Organização Panamericana de Saúde
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“Procedimento utilizado pela USEPA para estabilizar os valores orientadores de prevenção e intervenção”

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"USEPA Procedures for Establishing Environmental Screening and Cleanup Levels"

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PRESENTATION CONTENT

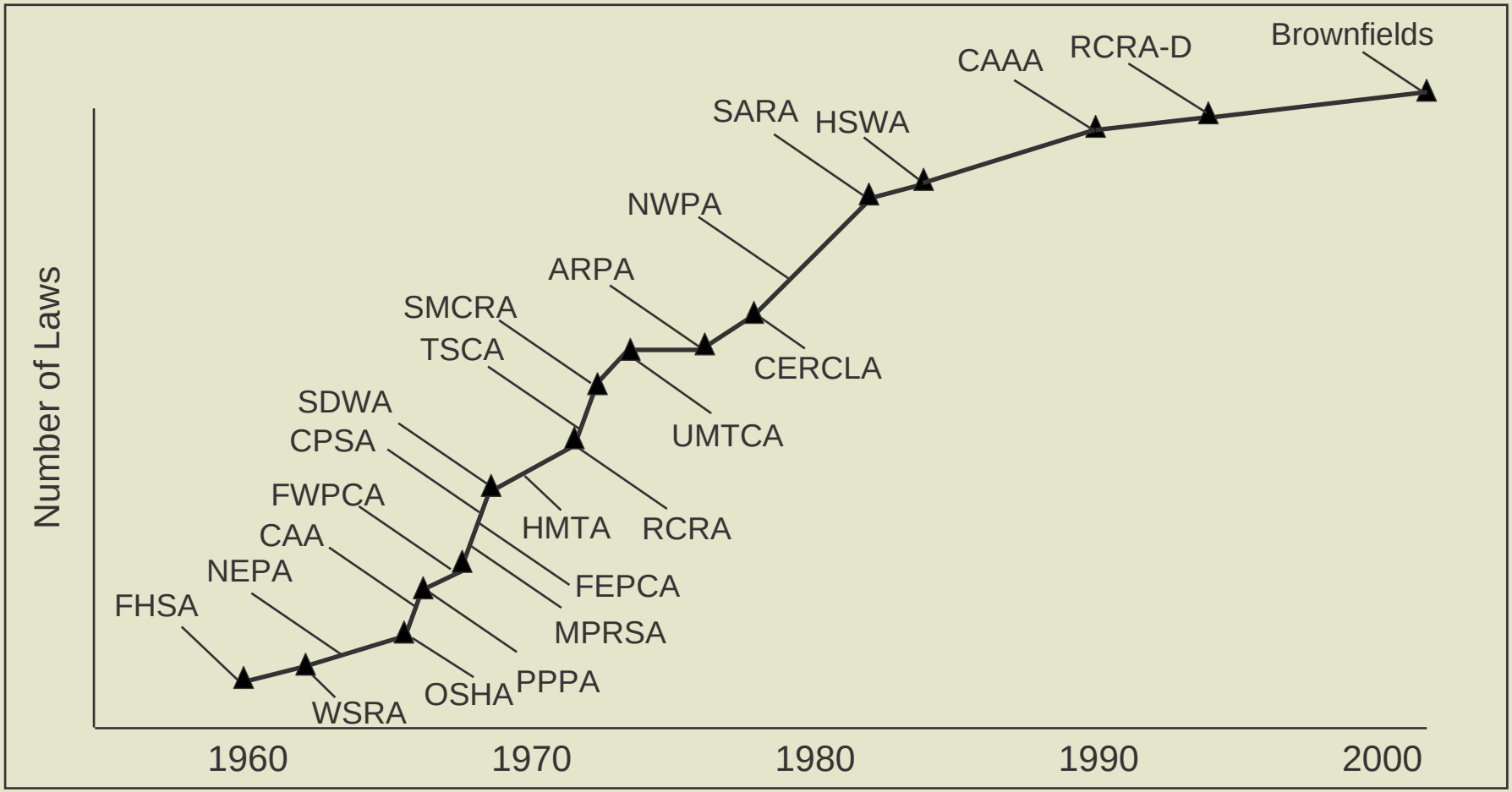
1. **BACKGROUND**
2. **SITE REMEDIATION PROCESS**
3. **INTERVENTION VALUE DEVELOPMENT**
    1. PURPOSE
    2. PROGRAMS
4. **INPUT PARAMETERS**
5. **PROCEDURE SUMMARY**
6. **EXAMPLE PROJECTS**

BACKGROUND

Major U.S. Contaminated Sites:

- **Cuyahoga River Fire - 1969**
- **Love Canal – 1978**
- **Times Beach - 1980**

DEVELOPMENT OF MAJOR U.S. ENVIRONMENTAL REGULATIONS



GENERAL SITE REMEDIATION PROCESS

- **SITE INVESTIGATION**
  - Identification
  - Delineation
- **RISK CHARACTERIZATION**
  - Human Health
  - Environmental Receptors
- **REMEDIAL ACTION**
  - Remedial Action Objectives
  - Remedial Design
  - Remedy Implementation
  - Operation & Management

DEVELOPMENT OF "INTERVENTION" VALUES AND CLEANUP GOALS IN U.S.

- **Initial sites managed through formal Risk-Assessment under Superfund**
- **Not all sites are Superfund Sites – what about small sites?**
- **Agencies needed simple process to screen and prioritize**
- **Owners wanted simple cleanup goals without formal risk assessment**
- **Values/goals specific for chemicals, industries, land uses, exposures, etc.**
- **Values are not mandated by law; programs continue to offer flexibility**

MANY U.S. INTERVENTION VALUE AND REMEDIATION GOAL PROGRAMS

Federal Cleanup Levels (www.cleanuplevels.com)

USEPA Soil Screening Guidance (SSG) - This is a great source for soil screening levels (SSLs), information on calculating site cleanup levels, and general guidelines for the use of levels at sites. GO

USEPA Region 9 Preliminary Removal Goals (PRGs) - This source, called R9 PRGs for short, not only gives you lots of soil cleanup values in table form but also has detailed technical information on calculating site-specific goals GO

USEPA Region 6 Medium-Specific Screening Levels (MSLs) - According to Region 6, these are very general and should be used as screening levels only. Tables have toxicity info, physical parameters and soil screening levels. GO

USEPA Region 3 Risk-Based Concentrations (RBCs) - This site presents the R3 Risk-Based Concentrations (RBCs) tables along with guidance on Monte Carlo, groundwater exposure point concentrations and assessing dermal exposure to and risk from soils. GO.

USEPA Risk Assessment Guidance For Superfund: Part B, Preliminary Removal Goals (RAGS, Part B) - RAGS Part B is the holy grail of cleanup levels. Simple document that gives the general risk (intake) equations used in a quantitative risk assessment and the general equations for cleanup goals or PRGs GO

Federal Drinking Water Standards and Health Advisories - This has the national primary (MCLs and MCLGs) and the secondary drinking water standards. A must-have for sites with possibly contaminated groundwater. GO

MTBE Groundwater Clean-up Levels for LUST Sites - This is a really cool map of the states on EPA's website that shows the current and proposed cleanup levels for MTBE in each of the states. GO

SEVERAL STATE SCREENING AND REMEDIATION GOAL PROGRAMS

State-Specific Cleanup Levels (www.cleanuplevels.com)

Tennessee: Cleanup Criteria for Petroleum Contaminated Sites - TN's Division of Solid Waste Management has levels for benzene and TPH in the document at the end of the GO link. For state site remediations, the division uses EPA Region 9 PRGs for screening purposes. GO

Texas: State Cleanup Levels - This site is from PEL Labs (no, they have not paid us but we will take cash if they feel generous) and calculates cleanup levels depending on media, source area and and land use. Cool toy to play with. GO

Utah: Estimating Numeric Cleanup Levels for Petroleum-Contaminated Soil at Underground Storage Tank Release Sites - This document covers Utah's guidelines for Recommended Soil Cleanup Levels (RCLs) related to Underground Storage Tanks. Presents levels for TPH and BTEX. Numbers are for gasoline constituents and a little hard to find: go to the end of the document to Tables 10 - 12. GO

Virginia: Voluntary Remediation Program Risk Assessment Guidance - Virginia's Department of Environmental Quality has a tiered procedure similar to other states. They have Excel tables with information on toxicity, exposure factors, etc. to use in your calculations. They also have tables for soil levels (residential - vrp25.xls, industrial - vrp29.xls), groundwater values, and some surface water info. For the list of available tables and direct links: GO.

Washington: RAIS Federal Guidelines Retrieval System - This search engine brought to us on RAIS's web pages presents a service to readers, letting them search for many different kinds of goals for the waters of Washington. GO

USEPA SOIL SCREENING LEVELS (2004)

Inorganics				Migration to ground water	
CAS No.	Compound	Ingestion (mg/kg)	Inhalation fugitive particulate (mg/kg)	20 DAF (mg/kg)	1 DAF (mg/kg)
7440-36-0	Antimony	31 [b]	— [c]	5	0.3
7440-38-2	Arsenic	0.4 [e]	760 [e]	29 [i]	1 [i]
7440-39-3	Barium	5,500 [b]	6.9E+05 [b]	1,600 [i]	82 [i]
7440-41-7	Beryllium	0.1 [e]	1,300 [e]	63 [i]	3 [i]
7440-43-9	Cadmium	78 [b,m]	1,800 [e]	8 [i]	0.4 [i]
7440-47-3	Chromium (total)	390 [b]	270 [e]	38 [i]	2 [i]
16065-83-1	Chromium (III)	78,000 [b]	— [c]	— [g]	— [g]
18540-29-9	Chromium (VI)	390 [b]	270 [e]	38 [i]	2 [i]
57-12-5	Cyanide (amenable)	1,600 [b]	— [c]	40	2
7439-92-1	Lead	400 [k]	— [k]	— [k]	— [k]
7440-02-0	Nickel	1,600 [b]	13,000 [e]	130 [i]	7 [i]
7782-49-2	Selenium	390 [b]	— [c]	5 [i]	0.3 [i]
7440-22-4	Silver	390 [b]	— [c]	34 [b,i]	2 [b,i]
7440-28-0	Thallium	— [c]	— [c]	0.7 [i]	0.04 [i]
7440-62-2	Vanadium	550 [b]	— [c]	6,000 [b]	300 [b]
7440-66-6	Zinc	23,000 [b]	— [c]	12,000 [b,i]	620 [b,i]

DAF = Dilution and attenuation factor.

USEPA REGION 9 – PRGs (2004)

Key : SFo,i=Cancer Slope Factor oral, inhalation RfDo,i=Reference Dose oral, inhalation i=IRIS p=PPRTV c=California EPA n=NCEA h=HEAST x=Withdrawn r=Route-extrapolation ca=Cancer PRG nc= Noncancer PRG ca* (where nc PRG < 100X ca PRG) ca** (where nc PRG < 10X ca PRG) +++=Non-Standard Method Applied (See User's Guide) sat=Soil Saturation (See User's Guide) max=Ceiling limit (See User's Guide) DAF=Dilution Attenuation Factor (See User's Guide) CAS=Chemical Abstract Services

