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Streamlining the RI/FS for CERCLA Municipal Landfill Sites

Office of Emergency and Remedial Response
Hazardous Site Control Division
Quick Reference Fact Sheet

Approximately 20 percent of the sites on the National Priorities List (NPL) are municipal landfills which typically share similar characteristics. Because of this similarity the Superfund Program anticipates that their remediation will involve similar waste management approaches. As stated in the National Contingency Plan, EPA expects that containment technologies will generally be appropriate for waste that poses a relatively low long-term threat or where treatment is impracticable (Sec. 300.430(a)(1)(iii)(B), 55 FR 8846 (March 8, 1990)). In addition, EPA expects treatment to be considered for identifiable areas of highly toxic and/or mobile material that constitute the principal threat(s) posed by the site (Sec. 300.430(a)(1)(iii)(A)). The similarity in landfill characteristics and the NCP expectations make it possible to streamline the RI/FS for municipal landfills with respect to site characterization, risk assessment, and the development of remedial action alternatives. This fact sheet outlines available streamlining techniques for each of these three phases of an RI/FS. Additional information, including tools to assist in scoping activities, will be included in the document *Conducting Remedial Investigations/Feasibility Studies for CERCLA Municipal Landfill Sites* (November 1990, Directive No. 9355.3-11). This document will be available from the Center for Environmental Research Information (FTS 684-7562 or 513-569-7562).

Landfill Site Characteristics

For the purpose of this fact sheet, CERCLA municipal landfills are those facilities where a combination of principally municipal and to a lesser extent hazardous wastes have been co-disposed. Because of the volume and heterogeneity of waste within these landfills, treatment of the entire contents is often impracticable. Potential threats to human health and the environment resulting from municipal landfills may include: (1) leachate generation and groundwater contamination; (2) soil contamination; (3) landfill contents; (4) landfill gases; and (5) contamination of surface waters, sediments, and adjacent wetlands. A conceptual model of the potential pathways of exposure to hazardous substances that may exist at municipal landfill sites is presented in Figure 1. Affected media and their pathways of exposure that are unique to landfills are the subject of this fact sheet; other media are discussed in the forthcoming guidance.

Streamlining Site Characterization

The characterization of a municipal landfill site can be expedited by focusing field activities on the information needed to (1) sufficiently assess risks posed by the site, and (2) evaluate practicable remedial actions. Additionally, site characterization may be streamlined by conducting a limited field investigation during scoping of the RI/FS to assist in identifying necessary fieldwork. Examples of limited field investigation activities may include evaluating usefulness of an existing monitoring well network or verifying that the landfill was constructed as designed.

Leachate/Groundwater Contamination

Characterization of a site's geology and hydrogeology are necessary to adequately assess the design of extraction and treatment systems for leachate and groundwater as well as capping options. Groundwater contamination at municipal landfill sites may vary in composition from that at other types of sites in that it often contains high levels of organic matter and metals. Data gathered during the hydrogeologic investigation, however, are similar to those gathered at other types of NPL sites.

Leachate generation is of specific concern when characterizing municipal landfill sites. The main factors contributing to leachate quantity include precipitation as well as recharge from groundwater and surface water. Information to be gathered during characterization of leachate generally may be limited to:

