

# SITE SPECIFIC RISK ASSESSMENT

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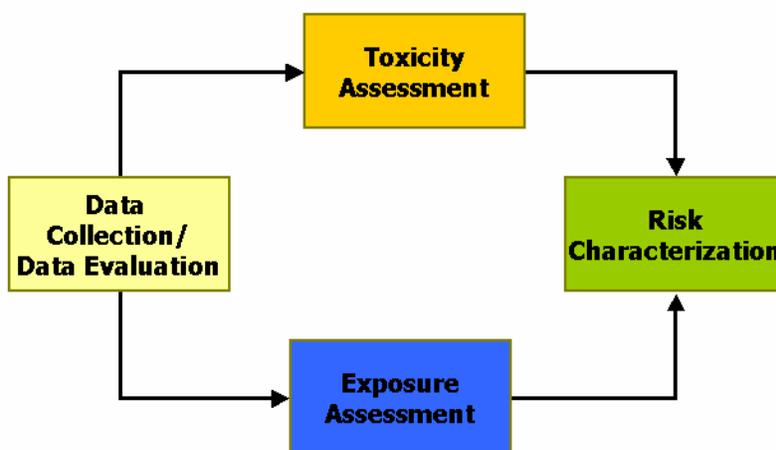
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## Introduction

A site-specific risk assessment is conducted to accurately characterize the nature and extent of the risk posed by a site of environmental contamination. *Risk Assessment Guidance for Superfund (RAGS)* provides guidance on the performance of a risk assessment related to a CERCLA release. RAGS is also used as the basic guidance document for the performance of RCRA risk evaluations. A risk assessment consists of four basic steps as shown in Figure 1.



**FIGURE 1**

The first step in the process is the data collection/data evaluation. The toxicity assessment and exposure assessment may be performed concurrently once the constituents of potential concern (COPCs) have been identified in the first step. The risk characterization step combines the results of the first three steps and generates numeric estimates of the potential risk and identifies the uncertainties associated with the risk assessment.

The four basic risk assessment steps are discussed as well as the uncertainty analysis.

## Discussion

The risk assessment process consists of four basic steps. The data collection and evaluation is performed to identify what constituents are present at the site and determine if the data is appropriate for use in the risk assessment process. Detection limits, blank contamination, background concentrations, frequency of detection, and historical use of the constituents are all evaluated in this step. At the completion of the data collection/data evaluation step, the list of COPCs has been generated. If sufficient planning was performed prior to the field investigation, appropriate detection limits and background concentrations are available for use in the risk assessment.

The toxicity assessment is conducted to determine the potential health effects associated with exposure to the COPCs and the appropriate toxicity value to use in the calculation of potential carcinogenic and noncarcinogenic risks. It is important to note that the carcinogenic risk that is calculated is a probability of contracting cancer in a lifetime due to exposure to constituents present as a result of a release at the site of environmental contamination. The evaluation of potential noncarcinogenic effects is not a probability; a ratio of the site

concentration to a reference dose (RfD) is generated. The RfD is the concentration to which an individual may be exposed, with an adequate margin of safety, without adverse health effects. A hazard index of = 1 is considered acceptable. A hazard index > 1 represents a potential health effect; the magnitude of the exceedence is not related to the potential increase in risk (a hazard index of 10 does not mean you are ten times more likely to experience an adverse health effect).

Toxicity values are available through the Integrated Risk Information System (IRIS) maintained by EPA. Reference doses for ingestion and dermal exposure, reference concentrations for inhalation exposures are available for potential noncarcinogenic health effects. Slope factors are available for carcinogenic health effects. IRIS is the preferred source of toxicity values, but additional values may be found in the Health Effects Assessment Summary Tables (HEAST), which is available in hardcopy through EPA.

It is extremely difficult to gain agency acceptance for modified toxicity values and therefore the toxicity assessment is merely the compilation of the appropriate values for use in the risk assessment.

The area where significant impacts may be made in the risk assessment is the exposure assessment. The purpose of a site-specific risk assessment is to identify the exposure scenarios that are most appropriate for the site (current and reasonably foreseeable future land use), identify receptors, and develop exposure parameters that best represent the exposure scenarios based on site-specific conditions. Climatic conditions, topography, lifestyle, age groups, and population mobility are all factors that can be considered in the site-specific assessment of risk.

A site conceptual model is used to identify the exposure scenarios and exposure pathways for a site. The site conceptual model may be presented in the form of a chart, table or figure as shown in Figure 2 below.

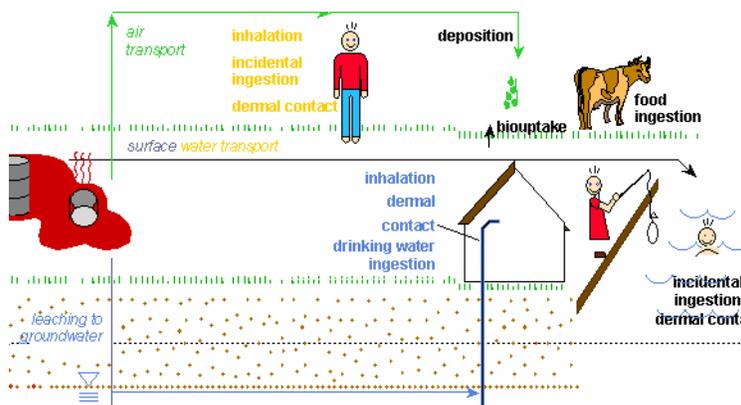


TABLE 1  
SELECTION OF EXPOSURE PATHWAYS  
SITE NAME

Scenario Timeframe	Medium	Exposure Medium	Exposure Point	Receptor Population	Receptor Age	Exposure Route	On-Site/ Off-Site	Type of Analysis	Rationale for Selection or Exclusion of Exposure Pathway
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FIGURE 2

