

Hazard Ranking System (HRS)

An Introduction

Universal Concepts

October 26, 2023

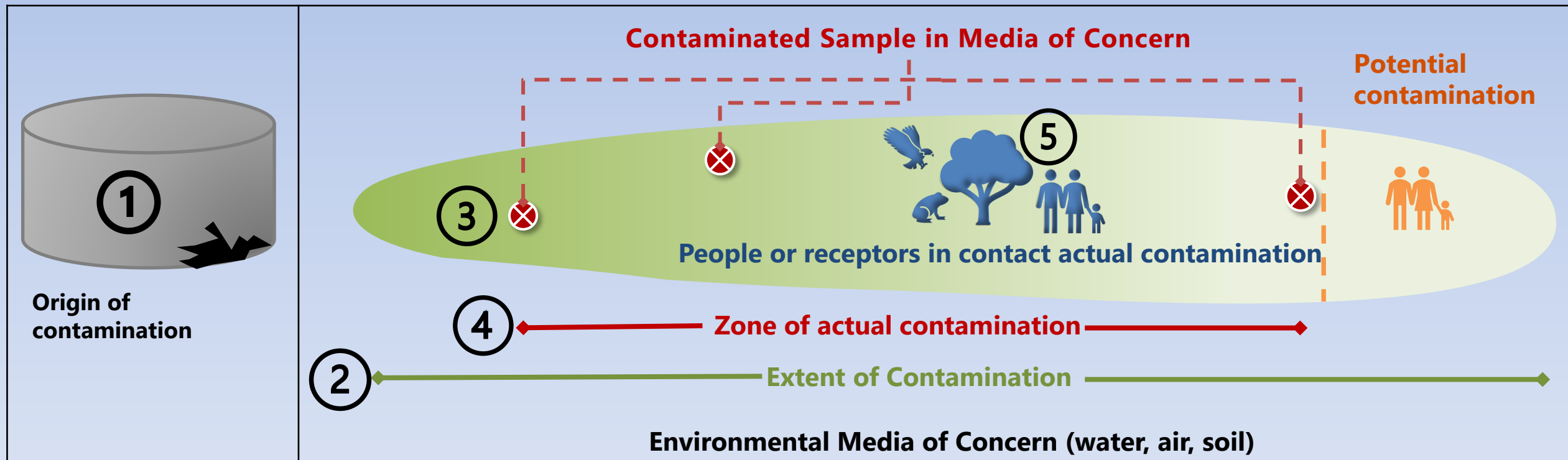
Molly Wenner



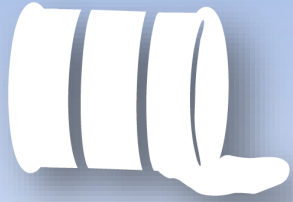
Purpose and Overview

- The purpose of this module is to gain an understanding of concepts common across pathways and components
- This module will include:
 - A review of the HRS generic conceptual site model
 - A brief review of each factor category, the purpose of each, and what it measures
 - A more detailed review of certain factors that are foundational to a site evaluation

HRS Generic Conceptual Site Model

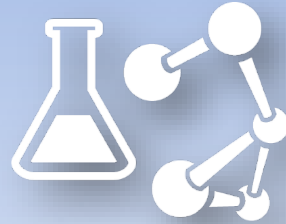


HRS Factor Categories



Likelihood of Release

- Has any contamination escaped?
- Evaluates the actual or potential release of hazardous substances into the environment



Waste Characteristics

- How harmful is contamination and how much?
- Evaluates the toxicity, fate and transport characteristics and amount of a hazardous substance



Targets

- Who or what is threatened by the contamination?
- Evaluates the populations, sensitive environments, and resources impacted by contamination