TOXICITY VALUES										CONTAMINANT	PRELIMINARY REMEDIATION GOALS (PRGs) "Direct Contact Exposure Pathways"								SOIL SCREENING LEVELS "Migration to Ground Water"	
SFo 1/(mg/kg-d)		RfDo (mg/kg-d)		SFi 1/(mg/kg-d)		RfDi (mg/kg-d)		V O C	skin abs.	CAS No.		Residential Soil (mg/kg)		Industrial Soil (mg/kg)		Ambient Air (ug/m^3)		Tap Water (ug/l)		DAF 20 (mg/kg)	DAF 1 (mg/kg)
8.7E-03	i	4.0E-03	i	8.7E-03	r	4.0E-03	r		0.1	30560-19-1	Acephate	5.6E+01	ca**	2.0E+02	ca*	7.7E-01	ca*	7.7E+00	ca*		
				7.7E-03	i	2.6E-03	i	y		75-07-0	Acetaldehyde	1.1E+01	ca**	2.3E+01	ca**	8.7E-01	ca*	1.7E+00	ca		
		2.0E-02	i			2.0E-02	r		0.1	34256-82-1	Acetochlor	1.2E+03	nc	1.2E+04	nc	7.3E+01	nc	7.3E+02	nc		
		9.0E-01	i			9.0E-01	r	y		67-64-1	**Acetone**	1.4E+04	nc	5.4E+04	nc	3.3E+03	nc	5.5E+03	nc	1.6E+01	8.0E-01
		8.0E-04	h			8.0E-04	r		0.1	75-86-5	Acetone cyanohydrin	4.9E+01	nc	4.9E+02	nc	2.9E+00	nc	2.9E+01	nc		
		1.7E-02	r			1.7E-02	i	y		75-05-8	Acetonitrile	4.2E+02	nc	1.8E+03	nc	6.2E+01	nc	1.0E+02	nc		
		5.0E-04	i			5.7E-06	i	y		107-02-8	**Acrolein**	1.0E-01	nc	3.4E-01	nc	2.1E-02	nc	4.2E-02	nc		
4.5E+00	i	2.0E-04	i	4.5E+00	i	2.0E-04	r		0.1	79-06-1	Acrylamide	1.1E-01	ca	3.8E-01	ca	1.5E-03	ca	1.5E-02	ca		
		5.0E-01	i			2.9E-04	i		0.1	79-10-7	Acrylic acid	2.9E+04	nc	1.0E+05	max	1.0E+00	nc	1.8E+04	nc		
5.4E-01	i	1.0E-03	h	2.4E-01	i	5.7E-04	i	y		107-13-1	Acrylonitrile	2.1E-01	ca*	4.9E-01	ca*	2.8E-02	ca*	3.9E-02	ca*		
1.0E+00	r			1.0E+00	c			y			**"CAL-Modified PRG"**	5.5E-02	ca	1.2E-01	ca	6.7E-03	ca	1.1E-02	ca		
8.1E-02	h	1.0E-02	i	8.0E-02	r	1.0E-02	r		0.1	15972-60-8	Alachlor	6.0E+00	ca	2.1E+01	ca	8.4E-02	ca	8.4E-01	ca		
		1.5E-01	i			1.5E-01	r		0.1	1596-84-5	Alar	9.2E+03	nc	9.2E+04	nc	5.5E+02	nc	5.5E+03	nc		
		1.0E-03	i			1.0E-03	r		0.1	116-06-3	Aldicarb	6.1E+01	nc	6.2E+02	nc	3.7E+00	nc	3.6E+01	nc		
		1.0E-03	i			1.0E-03	r		0.1	1646-88-4	Aldicarb sulfone	6.1E+01	nc	6.2E+02	nc	3.7E+00	nc	3.6E+01	nc		
1.7E+01	i	3.0E-05	i	1.7E+01	i	3.0E-05	r		0.1	309-00-2	Aldrin	2.9E-02	ca*	1.0E-01	ca	3.9E-04	ca	4.0E-03	ca	5.0E-01	2.0E-02
		2.5E-01	i			2.5E-01	r		0.1	74223-64-6	Ally	1.5E+04	nc	1.0E+05	max	9.1E+02	nc	9.1E+03	nc		
		5.0E-03	i			5.0E-03	r		0.1	107-18-6	Allyl alcohol	3.1E+02	nc	3.1E+03	nc	1.8E+01	nc	1.8E+02	nc		
		2.3E-04	r			2.3E-04	i		0.1	107-05-1	**Allyl chloride**	1.7E+01	nc	1.8E+02	nc	1.0E+00	nc	1.0E+01	nc		
		1.0E+00	p			1.4E-03	p			7429-90-5	Aluminum	7.6E+04	nc	1.0E+05	max	5.1E+00	nc	3.6E+04	nc		
		4.0E-04	i							20859-73-8	Aluminum phosphide	3.1E+01	nc	4.1E+02	nc			1.5E+01	nc		
		3.0E-04	i			3.0E-04	r		0.1	67485-29-4	Amdro	1.8E+01	nc	1.8E+02	nc	1.1E+00	nc	1.1E+01	nc		
		3.0E-03	i			3.0E-03	r		0.1	834-12-8	Ametryn	5.5E+02	nc	5.5E+03	nc	3.3E+01	nc	3.3E+02	nc		
		2.0E-04	n			2.0E-04	r		0.1	1321-12-6	**Aminodinitrotoluene**	1.2E+01	nc	1.2E+02	nc	7.3E-01	nc	7.3E+00	nc		
		7.0E-02	h			7.0E-02	r		0.1	591-27-5	m-Aminophenol	4.3E+03	nc	4.3E+04	nc	2.6E+02	nc	2.6E+03	nc		
		2.0E-05	h			2.0E-05	r		0.1	504-24-5	4-Aminopyridine	1.2E+00	nc	1.2E+01	nc	7.3E-02	nc	7.3E-01	nc		
		2.5E-03	i			2.5E-03	r		0.1	33089-61-1	Amitraz	1.5E+02	nc	1.5E+03	nc	9.1E+00	nc	9.1E+01	nc		

PhysChem | Soils | Air-H20 | PRG TABLE 2004

U.S. EPA. 2004. *Preliminary Remediation Goals Table*, 2004. Região 9

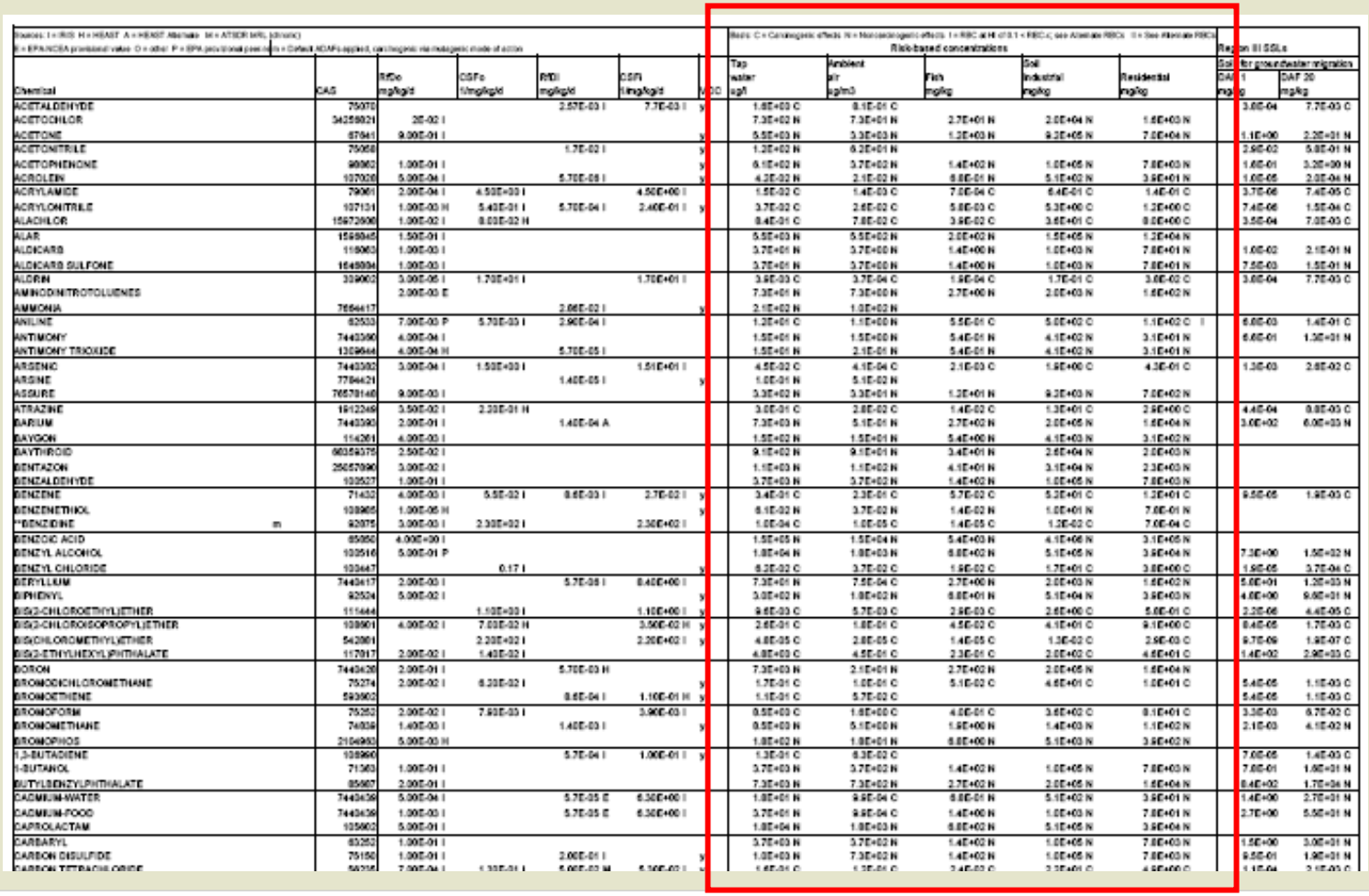
On-line:http://www.epa.gov/Region9/waste/sfund/prg/files/04prgtable.pdf

Key U.S. Programs – EPA Region 9 Preliminary Remediation Goals (PRGs)

Preliminary Remediation Goals (PRGs) are tools for evaluating and cleaning up contaminated sites. They are risk-based concentrations that are intended to assist risk assessors and others in **initial screening-level evaluations** of environmental measurements. The PRGs contained in the Region 9 PRG Table are generic; they are **calculated without site specific information**. However, they may be re-calculated using site specific data.

PRGs should be viewed as **Agency guidelines, not legally enforceable standards**. They are used for site "screening" and as **initial cleanup goals** if applicable. **PRGs are not *de facto* cleanup standards** and should not be applied as such. However, they are helpful in providing long-term targets to use during the analysis of different remedial alternatives. By developing PRGs early in the decision-making process, design staff may be able to streamline the consideration of remedial alternatives.

USEPA REGION 3 – RBCs (2006)