The goal in a risk assessment performed under CERCLA or RCRA is to determine the risk for the reasonable maximum exposed individual (RME) and the central tendency estimate (CTE). The RME is representative of the maximum reasonable exposure that may occur but is not considered the worst-case scenario. The exposure point concentrations are calculated for the exposure domain based on the exposure scenarios. All the information from the exposure assessment is used to determine the daily intake of the constituents for each receptor under each exposure scenario.

The risk characterization is performed by combining the daily intake of the COPC derived from the exposure assessment with the toxicity values identified in the toxicity assessment to provide a numerical estimate of the potential risk associated with each constituent for each exposure pathway for each receptor. The risks associated

with each constituent are then added for each exposure pathway. The relevant exposure pathways are then combined to generate the total risk for a receptor. RAGS states that only if you can explain why the key RME assumptions for more than one pathway apply to the same individual or subpopulation should the RME risks for more than one pathway be combined. In practice, the opposite is generally applied – we combine all the pathways as the default methodology for assessing risk. This results in an overestimate of the potential risk posed by a site.

The numerical estimates in the risk characterization section of the risk assessment should not be presented as more than one significant figure. The uncertainties associated with the risk assessment process can span several orders of magnitude so presenting more than one significant figure implies a level of certainty in the estimate that is not justified by the methodology.

It is important to distinguish between those parameters with high uncertainty and high variability. Collecting more data can decrease the uncertainty in an exposure parameter such as the representative exposure concentration or the amount of time recreational fisherman spend at a particular lake. Collecting more data will not decrease variability; the variability in population height and weight will not decrease by collecting more information. Both uncertainty and variability can be addressed in a risk assessment.

Uncertainties are inherent in the risk assessment process. The risk characterization should present the uncertainties so as to put the estimated risks into perspective. What is known and not known as well as the level of confidence associated with the various estimates must be presented. The purpose of presenting the RME and CTE estimates is to provide a range of potential risks for the site. It is important to communicate to all stakeholders that the estimated risks apply only to individuals that are exposed under the exact same conditions used to assess the risk. All pertinent information used in the calculation of risk must be provided so that anyone can independently calculate the risks. A suggested table format is provided in Figure 3 below.

Exposure Route	Parameter Code	Parameter Definition	Units	RME Value	RME Reference
<b>Adult Recreational: Soil</b>					
Ingestion	CS	Chemical Concentration in Soil	mg/kg	(1)	(1)
	R	Ingestion Rate of Soil	mg soil/day	50	EPA, 1991
	EF	Exposure Frequency	days/year	40	(2)(3)
	ED	Exposure Duration	years	25	EPA, 1991
	ABS	Absorption Factor	--	1	(4)
	CF1	Conversion Factor	kg/mg	1.00E-06	--
	BW	Body Weight	kg	70	EPA, 1991
	ATC	Averaging Time (Cancer)	days	25,550	EPA, 1991
	ATN	Averaging Time (Non-Cancer)	days	3,650	EPA, 1991
FI	Fraction Ingested	--	1.00	(2)	
<b>Worst Case Scenario</b>					
Parameter	Slope Factor (SF)	Reference Dose (RfD)	Reference		
Arsenic	1.50E+00	3.00E-04	II	II-IRIS	
Benz(a)anthracene	7.30E-01			I-HEAST	
Benz(a)pyrene	7.30E+00			I-NCEA	
TEQ	1.50E+05				
Aluminum		1.00E+00	I		
Antimony		4.00E-04	II		
Barium		7.00E-02	II		
Cadmium		5.00E-04	II		
Cyanide		2.00E-02	II		
Iron		3.00E-01	II		
<b>Lead</b>					
Manganese		2.40E-02			
<b>Mercury</b>					
Selenium		5.00E-03	II		
Silver		5.00E-03	II		
Vanadium		7.00E-03	I		
Zinc		3.00E-01	II		
Pyrene		3.00E-02	II		
<b>Fluoranthene</b>					
Fluorenone		4.00E-02	II		
Naphthalene		2.00E-02	II		

**FIGURE 3**

### Summary

A site-specific risk assessment incorporates information from the data collection/data evaluation step by identifying the constituents of potential concern. The toxicity assessment evaluates the potential health effects associated with particular constituent and documents the appropriate toxicity values for use in the quantitative risk assessment. The exposure assessment uses a site conceptual model to identify exposure scenarios including potential receptors and exposure pathways. Exposure parameters are selected for each scenario, receptor and pathway to represent the reasonable maximum exposed and the central tendency estimate. The outcome of the exposure assessment is the estimated daily intake of each constituent for each receptor. The daily intake is then combined with the toxicity values during risk characterization to generate the numerical estimate of the risk. Due to the inherent uncertainties in the risk assessment process, an evaluation of the uncertainties is provided in the risk characterization section of the risk assessment.