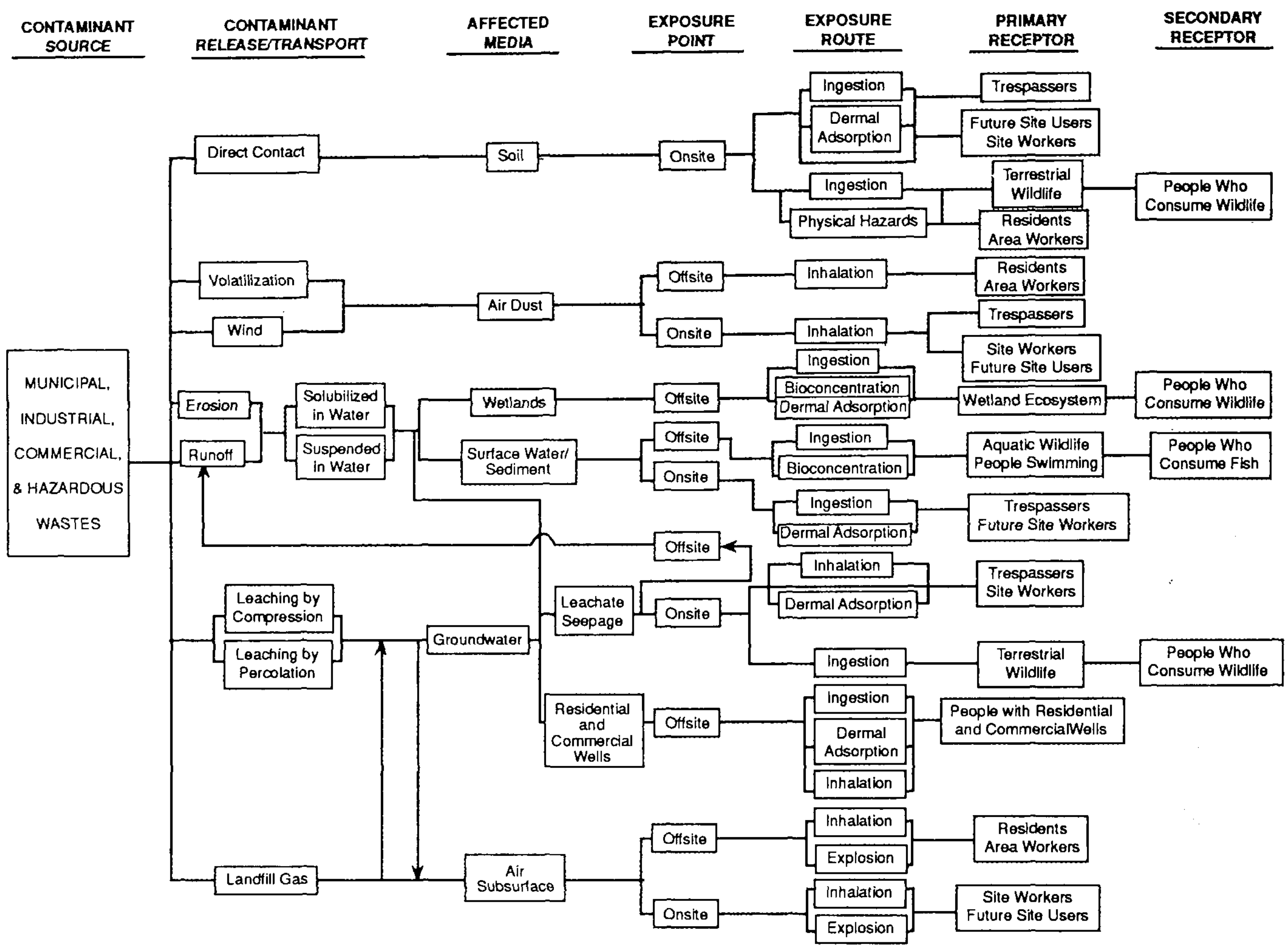
- Surface water drainage patterns
- Climatological characteristics (e.g., precipitation and evapotranspiration)
- Leachate characteristics (e.g., TCL organics, TAL metals, BOD, COD, pH, TDS, TSS, phosphorus, nitrogen, and oil and grease)
- Identification of Class I and II aquifers and their associated water levels, flow rates, and chemistry

In many landfills, leachate is perched within the landfill contents, above the water table. The placement of a limited number of leachate wells in the landfill is an efficient means of gathering information regarding the depth, thickness, and types of waste, the moisture content and degree of decomposition of the waste, leachate head levels, the composition of the leachate, and the elevation of the underlying natural soil layer. Additionally, leachate wells provide good locations for landfill gas sampling. It should be noted that, without the proper precautions, placing wells into the landfill contents may create health and safety risks. Additionally, installation of wells through the landfill base may create conduits through which leachate can migrate to lower geologic strata. The installation of wells into landfill contents may also make it difficult to ensure the reliability of the sampling locations.