HRS Factor Categories and Factors Evaluated



Likelihood of Release

Observed Release/Contamination/Exposure

Potential for Release/Exposure

Waste Characteristics

Toxicity

Fate and Transport Characteristics

Hazardous Waste Quantity

Targets

Individual

Population

Resources

Sensitive Environments

TABLE 2-1—SAMPLE PATHWAY SCORESHEET

Factor category	Maximum value	Value assigned
Likelihood of Release		
1. Observed Release	550	
2. Potential to Release	500	
3. Likelihood of Release (higher of lines 1 and 2)	550	
Waste Characteristics		
4. Toxicity/Mobility	(a)	
5. Hazardous Waste Quantity	(a)	
6. Waste Characteristics	100	
Targets		
7. Nearest Individual.		
7a. Level I	50	
7b. Level II	45	
7c. Potential Contamination	20	
7d. Nearest Individual (higher of lines 7a, 7b, or 7c)	50	
8. Population	(b)	
8a. Level I	(b)	
8b. Level II	(b)	
8c. Potential Contamination	(b)	
8d. Total Population (lines 8a+8b+8c).	(b)	
9. Resources	5	
10. Sensitive Environments	(b)	
10a. Actual Contamination	(b)	
10b. Potential Environments	(b)	
10c. Sensitive Environments (lines 10a+10b)	(b)	
11. Targets (lines 7d+8d+9+10c)	(b)	
12. Pathway Score is the product of Likelihood of Release, Waste Characteristics, and Targets, divided by 82,500. Pathway scores are limited to a maximum of 100 points.		

^aMaximum value applies to waste characteristics category. The product of lines 4 and 5 is used in Table 2-7 to derive the value for the waste characteristics factor category.

^bThere is no limit to the human population or sensitive environments factor values. However, the pathway score based solely on sensitive environments is limited to a maximum of 60 points.



LIKELIHOOD OF RELEASE

Likelihood of Release – 1st Factor Category

- Evaluates the actual or potential release of hazardous substances into the environment
- 2 factors can be evaluated



Observed Release

- A hazardous substance has entered a pathway medium of concern
- Typically, establishing an observed release will be the foundation for evaluating the site
- Established by either direct observation or chemical analysis



Observed Release by Chemical Analysis

HRS requirements to establish an observed release by chemical analysis:

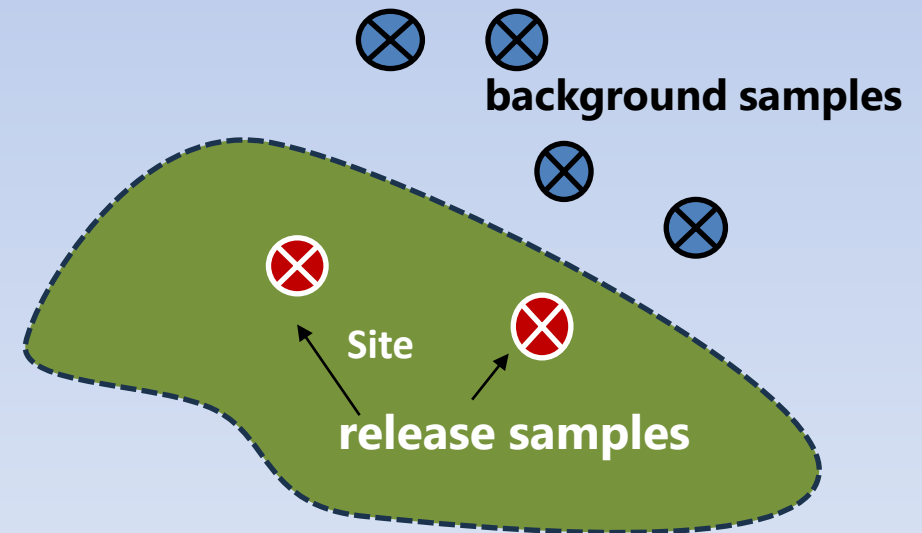
- Establish a **(1) background level** for the sample medium
- Contamination concentration **(2) significantly above the background level** for that sample medium, **and**
- Some portion of the significant increase in the release substances is **(3) attributable to the site**

Observed Release by Chemical Analysis

(1) Background Level

What it means:

- Represents concentration of hazardous substance outside influence of site contamination
- Serves as a control to compare release samples against
- Are not necessarily "clean" samples
 - Representative of what the levels of contaminants would be "if not for the site"



Observed Release by Chemical Analysis

(2) Significantly above the background level

Significant increase when:

- **Contaminated sample concentration** \geq analytical limit for contaminated sample
and
- **Increase above background via**
 - If **background level = not detected**, then
Significant increase = contaminated sample concentration \geq analytical limit associated with background result
or
 - If **background level = detected**, then
Significant increase = contaminated sample concentration \geq 3x background concentration

TABLE 2-3—OBSERVED RELEASE CRITERIA FOR CHEMICAL ANALYSIS

Sample Measurement < Sample Quantitation Limit^a
No observed release is established.