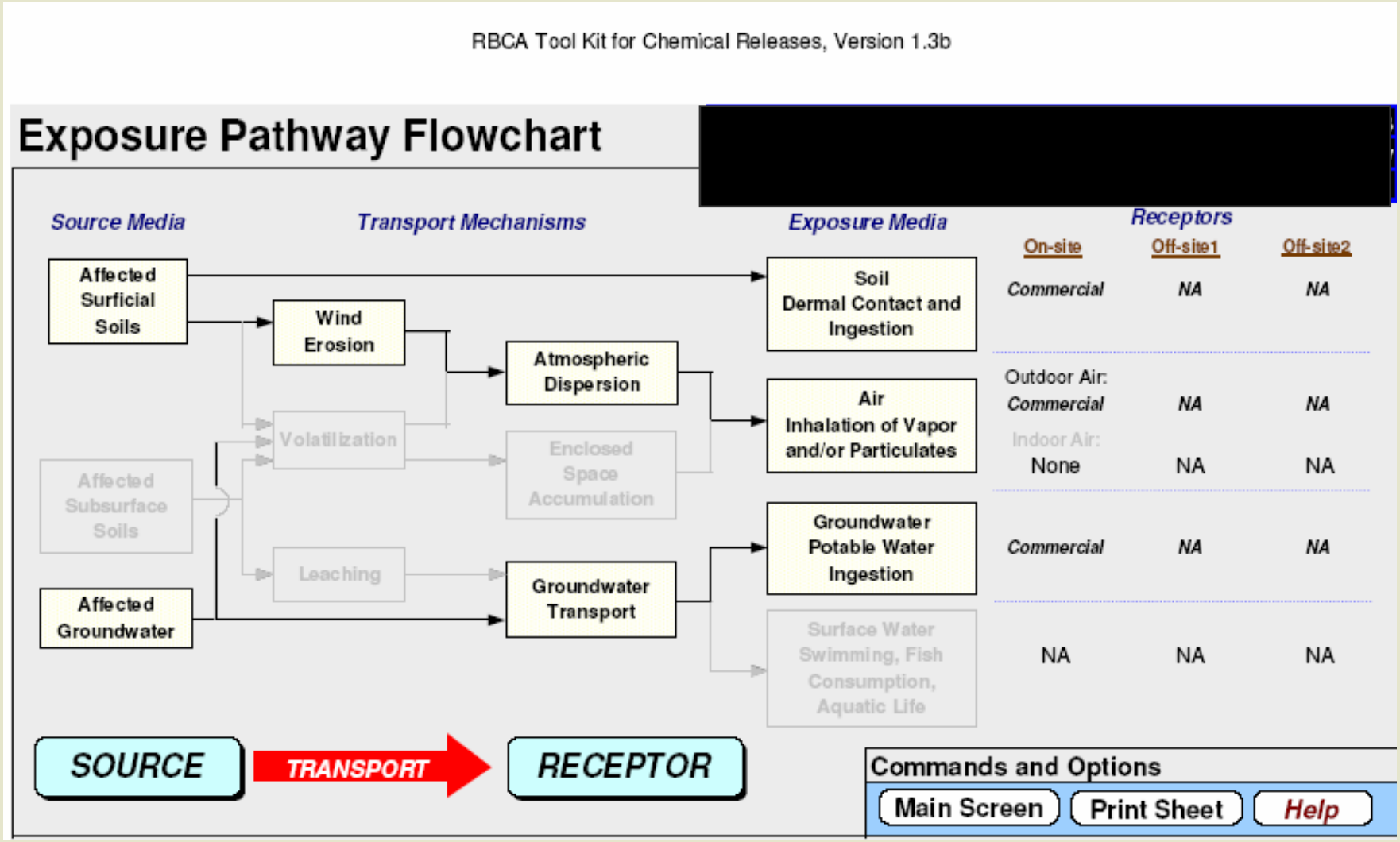
Chemical	CAS	RfDo mg/kg/d	OSFo 1/mg/kg/d	RfDi mg/kg/d	OSFi 1/mg/kg/d	Tap water ug/l	Ambient air ug/m3	Fish mg/kg	Soil Industrial mg/kg	Soil Residential mg/kg	Region III SSLs Soil DAF 1 mg/kg	Region III SSLs DAF 20 mg/kg
ACETALDEHYDE	75070			2.57E-03 I	7.7E-03 I	1.6E+03 C	8.1E-01 C				3.6E-04	7.7E-03 C
ACETOCHLOR	34256821	2E-02 I				7.3E+02 N	7.3E+01 N	2.7E+01 N	2.0E+04 N	1.6E+03 N		
ACETONE	67641	9.00E-01 I				5.5E+03 N	3.3E+03 N	1.2E+03 N	9.2E+05 N	7.0E+04 N	1.1E+00	2.2E+01 N
ACETONITRILE	75058			1.7E-02 I		1.2E+02 N	6.2E+01 N				2.6E-02	5.6E-01 N
ACETOPHENONE	98862	1.00E-01 I				6.1E+02 N	3.7E+02 N	1.4E+02 N	1.0E+05 N	7.8E+03 N	1.6E-01	3.2E+00 N
ACROLEIN	107028	5.00E-04 I		5.70E-06 I		4.2E-02 N	2.1E-02 N	8.6E-01 N	5.1E+02 N	3.9E+01 N	1.0E-05	2.0E-04 N
ACRYLAMIDE	79061	2.00E-04 I	4.50E+00 I		4.5E+00 I	1.5E-02 C	1.4E-03 C	7.0E-04 C	6.4E-01 C	1.4E-01 C	3.7E-06	7.4E-05 C
ACRYLONITRILE	107131	1.00E-03 H	5.40E-01 I	5.70E-04 I	2.40E-01 I	3.7E-02 C	2.6E-02 C	5.8E-03 C	5.3E+00 C	1.2E+00 C	7.4E-06	1.5E-04 C
ALACHLOR	15972608	1.00E-02 I	8.03E-02 H			8.4E-01 C	7.8E-02 C	3.6E-02 C	3.6E+01 C	8.0E+00 C	3.5E-04	7.0E-03 C
ALAR	1596845	1.50E-01 I				5.5E+03 N	5.5E+02 N	2.0E+02 N	1.5E+05 N	1.2E+04 N		
ALDICARB	116063	1.00E-03 I				3.7E+01 N	3.7E+00 N	1.4E+00 N	1.0E+03 N	7.8E+01 N	1.0E-02	2.1E-01 N
ALDICARB SULFONE	1646884	1.00E-03 I				3.7E+01 N	3.7E+00 N	1.4E+00 N	1.0E+03 N	7.8E+01 N	7.5E-03	1.5E-01 N
ALDRIN	309002	3.00E-05 I	1.70E+01 I		1.7E+01 I	3.9E-03 C	3.7E-04 C	1.6E-04 C	1.7E-01 C	3.8E-02 C	3.6E-04	7.7E-03 C
AMINODINITROTOLUENES		2.00E-03 E				7.3E+01 N	7.3E+00 N	2.7E+00 N	2.0E+03 N	1.6E+02 N		
AMMONIA	7664417			2.86E-02 I		2.1E+02 N	1.0E+02 N					
ANILINE	62533	7.00E-03 P	5.70E-03 I	2.86E-04 I		1.2E+01 C	1.1E+00 N	5.5E-01 C	5.0E+02 C	1.1E+02 C	6.6E-03	1.4E-01 C
ANTIMONY	7440360	4.00E-04 I				1.5E+01 N	1.5E+00 N	5.4E-01 N	4.1E+02 N	3.1E+01 N	6.6E-01	1.3E+01 N
ANTIMONY TRIOXIDE	1309644	4.00E-04 H		5.70E-05 I		1.5E+01 N	2.1E-01 N	5.4E-01 N	4.1E+02 N	3.1E+01 N		
ARSENIC	7440382	3.00E-04 I	1.50E+00 I		1.5E+01 I	4.5E-02 C	4.1E-04 C	2.1E-03 C	1.9E+00 C	4.3E-01 C	1.3E-03	2.6E-02 C
ARSINE	7784421			1.40E-05 I		1.0E-01 N	5.1E-02 N					
ASSURE	76578148	9.00E-03 I				3.3E+02 N	3.3E+01 N	1.2E+01 N	9.2E+03 N	7.0E+02 N		
ATRAZINE	1912249	3.50E-02 I	2.22E-01 H			3.0E-01 C	2.6E-02 C	1.4E-02 C	1.3E+01 C	2.9E+00 C	4.4E-04	8.8E-03 C
BARIUM	7440393	2.00E-01 I		1.40E-04 A		7.3E+03 N	5.1E-01 N	2.7E+02 N	2.0E+05 N	1.6E+04 N	3.0E+02	6.0E+03 N
BAYGON	114261	4.00E-03 I				1.5E+02 N	1.5E+01 N	5.4E+00 N	4.1E+03 N	3.1E+02 N		
BAYTHROID	68359375	2.50E-02 I				9.1E+02 N	9.1E+01 N	3.4E+01 N	2.6E+04 N	2.0E+03 N		
BENTAZON	25057890	3.00E-02 I				1.1E+03 N	1.1E+02 N	4.1E+01 N	3.1E+04 N	2.3E+03 N		
BENZALDEHYDE	100527	1.00E-01 I				3.7E+03 N	3.7E+02 N	1.4E+02 N	1.0E+05 N	7.8E+03 N		
BENZENE	71432	4.00E-03 I	5.5E-02 I	8.6E-03 I	2.7E-02 I	3.4E-01 C	2.3E-01 C	5.7E-02 C	5.2E+01 C	1.2E+01 C	9.5E-05	1.9E-03 C
BENZENEMETHOL	100860	1.00E-05 H				6.1E-02 N	3.7E-02 N	1.4E-02 N	1.0E+01 N	7.8E-01 N		
*BENZIDINE m	92875	3.00E-03 I	2.30E+02 I		2.3E+02 I	1.0E-04 C	1.0E-05 C	1.4E-05 C	1.2E-02 C	7.0E-04 C		
BENZOIC ACID	65850	4.00E+00 I				1.5E+05 N	1.5E+04 N	5.4E+03 N	4.1E+06 N	3.1E+05 N		
BENZYL ALCOHOL	100516	5.00E-01 P				1.8E+04 N	1.8E+03 N	6.8E+02 N	5.1E+05 N	3.9E+04 N	7.3E+00	1.5E+02 N
BENZYL CHLORIDE	100447		0.17 I			6.2E-02 C	3.7E-02 C	1.6E-02 C	1.7E+01 C	3.8E+00 C	1.9E-05	3.7E-04 C
BERYLLIUM	7440417	2.00E-03 I		5.7E-06 I	8.4E+00 I	7.3E+01 N	7.5E-04 C	2.7E+00 N	2.0E+03 N	1.6E+02 N	5.6E+01	1.2E+03 N
BIPHENYL	92524	5.00E-02 I				3.0E+02 N	1.8E+02 N	6.8E+01 N	5.1E+04 N	3.9E+03 N	4.6E+00	9.6E+01 N
BIS(2-CHLOROETHYL)ETHER	111444		1.10E+00 I		1.1E+00 I	9.6E-03 C	5.7E-03 C	2.9E-03 C	2.6E+00 C	5.6E-01 C	2.2E-06	4.4E-05 C
BIS(2-CHLOROISOPROPYL)ETHER	108601	4.00E-02 I	7.00E-02 H		3.5E-02 H	2.6E-01 C	1.6E-01 C	4.5E-02 C	4.1E+01 C	9.1E+00 C	8.4E-05	1.7E-03 C
BIS(CHLOROMETHYL)ETHER	542881		2.20E+02 I		2.2E+02 I	4.8E-05 C	2.8E-05 C	1.4E-05 C	1.3E-02 C	2.9E-03 C	9.7E-09	1.9E-07 C
BIS(2-ETHYLHEXYL)PHTHALATE	117817	2.00E-02 I	1.40E-02 I			4.8E-01 C	4.5E-01 C	2.3E-01 C	2.0E+02 C	4.6E+01 C	1.4E+02	2.9E+03 C
BORON	7440428	2.00E-01 I		5.70E-03 H		7.3E+03 N	2.1E+01 N	2.7E+02 N	2.0E+05 N	1.6E+04 N		
BROMODICHLOROMETHANE	75274	2.00E-02 I	6.20E-02 I			1.7E-01 C	1.0E-01 C	5.1E-02 C	4.6E+01 C	1.0E+01 C	5.4E-05	1.1E-03 C
BROMOETHENE	593602			8.6E-04 I	1.10E-01 H	1.1E-01 C	5.7E-02 C				5.4E-05	1.1E-03 C
BROMOFORM	75252	2.00E-02 I	7.90E-03 I		3.9E-03 I	8.5E+03 C	1.6E+00 C	4.0E-01 C	3.6E+02 C	8.1E+01 C	3.3E-03	6.7E-02 C
BROMOMETHANE	74839	1.40E-03 I		1.40E-03 I		8.5E+00 N	5.1E+00 N	1.9E+00 N	1.4E+03 N	1.1E+02 N	2.1E-03	4.1E-02 N
BROMOPHOS	2104964	5.00E-03 H				1.8E+02 N	1.8E+01 N	6.8E+00 N	5.1E+03 N	3.9E+02 N		
1,3-BUTADIENE	106990			5.7E-04 I	1.0E-01 I	1.3E-01 C	8.3E-02 C				7.0E-05	1.4E-03 C
1-BUTANOL	71363	1.00E-01 I				3.7E+03 N	3.7E+02 N	1.4E+02 N	1.0E+05 N	7.8E+03 N	7.6E-01	1.6E+01 N
BUTYLBENZYLPHTHALATE	85687	2.00E-01 I				7.3E+03 N	7.3E+02 N	2.7E+02 N	2.0E+05 N	1.6E+04 N	8.4E+02	1.7E+04 N
CADMIUM-WATER	7440439	5.00E-04 I		5.7E-05 E	6.3E+00 I	1.8E+01 N	9.6E-04 C	6.8E-01 N	5.1E+02 N	3.9E+01 N	1.4E+00	2.7E+01 N
CADMIUM-FOOD	7440439	1.00E-03 I		5.7E-05 E	6.3E+00 I	3.7E+01 N	9.6E-04 C	1.4E+00 N	1.0E+03 N	7.8E+01 N	2.7E+00	5.5E+01 N
CAPROLACTAM	105602	5.00E-01 I				1.8E+04 N	1.8E+03 N	6.8E+02 N	5.1E+05 N	3.9E+04 N		
CARBARYL	63252	1.00E-01 I				3.7E+03 N	3.7E+02 N	1.4E+02 N	1.0E+05 N	7.8E+03 N	1.5E+00	3.0E+01 N
CARBON DISULFIDE	75150	1.00E-01 I		2.00E-01 I		1.0E+03 N	7.3E+02 N	1.4E+02 N	1.0E+05 N	7.8E+03 N	9.5E-01	1.9E+01 N
CARBON TETRACHLORIDE	56235	7.00E-04 I	1.30E-01 I	5.00E-03 H	5.3E-02 I	1.6E-01 C	1.2E-01 C	2.4E-02 C	2.2E+01 C	4.9E+00 C	1.1E-04	2.1E-03 C

Key U.S. Programs – EPA Region 3 Risk-Based Concentrations (RBCs)

The Region III toxicologists use RBCs to screen sites not yet on the NPL, respond rapidly to citizen inquiries, and spot-check formal baseline risk assessments. **The primary use of RBCs is for chemical screening during baseline risk assessment**…. The exposure equations come from EPA's *Risk Assessment Guidance for Superfund* (RAGS), while the exposure factors are those recommended in RAGS or supplemental guidance from the Superfund program…. Simply put, RBCs are like risk assessments run in reverse. For a single contaminant in a single medium, under standard default exposure assumptions, the RBC corresponds to the target risk or hazard quotient.

To summarize, the **Table should generally not be used to set cleanup or no-action levels at CERCLA sites or RCRA Corrective Action sites**, to substitute for EPA guidance for preparing baseline risk assessments, or to determine if a waste is hazardous under RCRA.

RBCA *Tool Kit* – Underground Storage Tanks



STATE PROGRAMS – UTAH LUST ISLs

TIER 1 SCREENING LEVELS AND CRITERIA *Tier 1 Screening Levels (SL) are applicable only when the following site conditions are met:* *1. No buildings, property boundaries, or utility lines within 30 feet of the highest measured concentration of any contaminant that is greater than the Initial Screening Levels but less than or equal to the Tier 1 SLs AND,* *2. No water wells or surface water within 500 feet of the highest measured concentration of any contaminant that is greater than the Initial Screening Levels but less than or equal to the Tier 1 SLs.*			INITIAL SCREENING LEVELS (ISL)	
CONSTITUENT	Tier 1 SL GROUNDWATER (mg/L)	Tier 1 SL SOIL (mg/kg)	ISL GROUNDWATER (mg/L)	ISL SOIL (mg/kg)
Benzene	0.3	0.9	0.005	0.2
Toluene	3	25	1	9
Ethylbenzene	4	23	0.7	5
Xylenes	10	142	10	142
Naphthalene	0.7	51	0.7	51
Methyl t-butyl ether (MTBE)	0.2	0.3	0.2	0.3
TPH-Gasoline	10	1500	1	150
TPH-Diesel	10	5000	1	500
Oil and Grease (TRPH)	10	10000	10	1000

SERVICE COMPANY OFFERS COMPENDIUM OF FEDERAL SCREENING & CLEANUP VALUES

CleanupLevels.com

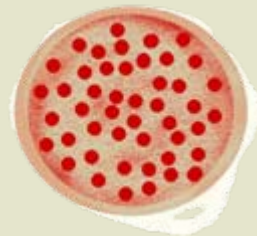
Federal Screening Levels

Chemical	CAS No	RESIDENTIAL SOIL				INDUSTRIAL SOIL			
		Region 3 PRGs	Region 6 MSLs	Region 9 PRGs	Soil Screening Guidance	Region 3 PRGs	Region 6 Indoor Worker	Region 6 Outdoor Worker	Region 9 PRGs
		mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
Linked Publication Date		Apr-04	Nov-03	Oct-02	Jun-96	Apr-04	Nov-03	Nov-03	Oct-02
Acenapthene	30560-19-1	4.7E+03	3.7E+03	3.7E+03	4.7E+03	6.1E+04	3.8E+04	3.3E+04	2.9E+04
Acephate	30560-19-1			5.6E+01					2.0E+02
Acetaldehyde	75-07-0		1.1E+01	1.1E+01			2.3E+01	2.6E+01	2.3E+01
Acetochlor	34256-82-1	1.6E+03	1.2E+03	1.2E+03		2.0E+04	4.1E+04	1.4E+04	1.2E+04
Acetone (2-Propanone)	67-64-1	7.0E+04	7.0E+04	1.6E+03	7.8E+03	9.2E+05	1.0E+05	1.0E+05	6.0E+03
Acetone cyanohydrin	75-86-5			4.9E+01					4.9E+02
Acetonitrile	75-05-8		6.2E+02	4.2E+02			2.0E+03	2.3E+03	1.8E+03
Acetophenone	98-86-2	7.8E+03	1.7E+03			1.0E+05	1.7E+03	1.7E+03	
Acifluorfen	50594-66-6								
Acrolein	107-02-8	3.9E+01	1.0E-01	1.0E-01		5.1E+02	3.4E-01	3.7E-01	3.4E-01
Acrylamide	79-06-1	1.4E-01	1.1E-01	1.1E-01		6.4E-01	1.3E+00	4.2E-01	3.8E-01
Acrylic acid	79-10-7		2.9E+04	2.9E+04			1.0E+05	1.0E+05	1.0E+05
Acrylonitrile	107-13-1	1.2E+00	2.1E-01	2.1E-01		5.3E+00	5.2E-01	5.5E-01	4.9E-01
Alachlor	15972-60-8	8.0E+00	6.0E+00	6.0E+00		3.6E+01	7.1E+01	2.4E+01	2.1E+01
Alar	1596-84-5	1.2E+04	9.2E+03	9.2E+03		1.5E+05	1.0E+05	1.0E+05	9.2E+04
Aldicarb	116-06-3	7.8E+01	6.1E+01	6.1E+01		1.0E+03	2.0E+03	6.8E+02	6.2E+02
Aldicarb sulfone	1646-88-4	7.8E+01	6.1E+01	6.1E+01		1.0E+03	2.0E+03	6.8E+02	6.2E+02
Aldrin	309-00-2	3.8E-02	2.9E-02	2.9E-02	4.0E-02	1.7E-01	3.4E-01	1.1E-01	1.0E-01
Ally	5585-64-8			1.5E+04					1.0E+05

Levels

$22 for the Excel File

We can accept checks, money orders and Paypal. Your purchase will help us pay for the bandwidth of this site, hosting costs and maybe a pizza for us grunts working on state values.