Landfill Contents/Hot Spots

Characterization of a municipal landfill's contents generally is not necessary because containment, which is often the most practicable technology, does not require such information. Certain data, however, are

Figure 1
Potential Exposure Pathways for Municipal Landfills



necessary to evaluate containment alternatives. These include:

- Contour maps
- Fill thickness, lateral extent, and age
- Estimate of landfill settlement rate
- Estimate of rate of landfill gas production and landfill gas composition
- Soil characteristics, including permeability, grain size, Atterberg limits, and erosion rates
- Climatic conditions, including frost depth, and the appropriate storm event creating the potential for significant erosion
- Geologic and hydrogeologic characteristics, particularly the permeability of the layer underlying the landfill; the depth to groundwater; thickness of waste below the water table; and groundwater flow through the waste, if applicable
- Physical characteristics of any existing cap including thickness, area, slope stability, evidence of freeze-thaw protection, and soil characteristics as well as its ability to reduce surface gas emissions and odors, prevent oxygen intrusion into the refuse, prevent surface water infiltration, provide erosion control, and improve site aesthetics
- Potential future uses of the site (e.g., residential or recreational use)

More extensive characterization activities and development of remedial alternatives (such as thermal treatment or stabilization) may be appropriate for hot spots. Hot spots consist of highly toxic and/or highly mobile material and present a potential principal threat to human health or the environment (see NCP Sec. 300.430 (a)(1)(iii)(C)). Excavation or treatment of hot spots is generally practicable where the waste type or mixture of wastes is in a discrete, accessible location of a landfill. A hot spot should be large enough that its remediation will significantly reduce the threat posed by the overall site, but small enough that it is reasonable to consider removal and/or treatment. It may generally be appropriate to excavate and/or treat the contents of a landfill where a low to moderate volume of toxic/mobile waste (e.g., 100,000 cy or less) poses a principal threat to human health and the environment.

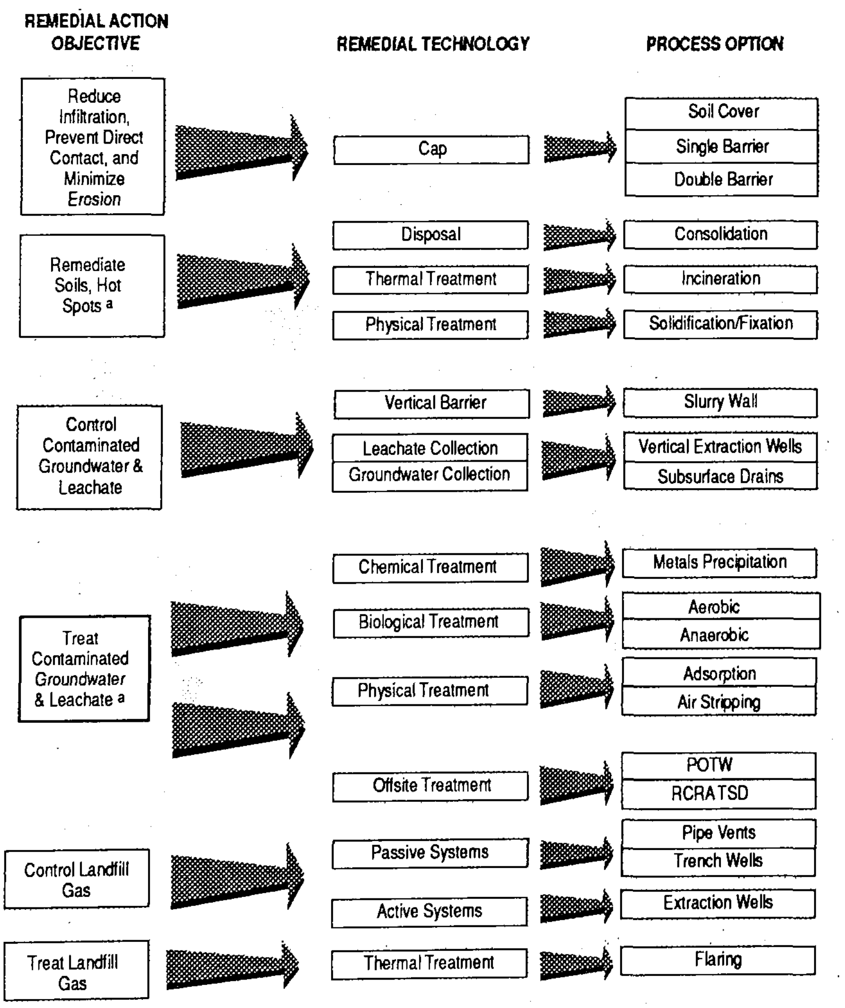
Hot spots should be characterized if documentation and/or physical evidence exists to indicate their presence and approximate location. Hot spots may be delineated using geophysical techniques or soil gas surveys and typically are confirmed by excavating test pits or drilling soil borings. When characterizing hot spots, soil samples should be collected to determine hot spot waste characteristics, including TAL metals, TCL organics, RCRA waste characteristics (e.g., TCLP), total Btu content, and bulk weight of the material. Treatability or pilot testing may be required to evaluate treatment alternatives.