Sample Measurement \geq Sample Quantitation Limit^a
An observed release is established as follows:

- If the background concentration is not detected (or is less than the detection limit), an observed release is established when the sample measurement equals or exceeds the sample quantitation limit.^a
- If the background concentration equals or exceeds the detection limit, an observed release is established when the sample measurement is 3 times or more above the background concentration.

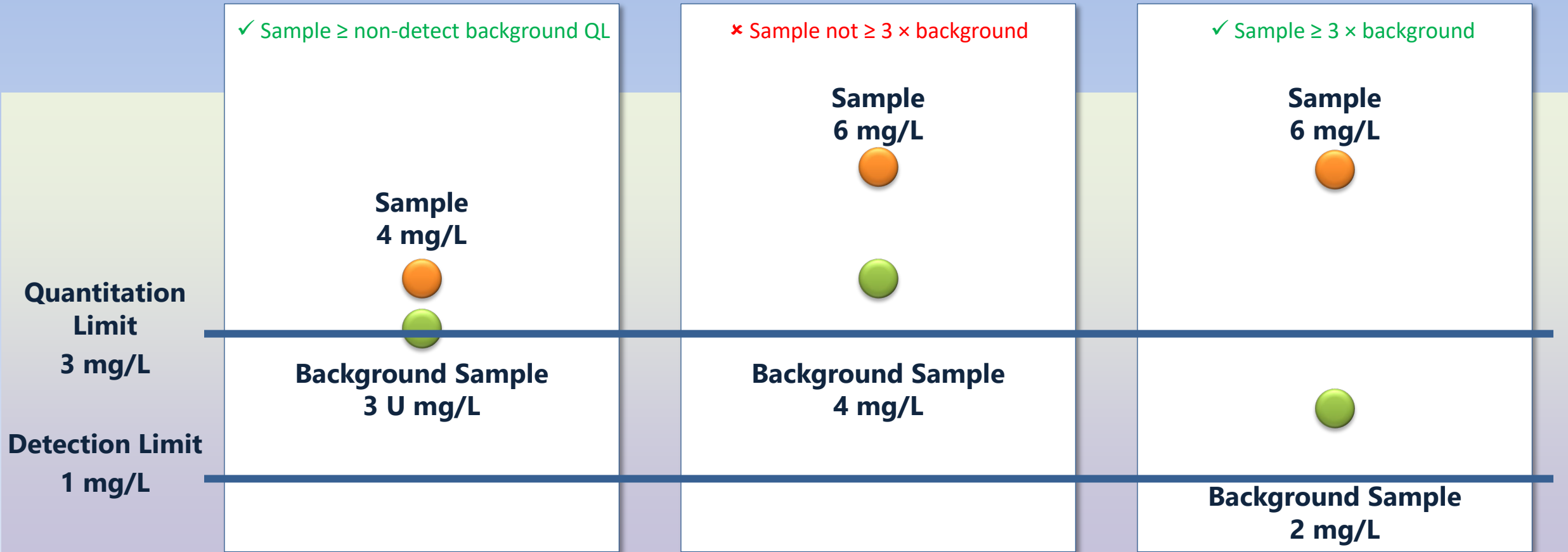
^aIf the sample quantitation limit (SQL) cannot be established, determine if there is an observed release as follows:

—If the sample analysis was performed under the EPA Contract Laboratory Program, use the EPA contract-required quantitation limit (CRQL) in place of the SQL.

—If the sample analysis is not performed under the EPA Contract Laboratory Program, use the detection limit (DL) in place of the SQL.