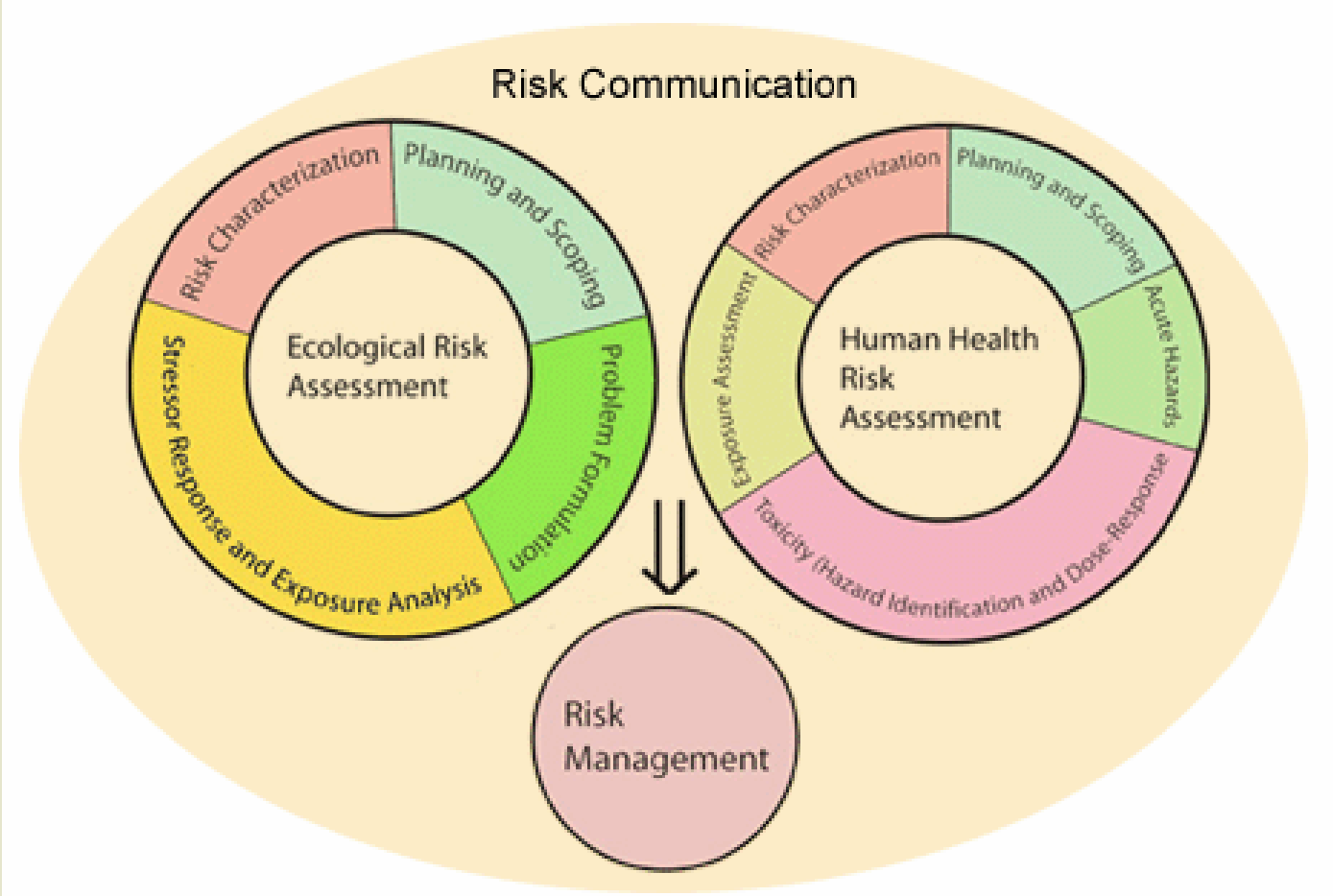
SUMMARY OF FEDERAL SCREENING AND CLEANUP VALUES FOR ARSENIC IN SOIL

Regulatory Program	Soil Ingestion (mg/kg)	Residential Exposure (mg/kg)	Industrial Exposure (mg/kg)	Inhalation Fugitive Particulate (mg/kg)	Migration to Groundwater DAF 20 (mg/kg)	Migration to Groundwater DAF 1 (mg/kg)
EPA Soil Screening Levels (SSL)	0.4	-	-	750	29	1
EPA Region 9 PRGs	-	0.39	1.6	-	29	1
EPA Region 3 RBC	-	0.43	1.9	-	-	-
CETESB Intervention Values	-	55	150	-	-	-

SUMMARY OF FEDERAL STANDARDS AND SCREENING VALUES FOR ARSENIC IN WATER

Water Source (Exposure)	EPA Drinking Water MCL	EPA Region 9 PRGs	EPA Region 3 RBC	CETESB Portaria 518 and Intervention Value
Drinking (Tap) Water (μg/L)	50	0.045	0.045	10
Agua Subterranea (μg/L)	-	-	-	5

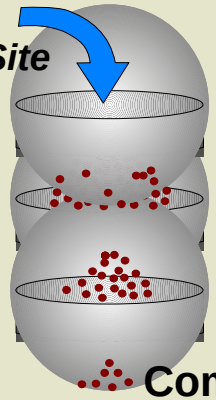
WHY SO MANY PROGRAMS?