Landfill Gas

Several gases typically are generated by decomposition of organic materials in a landfill. The composition, quantity, and generation rates of the gases depend on such factors as refuse quantity and composition, refuse placement characteristics, age of the disposal unit, landfill depth, refuse moisture content, and amount of oxygen present. The principal gases generated by volume are carbon dioxide, methane, trace thiols, and occasionally, hydrogen sulfide. Volatile organic compounds are also present in landfill gases, particularly at co-disposal facilities. Data generated during the site characterization of landfill gases should include:

- Contour drawings and rate of settlement
- Geologic and hydrogeologic characteristics, including permeability, moisture content, geologic strata, pH, depth to bedrock, and depth to groundwater
- Presence of offsite, subsurface migration
- Surface emissions
- Ambient air monitoring
- Landfill gas characteristics, including composition, moisture content, quantity, temperature, and methane content

Figure 2
Technologies Frequently Implemented for Remedial Action at CERCLA Municipal Landfills



[a] Other treatment technologies may be appropriate

Streamlining The Baseline Risk Assessment

The purpose of the baseline risk assessment is to determine whether a site poses risks to human health and the environment that are significant enough to warrant remedial action. Because options for remedial action at municipal landfill sites are limited, it may be possible to streamline or limit the scope of the baseline risk assessment by:

1. Using the conceptual site model and RI-generated data, to perform a qualitative risk assessment that identifies contaminants of concern in the affected media, their concentrations, and their hazardous properties which may pose a risk through the routes of exposure.
2. Identifying all pathways that are an obvious threat to human health or the environment (see Figure 1) by comparing RI-derived contaminant concentration levels to standards that are potential chemical-specific ARARs for the action. These may include: (1) Non-zero MCLGs and MCLs for groundwater and leachate and (2) State air quality standards for landfill gases.

   When potential ARARs do not exist for a specific contaminant, risk-based chemical concentrations should be used.
3. Where established standards for one or more contaminants in a given medium are clearly exceeded, the basis for taking remedial action is warranted (i.e., quantitative assessments that consider all chemicals, their potential additive effects, or additivity of multiple exposure pathways are not necessary to initiate remedial action).
4. In cases where clear exceedance of standards does not occur, a more thorough risk assessment will be necessary prior to initiating remedial action.

This streamlined approach may facilitate early action on the most obvious landfill problems—groundwater and leachate, landfill gas, and the landfill contents—while analysis continues on other problems such as affected wetlands and stream sediments. However, the effect of early action on obvious problems should be factored into any ongoing risk assessment. For example, if leachate seepage that had been contaminating surface water and wetlands is stopped as a result of an early action, then the risk assessment developed subsequently for the stream sediments and wetlands should assume no further loading. Any early actions also need to be designed for flexibility so that they will be consistent with subsequent actions. For example, it may be necessary to adjust a groundwater pump-and-treat early action designed to attain MCLs so that even lower levels, determined to be necessary under a subsequent risk assessment, are achieved in the interest of protecting environmental receptors in the wetlands into which the groundwater discharges.

Ultimately, it will be necessary to demonstrate that the final remedy, once implemented, will in fact address all pathways and contaminants of concern (including environmental risks), not just those that triggered the remedial action. The approach outlined above facilitates rapid implementation of protective, remedial measures for the major problems at a municipal landfill site.