Observed Release by Chemical Analysis

(2) *Significantly above the background level*

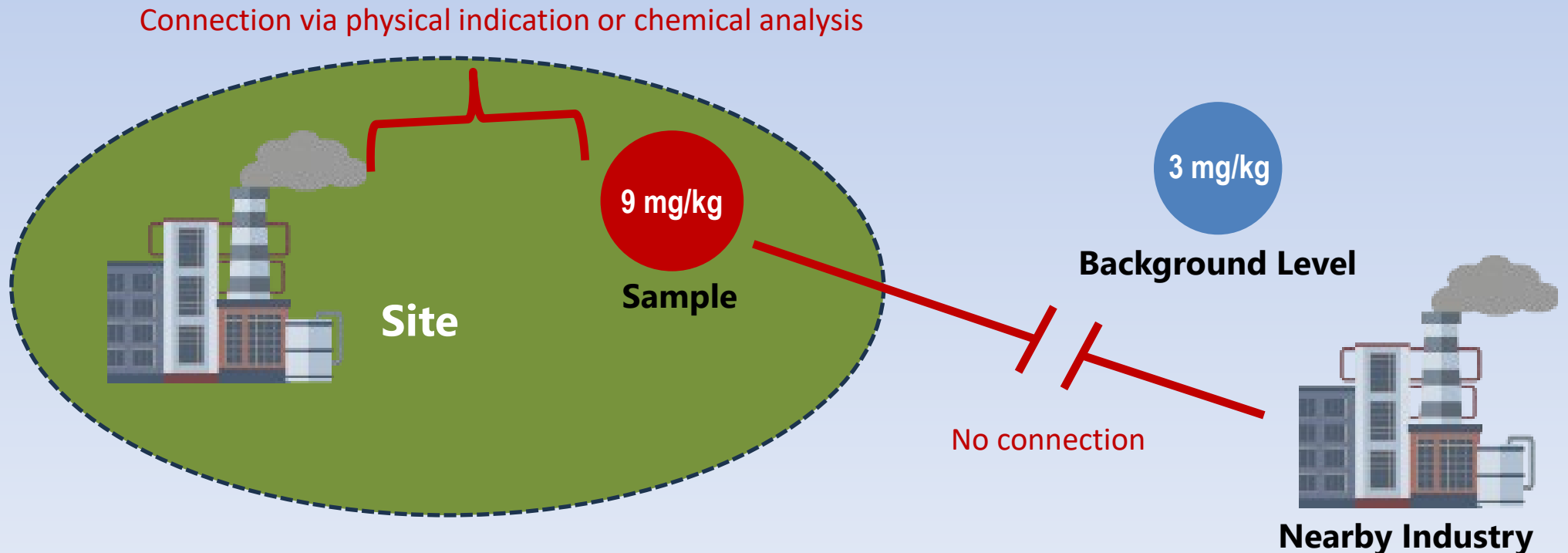


Observed Release by Chemical Analysis

(3) Attributable to the site

What it means:

The significant increase in a contaminant's concentration above a background level in a release sample is at least partially a result of the site being evaluated



Observed Release by Chemical Analysis

Other things to keep in mind – Sample similarity

- Ensure the increase in contamination is due to a release, **not** differences in physical characteristics of the sample media, sampling techniques, or analysis methods
- Compare samples of the same medium, and type of medium:
 - indoor air to indoor air, groundwater to groundwater
 - not groundwater to surface water, indoor air to soil gas, or river sediments to river water





WASTE CHARACTERISTICS

Waste Characteristics – 2nd Factor Category

Evaluates three types of factors:

- Substance-specific toxicity
- Fate and transport characteristics (media and pathway specific)
- Hazardous waste quantity (HWQ)



Superfund Chemical Data Matrix Query

Pick from a list of Available Substances

Acenaphthene, 000083-32-9
Acenaphthylene, 000208-96-8
Acetone, 000067-64-1

Add

Selected Substances

Tetrachloroethylene, 000127-18-4

Remove

Remove All Substances



A maximum of 75 substances can be reported at one time.

