into account appropriate considerations associated with contaminated ground water plumes.

A contaminated ground water plume exists when hazardous substances, pollutants, or contaminants are present within an aquifer system. A plume of contaminated ground water may be formed when substances are released to ground water from a source at a facility. The contaminated plume can spread horizontally, vertically, and transversely through the aquifer system by means of infiltration, migration, interaquifer exchange, and interaction with surface

water. This movement of contaminants throughout an aquifer usually occurs in the direction of ground water flow but can spread against the predominant flow direction.

According to the *Hazard Ranking System (40 C.F.R. Part 300, App. A, (1997))*, a contaminated ground water plume can only be evaluated as a source for HRS scoring purposes when the original source of hazardous substances contributing to the plume cannot be reasonably identified. A source is defined as any area where a hazardous substance has been deposited, stored, disposed, or placed, plus those soils that may have become contaminated from hazardous substance migration. Ground water that has become contaminated through migration is not generally considered a source. However, ground water plumes where the source of contamination is unidentified are an exception to this general rule.

Since ground water plume boundaries change over time, the extent of a plume may be difficult to define. For HRS purposes, ground water samples which meet HRS observed release criteria may be used to delineate plume boundaries. However, extent of site and associated liability issues are frequently misunderstood at ground water plume sites.

### **The Extent of a Ground Water Plume Site**

Many people incorrectly assume that at the listing stage of the CERCLA remediation process the precise boundaries of the site and the extent of contamination are known. However, the purpose of listing sites on the NPL is to identify releases that are priorities for further evaluation, not to identify the extent of the site. Defining the boundaries of a contaminated ground water plume in precise geographical terms would require more information than is routinely available at the listing stage.

Another common misconception is that a site's boundaries correspond with property boundaries. An NPL site listing encompasses all areas that are found to be contaminated. Therefore, in the evaluation of ground water plumes with no identified source, the extent of the site consisting of the plume is not limited by actual property boundaries. However, owners of property above aquifers contaminated by migration of hazardous substances from a source outside the property may not be responsible for cleanup in cases where the landowner did not cause, contribute to, or exacerbate the release ("Announcement and Publication of Final Policy Toward Owners of Property Containing Contaminated Aquifers," 60 FR 34790, July 3, 1995).

### **Naming Ground Water Plume Sites**

Still another misconception is that the site name implies the extent of the site or identifies responsible parties. To avoid confusion by the general public, sites consisting of ground water plumes with no identified source generally should be named according to the geographical area in which the plume is located (i.e., XYZ Ground Water Plume), instead of including potentially responsible parties in the site name (i.e., Smith Co. Plant). Regardless, the site as defined by the HRS is neither equal to nor confined by the boundaries of any specific property from which the site name is derived.

## **EVALUATING A GROUND WATER PLUME AS A SOURCE**

Under the HRS, a contaminated ground water plume can be evaluated as a source when the origin of hazardous substances which have contributed to the plume cannot be reasonably identified (55 FR 51587, December 14, 1990). The first step in evaluating a plume site is to show that contamination of an aquifer has occurred. Ground water sampling should generally be conducted to verify that a contaminated ground water plume is present. While the exact extent of the plume does not necessarily have to be defined, all samples used to characterize the

ground water plume should generally meet the criteria for establishing an observed release. For HRS purposes, the dimensions of the ground water plume should generally be based on the available samples that meet the criteria for an observed release. Areas lying between such samples should be considered a part of the plume, unless available information indicates contamination should not be inferred between these points.

Once ground water contamination is documented, an attempt should generally be made to identify a source in the area which has contributed to the plume. If hazardous substances contained in the plume can be attributed to a specific source in the vicinity, the actual plume is not considered the source. In this case, the identified source of the plume is evaluated as the source and the plume is considered an observed release attributable to that source.

The source of ground water contamination can be designated as unidentified if the Expanded Site Investigation (ESI), or an equivalent effort which involves sampling, concludes that the original source of the ground water contamination has not been documented. The ESI should at least include a site reconnaissance, record searches, employee interviews, and sampling to gain information on the possible origins of the ground water contamination. The attempt to identify a source should be discussed in the HRS documentation record and potential sources and potentially responsible parties should be identified to the extent reasonable.

After the source of contamination is designated as unidentified, the source for HRS scoring purposes is classified as "ground water plume with no identified source." The ground water plume should be evaluated as the source with an HRS source type of "other." An unidentified source should not be confused with an unallocated source (refer to Exhibit 1).

Once the ground water plume has been established as a source, the extent of the plume is generally considered to be the extent of the site. This means that in most cases the contaminated ground water plume will be the only source scored for the ground water pathway.