MANY INPUT VARIABLES IN CALCULATION PROCESS

Coleta e Avaliação de Dados

Compostos detectados no *Site*



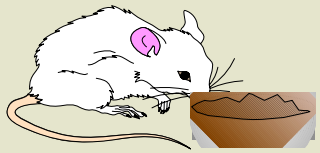
Background

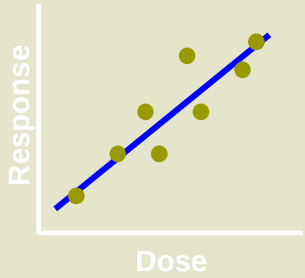
Estatística

Toxicidade

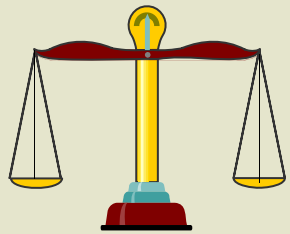
Compostos Químicos de Interesse

Avaliação da Toxicidade





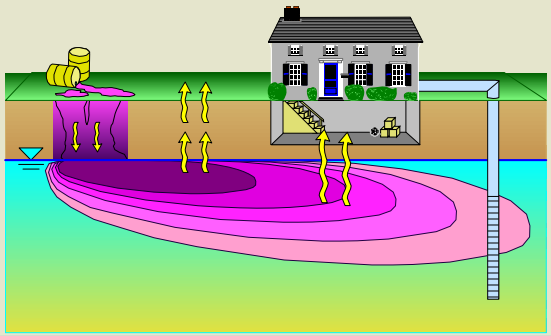
Caracterização do Risco



Risco Calculado

Exposição x Toxicidade

Avaliação da Exposição

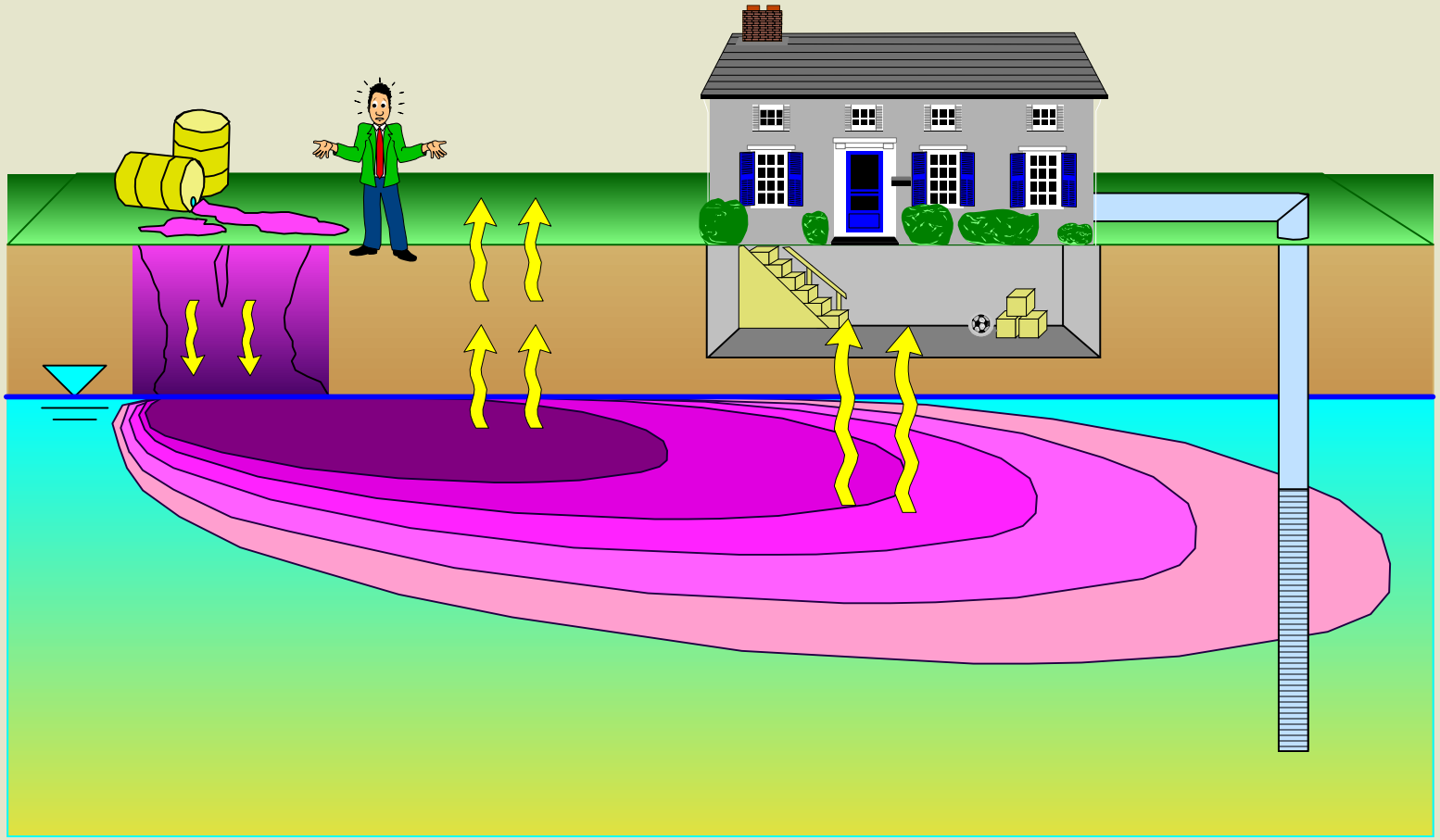


USEPA, 1989 – HHEM Part A – EPA/540/1-89/002

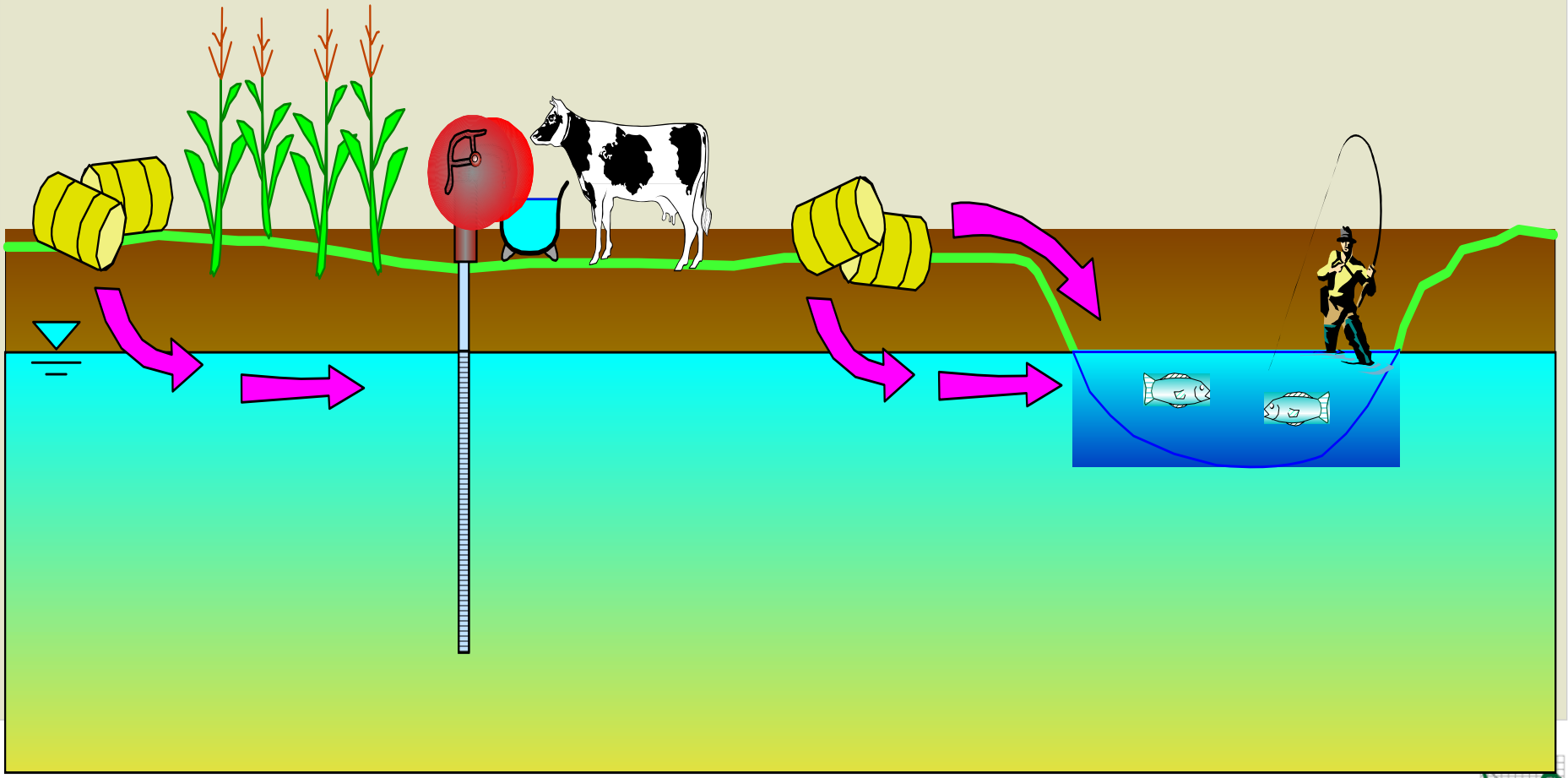
FORMAL RISK ASSESSMENT STEPS (USEPA,1989)

1. **Collect and evaluate data** (determine compounds of concern)
2. **Exposure assessment** (Identify potential receptors, exposure point concentrations, and intakes)
3. **Toxicity assessment** (rely on regulatory databases)
4. **Calculation of risk values – carcinogenic and noncarcinogenic** (combines chemicals, exposures and toxicities)
5. **Use process to calculate risk-based cleanup values**

WHAT TYPES OF EXPOSURE EXIST ?

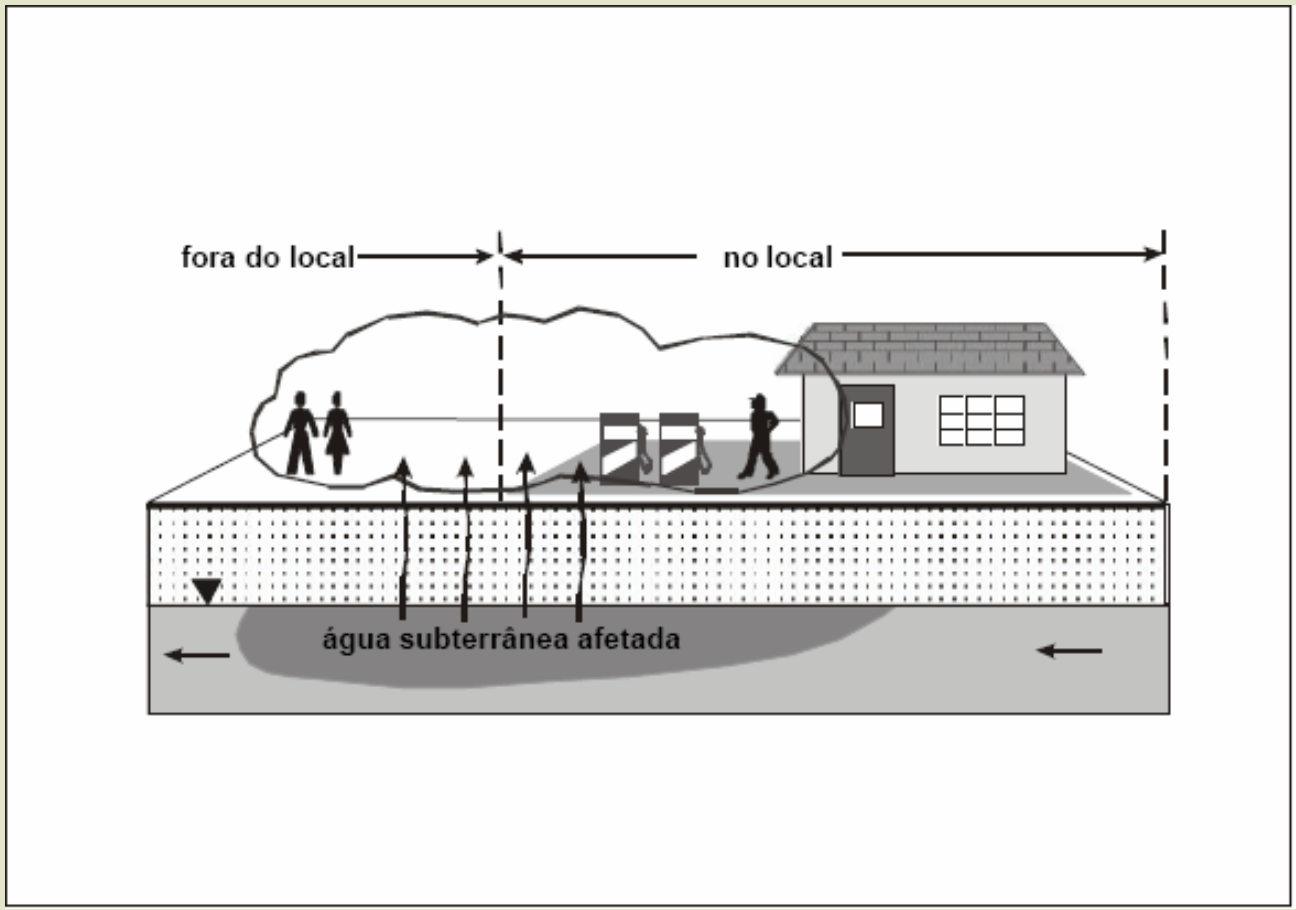


WHAT TYPES OF EXPOSURE EXIST ?



POINT OF EXPOSURE CALCULATION

Model – Volatilization from groundwater to outdoor air



POINT OF EXPOSURE CALCULATION

Model – Volatilization from groundwater to outdoor air

$$VF_{ss,amb}\left[\frac{(mg/m^3-ar)}{(mg/kg-solo)}\right]=\frac{C_{v,amb}}{C_s}=\frac{2W\rho_s}{U_{ar}\times\delta_{ar}}\sqrt{\frac{D_s^{eff}\times H_{eff}}{\pi(\theta_{ws}+k_s\rho_s+H_{eff}\theta_{as})\tau}}\times10^3\frac{cm^3-kg}{m^3-g}$$

ou

$$VF_{ss,amb}\left[\frac{(mg/m^3-ar)}{(mg/kg-solo)}\right]=\frac{C_{v,amb}}{C_s}=\frac{W\rho_s d}{U_{ar}\delta_{ar}}\times10^3\frac{cm^3-kg}{m^3-g}$$

onde:

$C_{v,amb}$	- concentração de vapor em ambiente aberto (mg/m^3);
C_s	- concentração retida no solo superficial (mg/kg);
W	- maior comprimento da área fonte paralela à direção do vento (cm);
ρ_s	- densidade do solo (g/cm^3);
δ_{ar}	- altura da zona de mistura do ambiente aberto (cm);
U_{ar}	- velocidade do ar acima da superfície do solo na zona de mistura do ambiente aberto (cm/s);
D_s^{eff}	- coeficiente de difusão efetiva na zona não saturada (cm^2/s);
H_{eff}	- coeficiente efetivo da Lei de Henry (atm-m^3/mol);
θ_{ws}	- conteúdo volumétrico de água na zona não saturada (cm^3-água/cm^3-solo);
k_s	- coeficiente de partição solo-água (cm^3-água/g-solo);
θ_{as}	- conteúdo volumétrico de ar na zona não saturada (cm^3-ar/cm^3-solo);
τ	- tempo médio do fluxo de vapor (anos);
d	- menor profundidade da zona de solo superficial (cm).
$10^3\frac{cm^3-kg}{m^3-g}$	- fator de conversão.

General Equation for Chemical Intake (Portuguese definitions)

$$I = C \times \frac{IR \times EF \times ED}{BW \times AT}$$

I	mg/kg-dia	Ingresso ou quantidade de contaminante que ingressa no organismo humano por um Caminho de Exposição
C	mg/L ou mg/kg	Concentração do contaminante no meio enfocado
IR	L/dia ou kg/dia	Taxa de contato com o meio enfocado
EF	dias/ano	Freqüência de Exposição
ED	Ano	Duração da Exposição
BW	kg	Peso Corporal
AT	Dias	Período de Exposição

TOXICITY VALUES - EXAMPLE

Key : SFo,i=Cancer Slope Factor oral, inhalation RfDo,i=Reference Dose oral, inhalation i=IRIS p=PPRTV c=California EPA n=NCEA
ca** (where nc PRG < 10X ca PRG) +++=Non-Standard Method Applied (See User's Guide) sat=Soil Saturation (See User's Guide) r

TOXICITY VALUES											CONTAMINANT
SFo 1/(mg/kg-d)		RfDo (mg/kg-d)		SFi 1/(mg/kg-d)		RfDi (mg/kg-d)		V O C	skin abs. soils	CAS No.	
8.7E-03	i	4.0E-03	i	8.7E-03	r	4.0E-03	r		0.1	30560-19-1	Acephate
				7.7E-03	i	2.6E-03	i	y		75-07-0	Acetaldehyde
		2.0E-02	i			2.0E-02	r		0.1	34256-82-1	Acetochlor
		9.0E-01	i			9.0E-01	r	y		67-64-1	**Acetone**
		8.0E-04	h			8.0E-04	r		0.1	75-86-5	Acetone cyanohydrin
		1.7E-02	r			1.7E-02	i	y		75-05-8	Acetonitrile
		5.0E-04	i			5.7E-06	i	y		107-02-8	**Acrolein**
4.5E+00	i	2.0E-04	i	4.5E+00	i	2.0E-04	r		0.1	79-06-1	Acrylamide
		5.0E-01	i			2.9E-04	i		0.1	79-10-7	Acrylic acid
5.4E-01	i	1.0E-03	h	2.4E-01	i	5.7E-04	i	y		107-13-1	Acrylonitrile
1.0E+00	r			1.0E+00	c			y			**"CAL-Modified PRG"**
8.1E-02	h	1.0E-02	i	8.0E-02	r	1.0E-02	r		0.1	15972-60-8	Alachlor
		1.5E-01	i			1.5E-01	r		0.1	1596-84-5	Alar
		1.0E-03	i			1.0E-03	r		0.1	116-06-3	Aldicarb
		1.0E-03	i			1.0E-03	r		0.1	1646-88-4	Aldicarb sulfone

GENERAL EQUATIONS FOR CARCINOGENIC RISK AND ACUTE HAZARD QUOTIENT

$$Risco = I_n \times SF$$

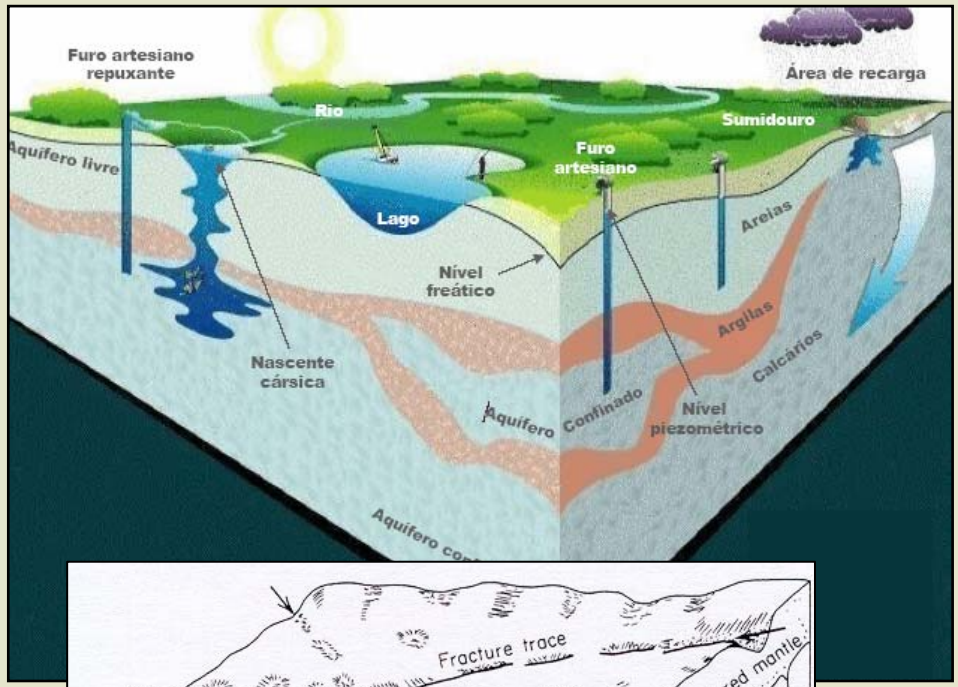
Risco	**-**	**Risco Carcinogênico**
I	**mg/kg-dia**	**Dose de Ingresso para o Cenário de Exposição "n"**
SF	**(1/ mg/kg-dia)**	**Fator de Carcinogenicidade**