Step 2. Select Parameters to Display

HRS Factor Values:

Select All HRS Factor Values

- Ground Water
- Surface Water
- Soil Exposure
- Subsurface Intrusion
- Air

HRS Benchmarks:

Select All HRS Benchmarks

- Ground Water
- Surface Water
- Soil Exposure
- Subsurface Intrusion
- Air
- Radionuclide

Data Elements:

Select All Data Elements

- Toxicity
- Persistence
- Ssl Degradation
- Mobility
- Bioaccumulation
- Physical Characteristics
- Other Data
- Class Information

Factor Values: Ground Water Pathway

Tetrachloroethylene [CASRN 000127-18-4]

Parameter	Value
Toxicity	100
Water Solubility	2.06E+02
Distribution Coefficient	1.44E+01
Geometric Mean Solubility	--
Mobility: Liquid, Karst	1.0E+00
Mobility: Liquid, Non-Karst	1.0E-02
Mobility: Non-Liquid, Karst	1.0E+00
Mobility: Non-Liquid, Non-Karst	1.0E-02

Evaluating Hazardous Waste Quantity

What it means:

- It represents an amount of hazardous substances in the waste being evaluated
- HWQ is documented using the following tiers:
 - Hazardous constituent quantity (Tier A)
 - Hazardous wastestream quantity (Tier B)
 - Volume (Tier C) or
 - Area (Tier D)
- The tier used to measure hazardous waste quantity depends on what information is available

Hazardous Waste Quantity

Tier Options

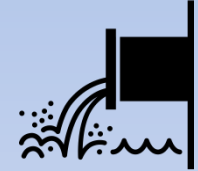
Tier A – Hazardous Constituent Quantity

- Measures: Total mass of CERCLA hazardous substances
- Information needed: Total amount (in pounds) or concentration of substance; volume; mass conversion



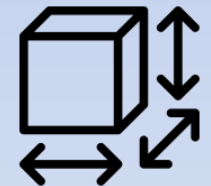
Tier B – Hazardous Wastestream Quantity

- Measures: Total mass of all hazardous wastestreams
- Information needed: Total mass (in pounds) of wastestreams and pollutants and contaminants; actual contents not capacity; mass conversion



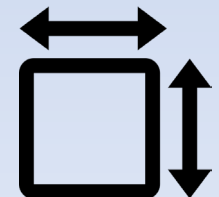
Tier C – Volume

- Measures: Volume
- Information needed: Area and height dimensions; based on capacity not the actual contents



Tier D – Area

- Measures: Area
- Information needed: Area dimensions



Total Hazardous Waste Quantity

What it means:

- A HWQ value is determined for each source, AOC or structure at a site
- Once a HWQ value is assigned for each, they are summed to get a total waste quantity value for the pathway/component
- This is the final HWQ factor value used in determining Waste Characteristics Factor Category Value



TARGETS

Targets – 3rd Factor Category

- The people or environments impacted by the contamination at the site
- 4 factors are evaluated



Actually Contaminated Targets

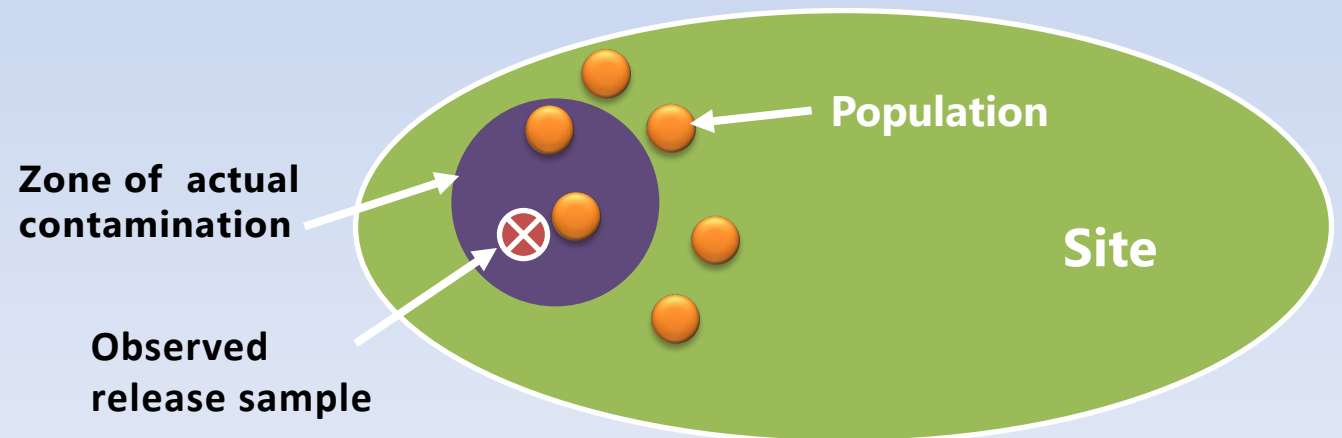
- Targets/population have come in contact with contamination or may be inferred to have come in contact with contamination
- More points are assigned to targets subject to actual contamination; therefore, major score driver