In summary, make note of the following points before evaluating a ground water plume as a source:

- The area of ground water contamination has been established by sampling or inference using the observed release criteria outlined in the HRS.

- A reasonable search for potential sources of the ground water contamination has been conducted and sampling indicates that no source of the ground water contamination has been identified (the level of effort to identify the original source should be equivalent to an ESI).
- In most cases, the ground water plume is evaluated as the source and the site.

**EXHIBIT 1**  
**UNIDENTIFIED VS.UNALLOCATED**  
**SOURCES**

Under the HRS, the terms *unidentified* and *unallocated* are not equivalent.

- An *unidentified* source is an example of the HRS source type "other." A source may be classified as unidentified when a contaminated ground water plume or surface water sediment contamination exists, but the original source of contamination is unknown and cannot be identified through the appropriate means.
- An *unallocated* source is not an HRS source type. Unallocated sources are used to account for the hazardous waste quantity at a site where the location of the hazardous substances cannot be associated with a specific source. A ground water plume should not be considered an unallocated source.

Source: *The Hazard Ranking System Guidance Manual*, Interim Final, OSWER Publication 9345.1-07, 1992.

#### **HRS SCORING CONSIDERATIONS OF GROUND WATER PLUMES AS SOURCES**

As for any site, an HRS score is calculated for the ground water pathway for each aquifer existing at or below the source at the site, or in this case, the contaminated ground water plume. Assign the highest ground water migration

score for an aquifer as the ground water migration pathway score for the site. In general, the aquifer in which the ground water plume has been identified will score higher than an underlying aquifer that is evaluated for potential to release. An exception occurs when the underlying aquifer is associated with a significantly larger target population factor value. In this case, the target factor category value must be sufficient to compensate for the lower likelihood of release factor category value.

#### **Evaluating Likelihood of Release**

The likelihood of release factor category reflects either an observed release to an aquifer or the potential to release to an aquifer. The presence of a ground water plume with contaminant levels significantly above background in an aquifer constitutes an observed release to that aquifer.

Documenting the presence of a ground water plume usually involves establishing an observed release by chemical analysis. Establishing an observed release by chemical analysis at a plume site with no identified source requires documenting that the concentration of at least one hazardous substance in the ground water plume is significantly increased above its background level. Background samples should be selected to demonstrate that the release cannot reasonably be attributed to any known source. As stated in the HRS, to establish an observed release by chemical analysis at a ground water plume site, no separate attribution is required when the source itself consists of a ground water plume with no identified source. It is generally not appropriate to attribute the hazardous substances to a site since the contaminated plume with no identified source is the site.

The data presented in the HRS documentation record to characterize the presence of a contaminated ground water plume should be of known and documented quality. Well siting, installation, completion, and development should be performed in accordance with protocols specified in EPA ground water monitoring guidance, in particular, *The Hazard Ranking System Guidance Manual*, Interim Final, OSWER Publication 9345.1-07 (1992). In addition, all guidelines specified in the HRS, or relevant guidance, regarding similarity of background and observed release samples should be met. For example, the *HRS Guidance Manual* states that background and release samples should be representative of the same portion of the aquifer that is being evaluated. Once an observed release has been established by chemical analysis, the analytical data used to associate the hazardous substances with the plume may also be used to define the extent of the source and the site for HRS purposes.

As discussed in the Evaluating Aquifers section, when multiple aquifers exist, it may be necessary to determine the potential for the release to migrate to an underlying aquifer. In this case, the contaminated ground water plume is evaluated for each of the four potential to release factors (containment, net precipitation, depth to aquifer, and travel time), as for any other source.

### Evaluating Waste Characteristics

At a contaminated ground water plume site with no identified source, the hazardous substances eligible for consideration in determining the pathway waste characteristics factor category value are those that meet the observed release criteria. Generally, mobility and toxicity should be evaluated for all observed release hazardous substances in the ground water plume.

When evaluating ground water mobility, any hazardous substance that meets the criteria of an observed release by chemical analysis to an aquifer underlying a source is assigned a mobility factor value of 1, regardless of the aquifer being evaluated. Therefore, a mobility factor value of 1 is assigned to any hazardous substance in the ground water plume that is used to characterize the contaminated plume (i.e., all substances that meet observed release criteria).