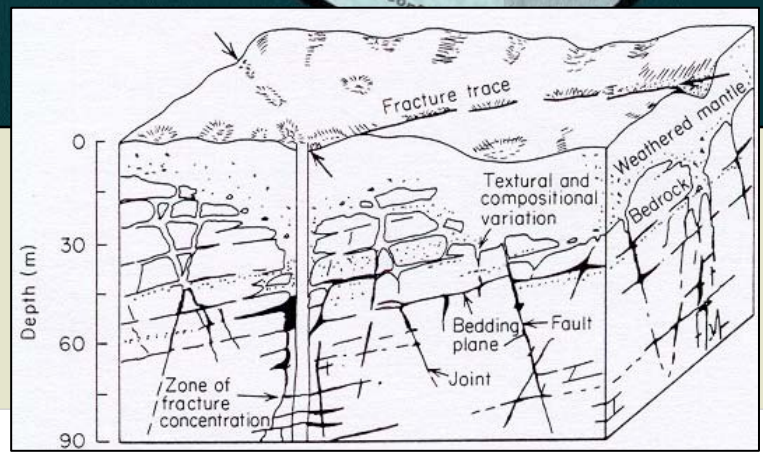
$$HQ = \frac{I_n}{RfD_i}$$

RfD	**-**	**Quociente de Perigo não Carcinogênico**
I	**mg/kg-dia**	**Dose de Ingresso para o Cenário de Exposição "n"**
RfD	**mg/kg-dia**	**Dose de Referencia para a Via de Ingresso "i"**

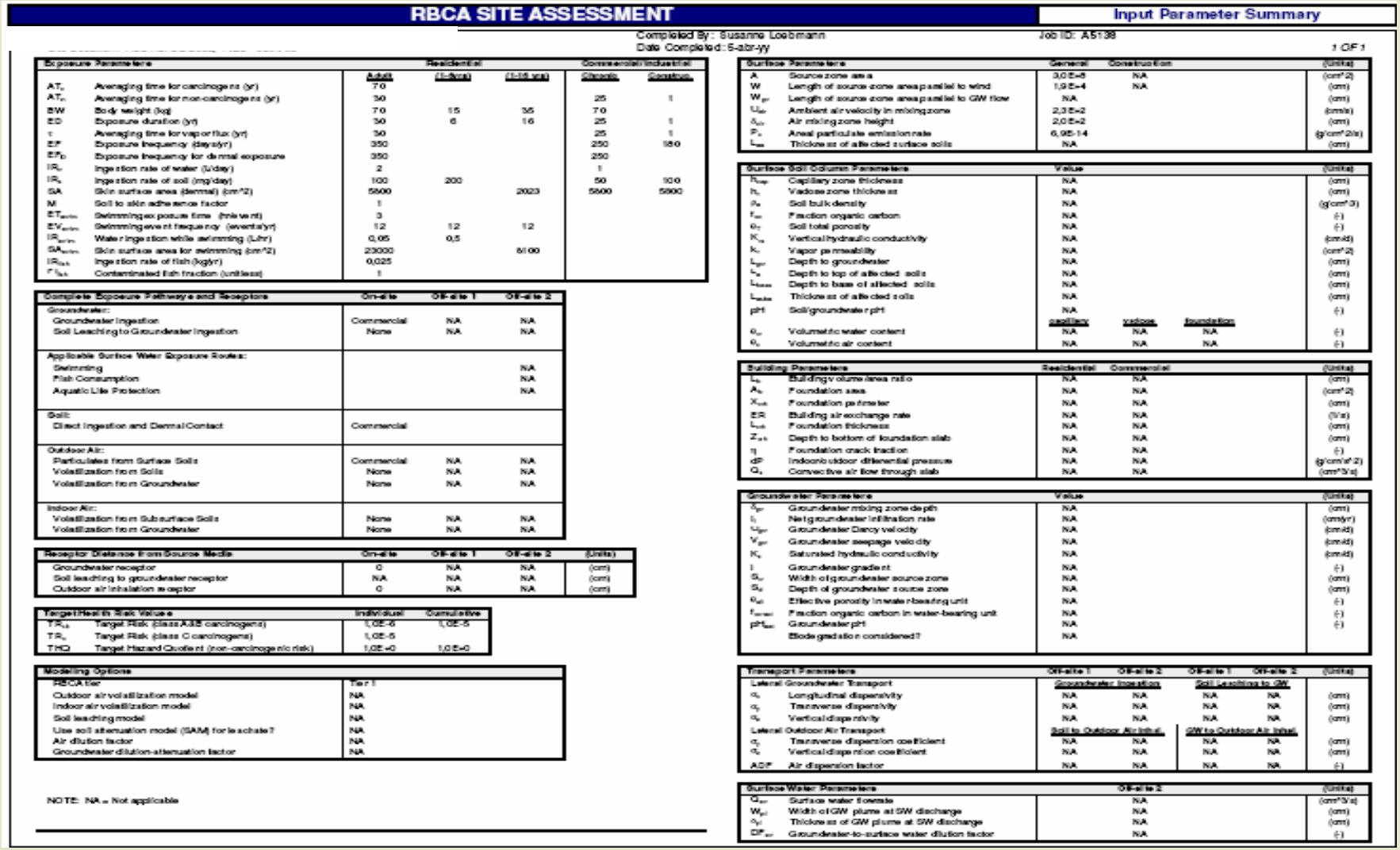
VARIABLES AFFECTING INTERVENTION VALUE OR SCREENING LEVEL DEVELOPMENT

- Geography
- Climate
- Geology/hydrogeology
- Land use/exposure scenarios
- Chemistry properties/ interactions
- Data sufficiency - statistics
- Toxicity value resources/ accuracy
- Model input parameters





DETAILED DATA ENTRY – SIMPLE RBCA MODEL



RBCA SITE ASSESSMENT — **Input Parameter Summary**

Completed By: Susanne Loebmann
Date Completed: 5-abr-yy
Job ID: A5138
1 OF 1

Exposure Parameters		Residential			Commercial/Industrial		
		Adult	(1-6 yrs)	(1-16 yrs)	Chronic	Construction	
AT_c	Averaging time for carcinogens (yr)	70					
AT_n	Averaging time for non-carcinogens (yr)	30			25	1	
BW	Body weight (kg)	70	15	35	70		
ED	Exposure duration (yr)	30	6	16	25	1	
t	Averaging time for vapor flux (yr)	30			25	1	
EF	Exposure frequency (days/yr)	350			250	180	
EF_D	Exposure frequency for dermal exposure	350			250		
IR_w	Ingestion rate of water (L/day)	2			1		
IR_s	Ingestion rate of soil (mg/day)	100	200		50	100	
SA	Skin surface area (dermal) (cm^2)	5800		2023	5800	5800	
M	Soil to skin adherence factor	1					
ET_{swim}	Swimming exposure time (hr/event)	3					
EV_{swim}	Swimming event frequency (events/yr)	12	12	12			
IR_{swim}	Water ingestion while swimming (L/hr)	0.05	0.5				
SA_{swim}	Skin surface area for swimming (cm^2)	23000		8100			
IR_{fish}	Ingestion rate of fish (kg/yr)	0.025					
FI_{fish}	Contaminated fish fraction (unitless)	1					

Complete Exposure Pathways and Receptors	On-site	Off-site 1	Off-site 2
Groundwater:			
Groundwater Ingestion	Commercial	NA	NA
Soil Leaching to Groundwater Ingestion	None	NA	NA
Applicable Surface Water Exposure Routes:			
Swimming			NA
Fish Consumption			NA
Aquatic Life Protection			NA
Soil:			
Direct Ingestion and Dermal Contact	Commercial		
Outdoor Air:			
Particulates from Surface Soils	Commercial	NA	NA
Volatilization from Soils	None	NA	NA
Volatilization from Groundwater	None	NA	NA
Indoor Air:			
Volatilization from Subsurface Soils	None	NA	NA
Volatilization from Groundwater	None	NA	NA

Receptor Distance from Source Media	On-site	Off-site 1	Off-site 2	(Units)
Groundwater receptor	0	NA	NA	(cm)
Soil leaching to groundwater receptor	NA	NA	NA	(cm)
Outdoor air inhalation receptor	0	NA	NA	(cm)

Target Health Risk Values		Individual	Cumulative
TR_{ca}	Target Risk (class A&B carcinogens)	1.0E-6	1.0E-5
TR_{ca}	Target Risk (class C carcinogens)	1.0E-5	
THQ	Target Hazard Quotient (non-carcinogenic risk)	1.0E+0	1.0E+0

Modelling Options	
RBCA tier	Tier 1
Outdoor air volatilization model	NA
Indoor air volatilization model	NA
Soil leaching model	NA
Use soil attenuation model (SAM) for leachate?	NA
Air dilution factor	NA
Groundwater dilution-attenuation factor	NA

NOTE: NA = Not applicable

Surface Parameters		General	Construction	(Units)
A	Source zone area	3.0E+6	NA	(cm^2)
W	Length of source zone area parallel to wind	1.9E+4	NA	(cm)
W_{gw}	Length of source zone area parallel to GW flow	NA		(cm)
U_{air}	Ambient air velocity in mixing zone	2.3E+2		(cm/s)
δ_{air}	Air mixing zone height	2.0E+2		(cm)
P_e	Areal particulate emission rate	6.9E-14		(g/cm^2/s)
L_{ss}	Thickness of affected surface soils	NA		(cm)

Surface Soil Column Parameters		Value	(Units)
h_{cap}	Capillary zone thickness	NA	(cm)
h_v	Vadose zone thickness	NA	(cm)
ρ_b	Soil bulk density	NA	(g/cm^3)
f_{oc}	Fraction organic carbon	NA	(-)
θ_T	Soil total porosity	NA	(-)
K_s	Vertical hydraulic conductivity	NA	(cm/d)
k_v	Vapor permeability	NA	(cm^2)
h_{gw}	Depth to groundwater	NA	(cm)
h_s	Depth to top of affected soils	NA	(cm)
h_{base}	Depth to base of affected soils	NA	(cm)
h_{soil}	Thickness of affected soils	NA	(cm)
pH	Soil/groundwater pH	NA	(-)
		capillary / vadose / foundation	
θ_w	Volumetric water content	NA / NA / NA	(-)
θ_a	Volumetric air content	NA / NA / NA	(-)

Building Parameters		Residential	Commercial	(Units)
L_B	Building volume/area ratio	NA	NA	(cm)
A_B	Foundation area	NA	NA	(cm^2)
X_{crack}	Foundation perimeter	NA	NA	(cm)
ER	Building air exchange rate	NA	NA	(1/s)
L_{crack}	Foundation thickness	NA	NA	(cm)
Z_{crack}	Depth to bottom of foundation slab	NA	NA	(cm)
η	Foundation crack fraction	NA	NA	(-)
dP	Indoor/outdoor differential pressure	NA	NA	(g/cm/s^2)
Q_s	Convective air flow through slab	NA	NA	(cm^3/s)

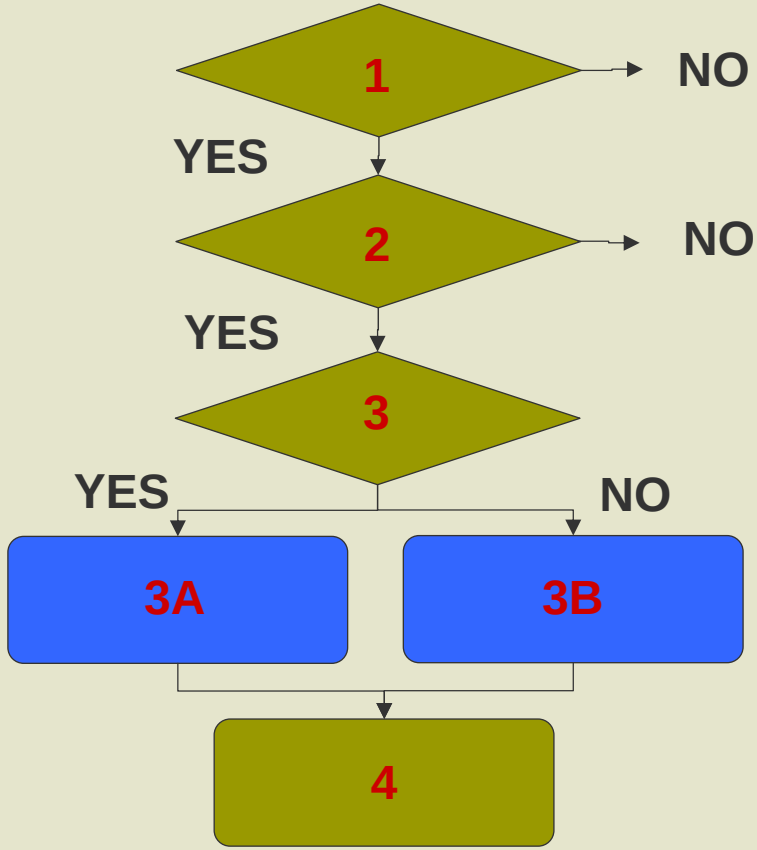
Groundwater Parameters		Value	(Units)
δ_{gw}	Groundwater mixing zone depth	NA	(cm)
I_r	Net groundwater infiltration rate	NA	(cm/yr)
U_{gw}	Groundwater Darcy velocity	NA	(cm/d)
V_{gw}	Groundwater seepage velocity	NA	(cm/d)
K_s	Saturated hydraulic conductivity	NA	(cm/d)
I	Groundwater gradient	NA	(-)
S_w	Width of groundwater source zone	NA	(cm)
S_d	Depth of groundwater source zone	NA	(cm)
θ_e	Effective porosity in water-bearing unit	NA	(-)
$f_{oc,sat}$	Fraction organic carbon in water-bearing unit	NA	(-)
pH_{sat}	Groundwater pH	NA	(-)
	Biodegradation considered?	NA	