Streamlining The Development Of Alternatives

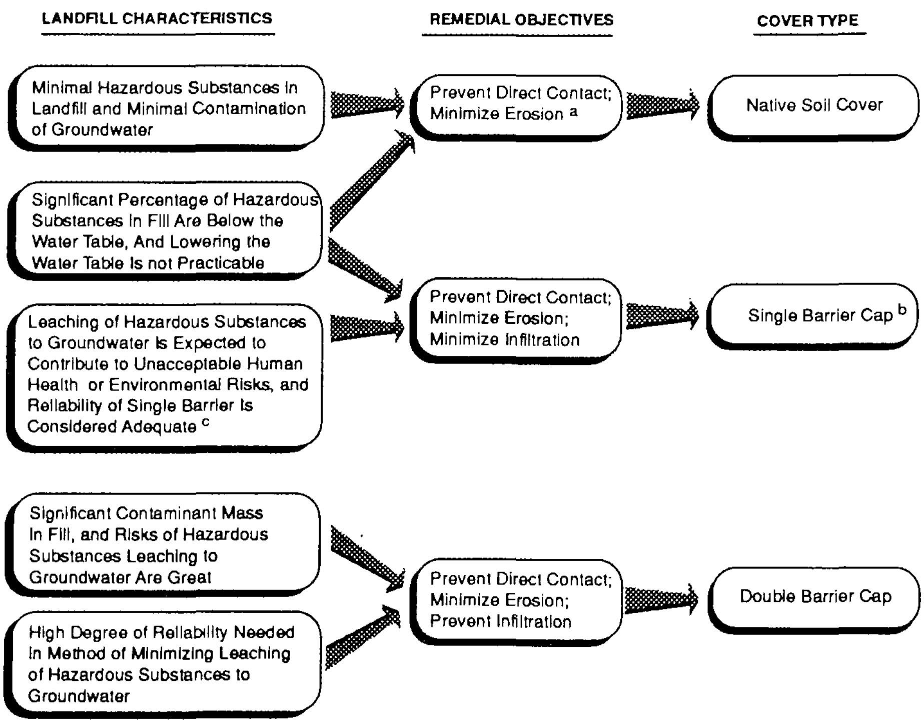
Figure 2 identifies remedial technologies and process options for achieving various remedial action objectives pertaining to municipal landfill sites. The following points should be considered in order to streamline the development of remedial action alternatives:

- The most practicable remedial alternative for landfills is generally containment. Figure 3 is a simplified decision tree for identifying the appropriate type of cap.
- Treatment of soils and wastes may be practicable for hot spots. Consolidation of hot spot materials under a landfill cap is a potential alternative in cases when treatment is not practicable or necessary.
- Extraction and treatment of contaminated groundwater and leachate may be required to control offsite migration of wastes. Collection and treatment may be necessary for an indefinite amount of time because of continued contaminant loadings from the landfill.
- Constructing an active landfill gas collection and treatment system should be considered in the following situation: (1) when existing or planned structures may be adversely affected through either explosion or inhalation hazards, (2) when final use of the site includes allowing public access, or (3) when the landfill produces excessive odors. Most landfills will require at least a passive gas collection (i.e., venting) system to prevent buildup of pressure below the cap and to prevent damage to the vegetative cover.

Onsite remedial actions at municipal landfill sites must comply with all ARARs of other environmental statutes, unless a waiver can be justified. The most significant ARARs for municipal landfills include:

- RCRA closure requirements (Subtitle D requirements will be applicable unless Subtitle C is determined to be applicable or relevant and appropriate; see *CERCLA Compliance with Other Laws Manual*, August 1988, for information on how to make these determinations.)
- More stringent state closure requirements
- Federal or state requirements pertaining to landfill gas emissions

Figure 3
Landfill Cover Selection Guide



[a] **Primary objective is to prevent direct contact, although the soil cover can be designed to reduce infiltration.**

[b] **Single barrier caps may include additional layers that provide protection to that barrier.**

[c] **Examples include situations where infiltration is not the primary concern and may include sites containing a small volume of contaminant mass, regions with low annual precipitation, or sites where groundwater is not being used as a source of drinking water.**