Since the extent of ground water plumes may not be completely characterized during the Site Investigation process, a definitive hazardous waste quantity may not be adequately determined at the listing stage. When evaluating the hazardous waste quantity at sites consisting solely of a ground water plume, only three of the four hazardous waste quantity tiers apply to the source: hazardous constituent quantity (tier A); hazardous wastestream quantity (tier B); and volume (tier C). The area measure (tier D) cannot be evaluated because the hazardous waste quantity table (HRS table 2-5) does not provide a divisor for source type "other" in this tier. In the evaluation of the hazardous waste quantity it is highly unlikely that adequate data on the amount, distribution, and deposition of hazardous substances in the plume will be available to evaluate the hazardous constituent or wastestream quantity. While data for tiers A and B may be available, it is more likely that the volume tier will be the best available means of evaluating the source hazardous waste quantity.

For HRS purposes, the areal and vertical extent of the plume as delineated by ground water samples that meet observed release criteria should be used in the evaluation of the volume measure. Therefore, the hazardous waste quantity for a plume site with no identified source can be determined by measuring the area within all observed

release samples combined with the vertical extent of contamination, to arrive at an estimate of the plume volume. However, if the volume of the plume cannot be determined or if it is not cost effective to do so, a volume of greater than zero cubic yards can be used.

If the source hazardous waste quantity cannot be determined through the tiered approach, it is still possible to obtain a pathway hazardous waste quantity factor value for a ground water plume by evaluating the tiers as greater than zero. In this case, minimum hazardous waste quantity factor values may be assigned. The HRS specifies that if the hazardous constituent quantity is not adequately determined, and if any target is subject to Level I or Level II concentrations, assign a value of 100 as the minimum pathway hazardous waste quantity factor value. If none of the targets are subject to Level I or Level II concentrations, assign a minimum value of 10 as the pathway hazardous waste quantity factor value, if the hazardous constituent quantity cannot be adequately determined (55 FR 51587, December 14, 1990).

### Evaluating Targets

As with all sites, evaluate targets for ground water plumes based on nearest well, actual and potential contamination of the population, resources, and Wellhead Protection Areas. The following are specific factors that should be considered at sites when a ground water plume with no identified source is evaluated.

#### Ground Water Target Distance Limit

According to the HRS, begin measuring the 4-mile target distance limit and associated distance rings at the geometric center of the area of observed ground water contamination. The area of contamination should be based on available samples that meet observed release criteria.

#### Establishing Actual Contamination

At a contaminated ground water plume site with no identified source, actual contamination is established for drinking water wells that meet observed release criteria. Evaluate other drinking water wells within the 4-mile target distance limit under potential contamination. If a drinking water well has been closed due to contamination from the plume being evaluated, classify the pre-closure population associated with the well as subject to actual contamination. Actual contamination cannot be inferred for drinking water wells that are screened within the dimensions of the plume. If none of the drinking water wells are subject to actual contamination, select a nearest well factor value based on the shortest distance to any drinking water well, as measured from the geometric

center of the ground water plume (55 FR 51587, December 14, 1990).

## QUESTIONS AND ANSWERS

Q: Can a contaminated ground water plume which is formed by the drainage of leachate from a landfill be evaluated as the source at a site?

A: *If the contaminants in the plume can be attributed to the landfill the plume should not be scored as the source. In this case, the source at the site should be classified as a landfill.*

Q: If several sources on distinct facilities (i.e., different property boundaries) are separated by large distances and are shown to contribute to a single large commingled contaminated ground water plume, can the plume itself be evaluated as the source?

A: *In general, if the original source of ground water contamination can be identified, the plume should not be evaluated as a source. In this case, since a site under the HRS is not restricted to property boundaries, the scorer should investigate the possibility of evaluating all of the sources that contribute to the plume as the sources at the site.*

Q: If a ground water plume is conclusively determined to be coming from one large facility that has a single owner, but the exact source of the contamination is not known, should the plume be considered the source?

A: *If the proper effort to identify a source is unsuccessful at the site, then the scorer should consider evaluating the facility as the source under HRS source type "other." This may be done when contamination is attributed to operations or processes at the facility but not to a specific source.*

Q: If two distinct ground water plumes with no identified source commingle and one of the plumes consists of petroleum products and the other contains CERCLA eligible hazardous substances, can the release be listed on the NPL?

A: *The release of any CERCLA eligible hazardous substance may be listed on the NPL. Petroleum products may not be used in scoring under the HRS.*

Q: If a ground water plume with no apparent identified source is documented, but soil-gas samples show contamination at a nearby area with the same substances, should the contaminated soil or the plume be evaluated as the source?

A: *Since soil-gas data do not establish actual soil contamination or ground water contamination at a site, the contaminated ground water plume can be considered a source if observed release samples are available. Soil-gas samples may generally only be used to identify the presence of hazardous substances in an existing source for purposes of scoring waste characteristics. Soil-gas data may, however, be used to establish the area of soil contamination if verified through correlation with soil samples.*