Transport Parameters		Off-site 1	Off-site 2	Off-site 1	Off-site 2	(Units)
Lateral Groundwater Transport		Groundwater Ingestion		Soil Leaching to GW		
α_x	Longitudinal dispersivity	NA	NA	NA	NA	(cm)
α_y	Transverse dispersivity	NA	NA	NA	NA	(cm)
α_z	Vertical dispersivity	NA	NA	NA	NA	(cm)
Lateral Outdoor Air Transport		Soil to Outdoor Air Inhal.		GW to Outdoor Air Inhal.		
σ_y	Transverse dispersion coefficient	NA	NA	NA	NA	(cm)
σ_z	Vertical dispersion coefficient	NA	NA	NA	NA	(cm)
ADF	Air dispersion factor	NA	NA	NA	NA	(-)

Surface Water Parameters		Off-site 2	(Units)
Q_{sw}	Surface water flowrate	NA	(cm^3/s)
W_{gw}	Width of GW plume at SW discharge	NA	(cm)
δ_{gz}	Thickness of GW plume at SW discharge	NA	(cm)
DF_{sw}	Groundwater-to-surface water dilution factor	NA	(-)

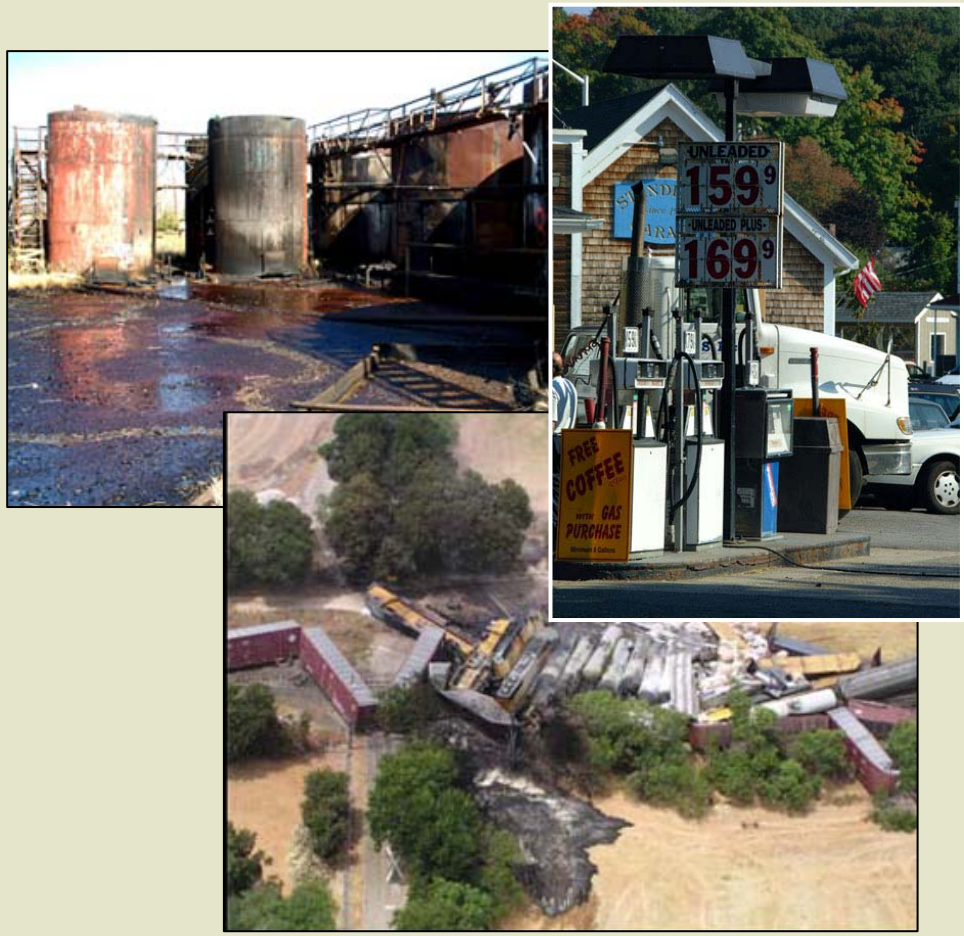
CONCLUSION:
SUMMARY OF PHASED USE OF REGULATORY VALUES

1. **Do impacts exist above background concentrations?**
2. **Are applicable or relevant screening levels exceeded?**
3. **Can screening levels serve as appropriate cleanup levels?**
   A. Yes - Implement cleanup to existing standards
   B. No – Develop site-specific cleanup goals
4. **Assure sufficient data during cleanup to warranty effective remedy**



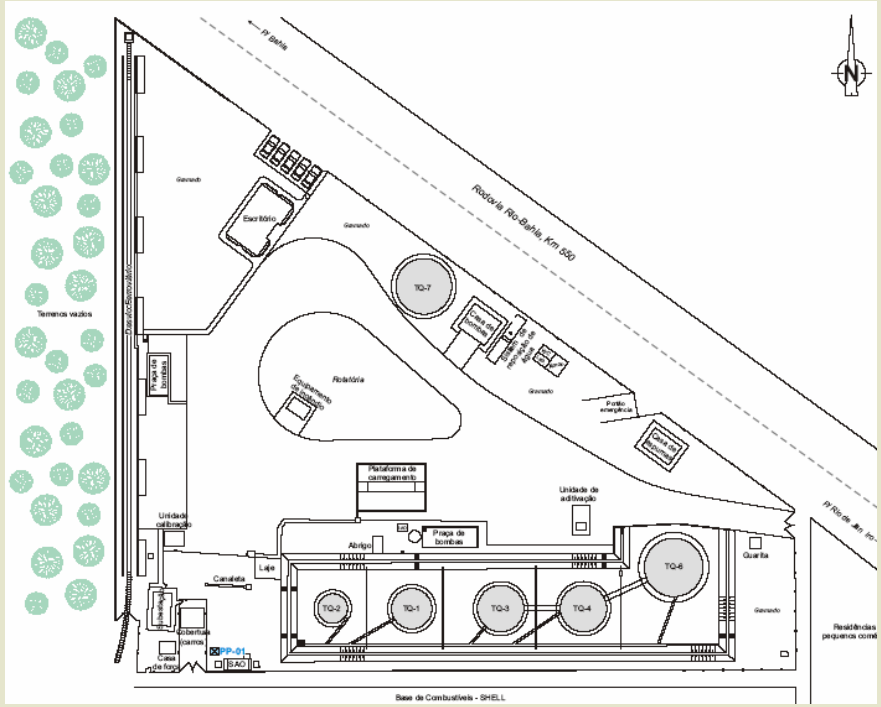
GENERAL SITE REMEDIATION PROCESS CONSULTING PRACTICE - EXAMPLES

- **CHARACTIZATION**
  - Identification
  - Delineation
- **RISK CHARACTERIZATION**
  - Human Health
  - Environmental Receptors
- **REMEDIAL ACTION**
  - Remedial Action Objectives
  - Remedial Design
  - Remedy Implementation
  - Operation & Management



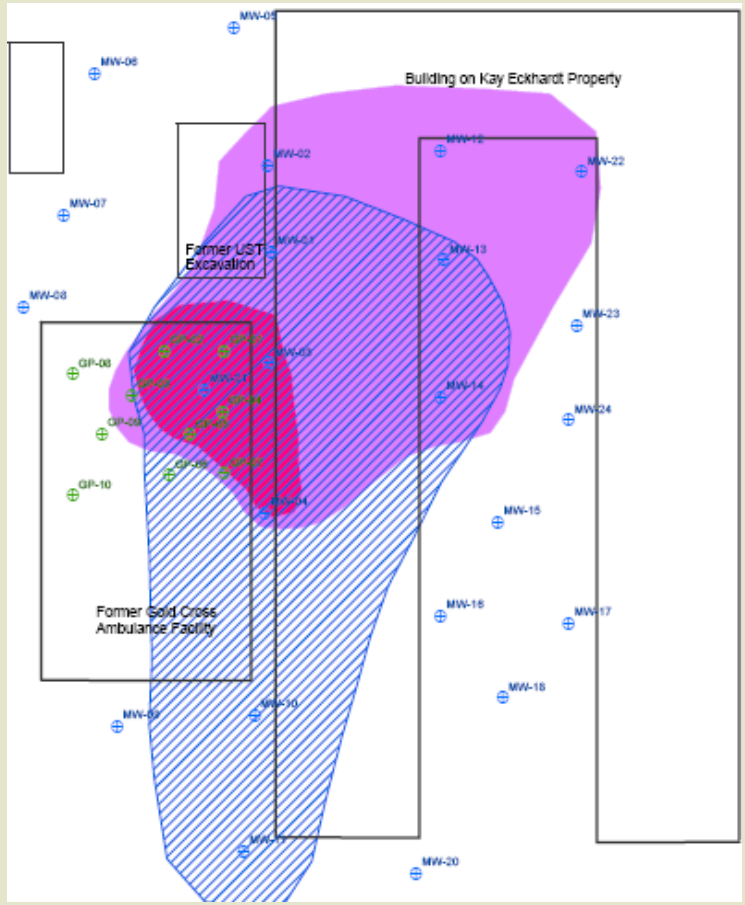
EXAMPLE 1 - USE OF INTERVENTION VALUES FOR SCREENING PURPOSES

- **Phase II ESA - property transaction (Brazil)**
- **Ten borings and wells for sampling**
- **Soil showed pyrene and chrysene at one location – below agency intervention values**
- **Groundwater showed select VOCs & PAHs at low concentrations – below agency intervention values**
- **Site suitable for sale with no remedial action**



EXAMPLE 2 - USE OF SCREENING VALUES FOR REMEDIATION PURPOSES

- **Leaking underground storage tank site (USA)**
- **Gasoline VOCs above State "Initial Screening Levels (ISLs)" in soil and groundwater**
- **Remediation to achieve ISLs rather than risk-based levels for site**
- **Target ISLs include 1 mg/L TPH, 0.005 mg/L benzene, and 0.2 mg/L MTBE**
- **Owner proposing MNA; adjacent land owner litigating for active remediation**



EXAMPLE 3 - USE OF SCREENING VALUES FOR REMEDIATION PURPOSES

- **Remediation of canal sediment via dredging (USA)**
- **Two meters of sediment containing TPH and oil & grease**
- **Cleanup levels were State LUST Program guidelines: 100 mg/kg TPH and 300 mg/kg O&G**
- **Quality assurance required visual confirmation at 100 foot (30 m) intervals**
- **Laboratory analysis every 2,000 feet (670 m)**

EXAMPLE 4 - DEVELOPMENT OF SITE-SPECIFIC REMEDIATION GOALS FOR GROUNDWATER

- **Brazil industrial site impacted by chlorinated solvents in shallow and deep groundwater**
- **PCE and breakdown products exceed intervention values**
- **No current groundwater ingestion or direct contact with soil or groundwater**
- **Site-specific risk assessment performed; showed unacceptable risks to "site workers" and "construction workers"**
- **Potential site-specific cleanup levels calculated using risk assessment formulas with results 2 to 3 orders higher than agency intervention values**
- **Remediation planning underway – difficult to predict if risk-based targets can be achieved**

EXAMPLE 4 - DEVELOPMENT OF SITE-SPECIFIC REMEDIATION GOALS FOR GROUNDWATER

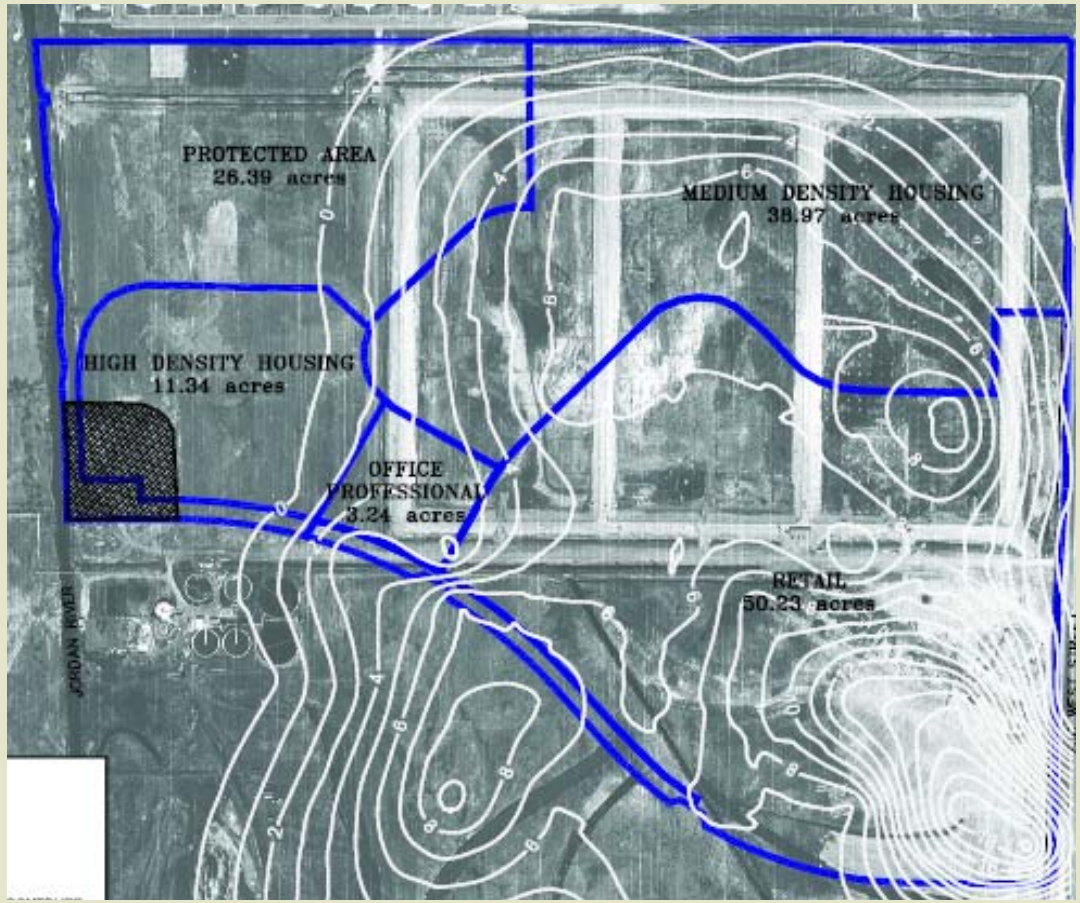
Compounds of Concern (COC)	Groundwater			
	Risk/HI > Threshold in On-Site Groundwater? [1]	Remedial Goals [2] (Site Worker) [3]	Remedial Goals [2] (Construction Worker) [3]	Concentration Range in Source Area [5]
		(mg/L)	(mg/L)	(mg/L)
Ammonia	No	---	---	---
Arsenic	No	---	---	---
Iron	No	---	---	---
Manganese	No	---	---	---
Chloroform	**Yes**	**18.7**	**18.4**	**9 to 24**
Chloroethane	No	---	---	---
Vinyl Chloride (adults)	**Yes**	**20.4**	**4.6**	**1.3 to 6.8**
1,1-Dichloroethane	No	---	---	---
1,1-Dichloroethene	No	---	---	---
cis-1,2-Dichloroethene	**Yes**	---	**12.4**	**18 to 105**
trans-1,2-Dichloroethene	No	---	---	---
1,1,1-Trichloroethane	No	---	---	---
Trichloroethene	**Yes**	**2.4**	**0.360**	**2.7 to 7.9**
Tetrachloroethene	**Yes**	**30.8**	**4.4**	**10 to 85**