Actually Contaminated Targets

Evaluation Elements

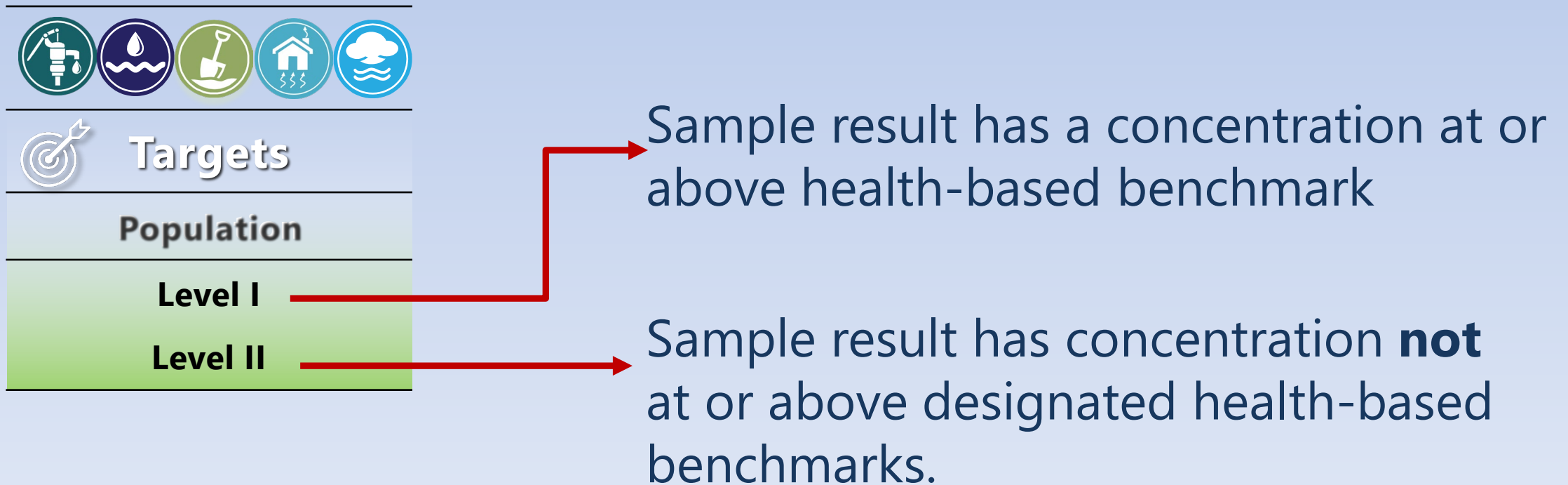
- Hazardous substance meeting observed release criteria
- Target/population associated with observed release sample
- Concentration of hazardous substance in observed release sample
- HRS Benchmark (SCDM)



Actually Contaminated Targets

Level of Contamination

- Once actually contaminated targets are determined, they are further grouped based on level of contamination



Actually Contaminated Targets

HRS Benchmarks

- Health-based benchmarks used for evaluating targets subject to actual contamination were developed to address long term risk
- Level I: Total population subject to Level I contamination x 10
- Level II: Total population subject to Level II contamination x 1