EXAMPLE 5 - USE OF SITE-SPECIFIC REMEDIATION GOALS FOR SOIL

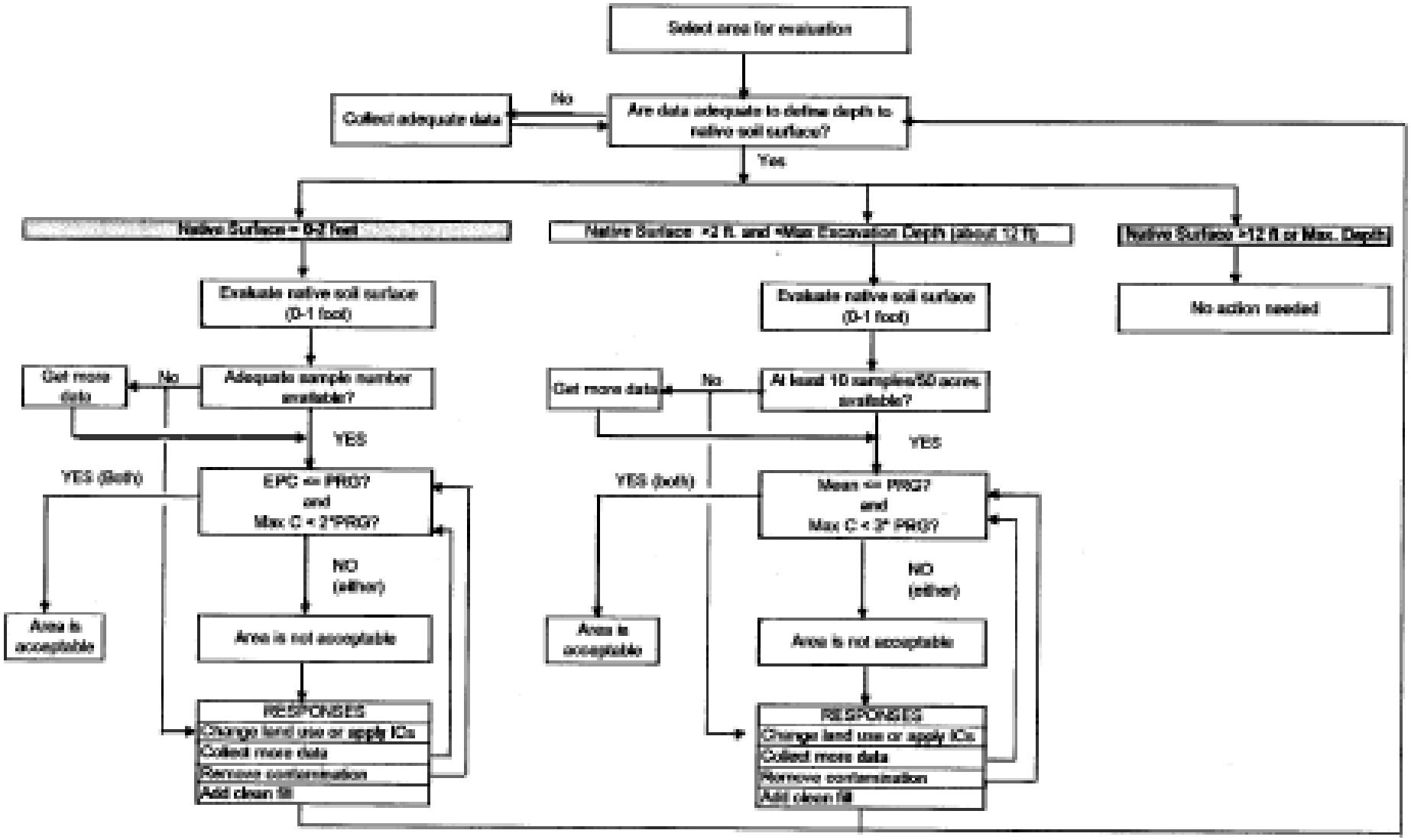
- **Brownfield redevelopment of Superfund site (USA)**
- **Plan for mixed commercial and residential use**
- **EPA provided risk-based "Decision Framework" for potential land uses**
- **Some soil contained Pb and As above residential targets (commercial use allowed w/o remediation)**

EXAMPLE 5 - USE OF SITE-SPECIFIC REMEDIATION GOALS FOR SOIL

- **Plan for affected soil removal from residential areas to commercial areas**
- **Cleanup complicated by historical (clean) fill over impacted soil**
- **Quality assurance during removal was key to successful remediation**
- **Remediation completed 2006 – development in progress**

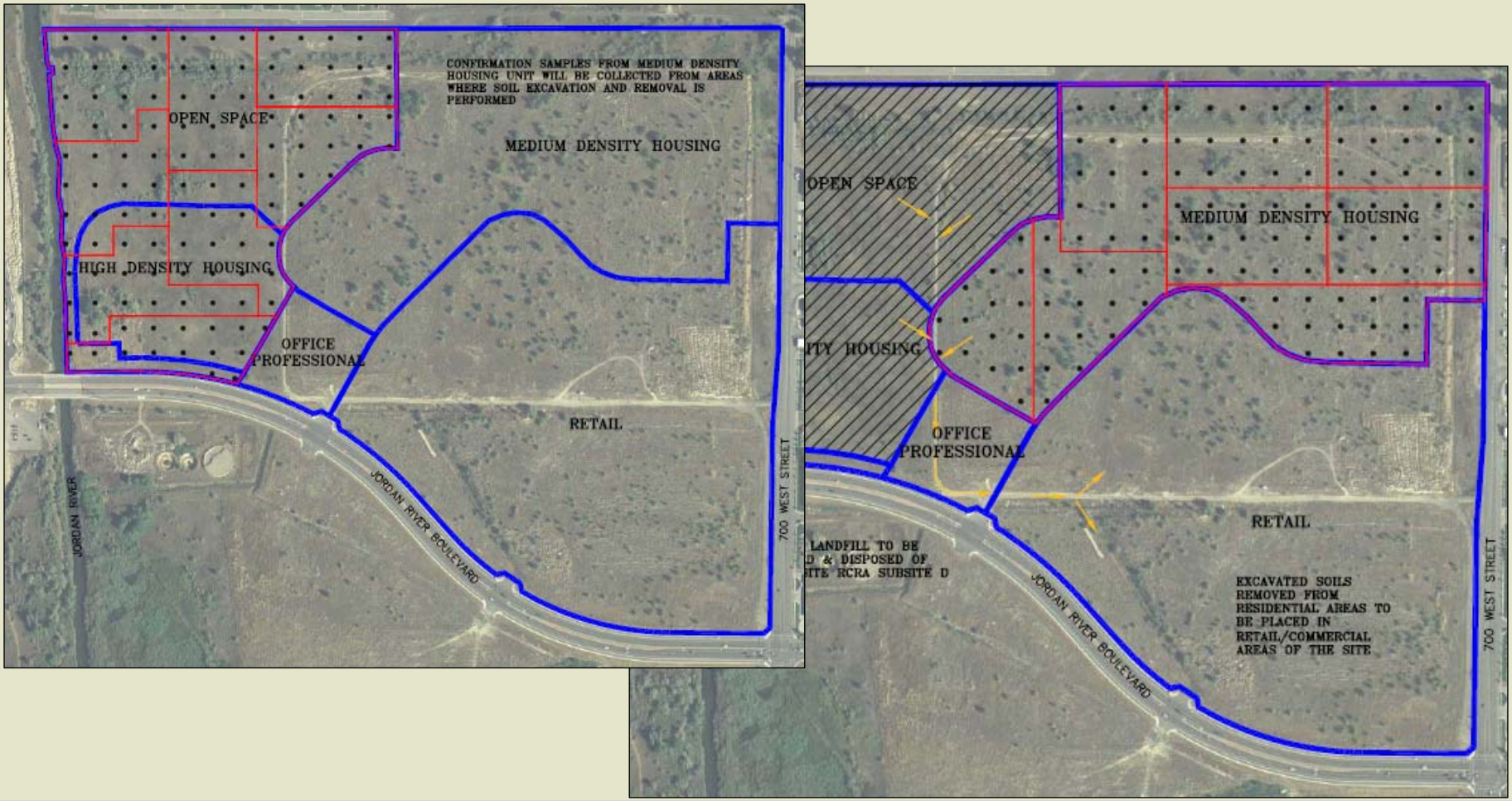


EXAMPLE 5 – EPA DECISION FRAMEWORK

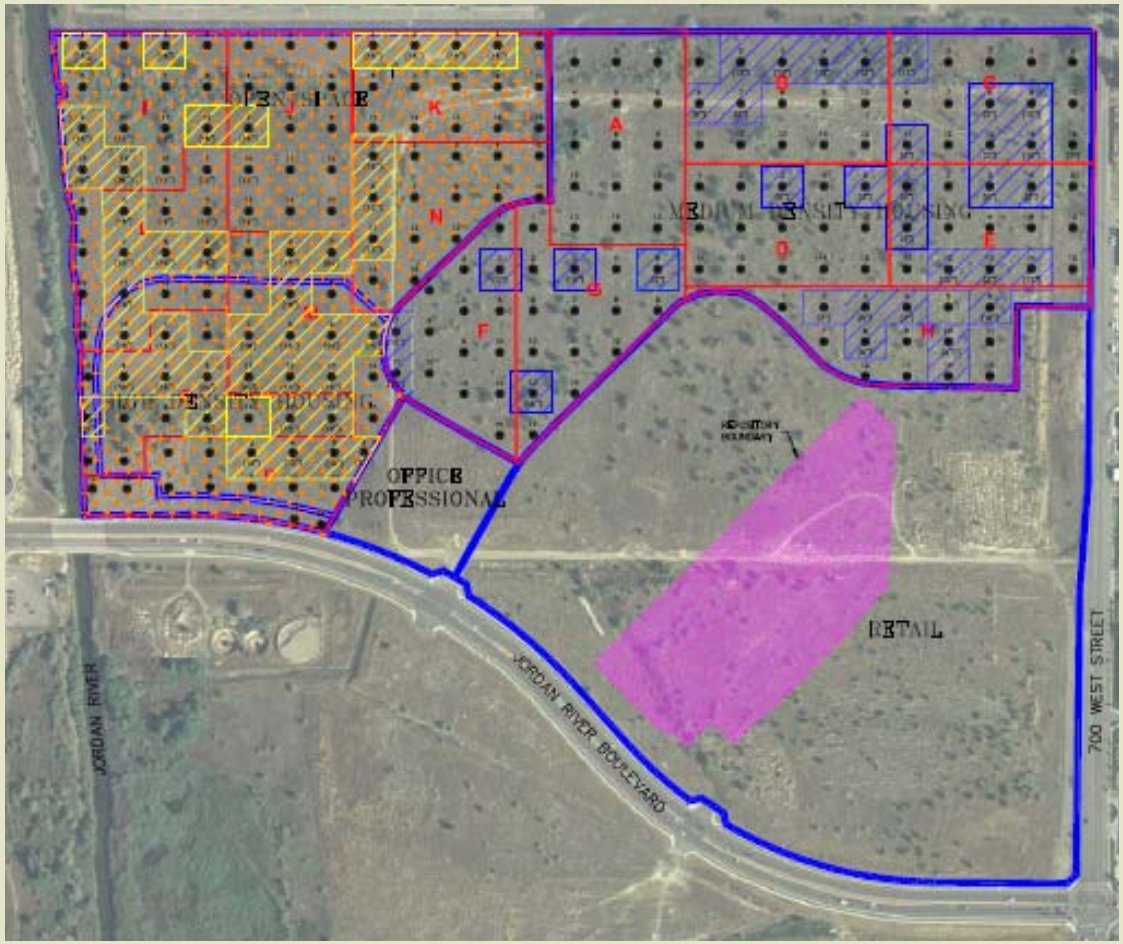


PRGs (no cover soil): As 73 mg/kg and Pb 650 mg/kg

EXAMPLE 5 – PLAN FOR SELECTIVE SOIL REMOVAL TO ENABLE REDEVELOPMENT



EXAMPLE 5 – MAP OF AREAS REQUIRING SOIL REMOVAL BASED ON ARSENIC & LEAD



EXAMPLE 5 – MAP AFTER REMEDIATION GOALS WERE ACHIEVED