Superfund Chemical Data Matrix (SCDM) Query

Last Update: July 2020

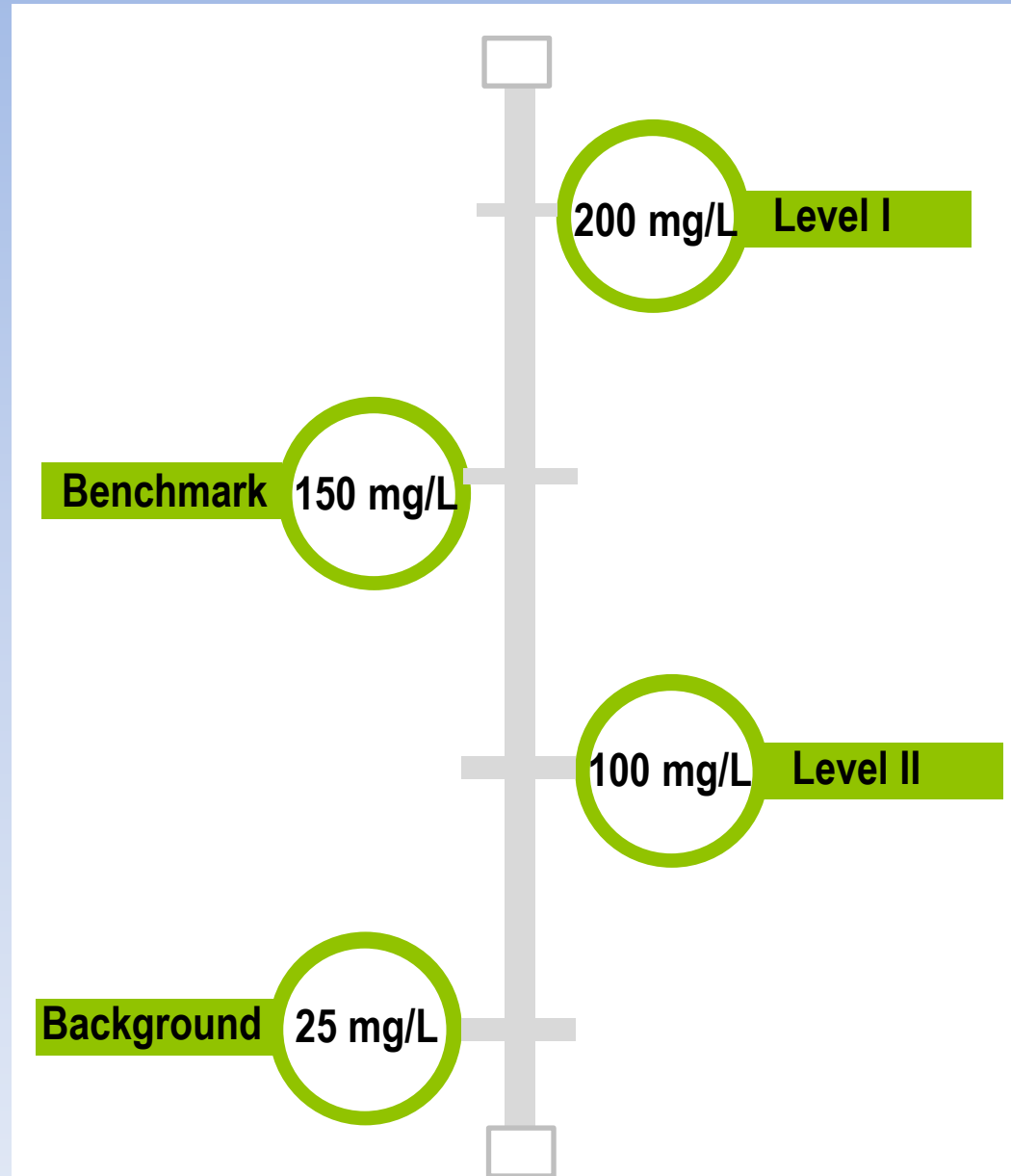
Substance: Tetrachloroethylene
[CASRN 000127-18-4]

Query Accessed: 12/3/2020

Benchmarks: Subsurface Intrusion Component
Tetrachloroethylene [CASRN 000127-18-4]

Parameter	Value	Unit
Cancer Risk	1.08E-02	mg/m ³
Non-Cancer Risk	4.17E-02	mg/m ³

Level of Contamination





Q & A