Risk Screening

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NEWFIELDS
25 Feb 2003

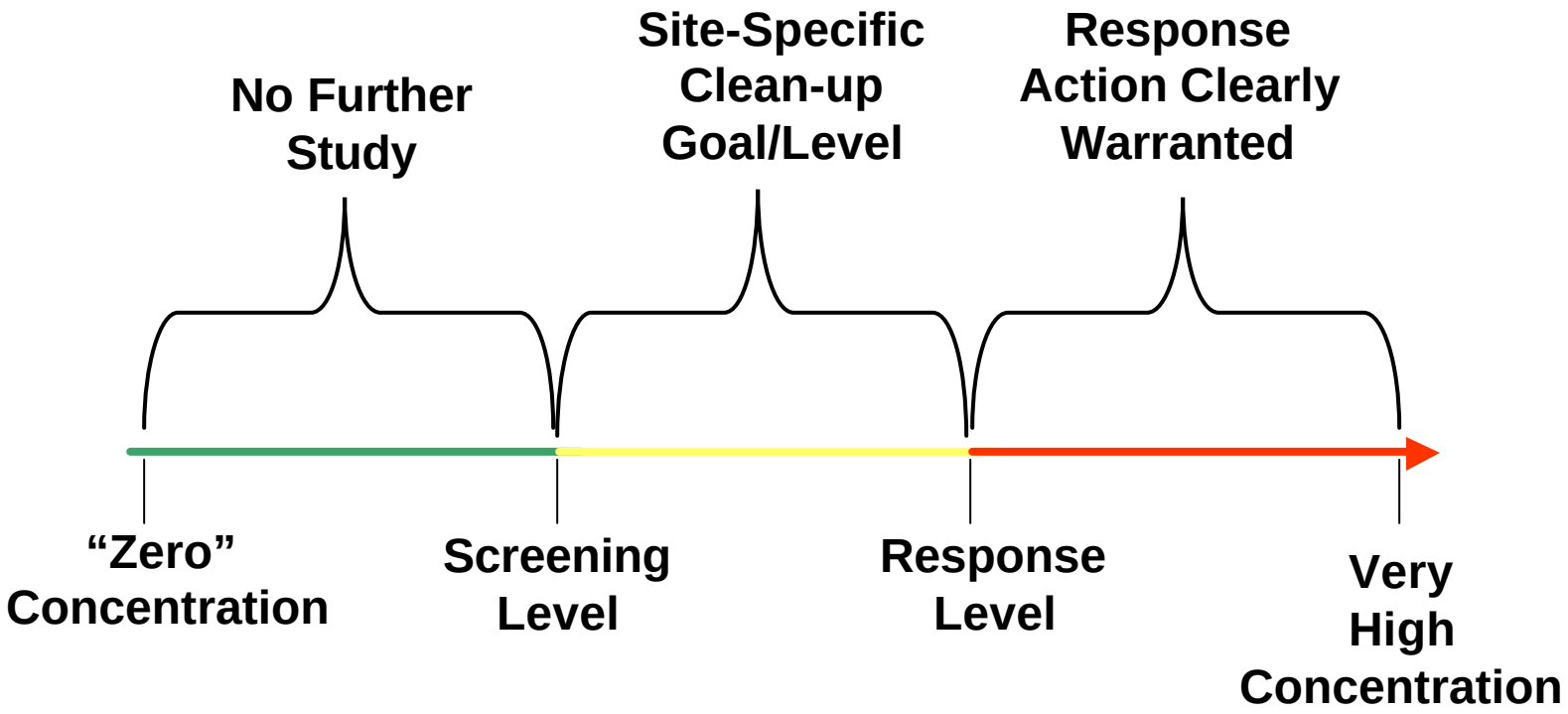
What is Risk-Based Screening?

It is a tool to promptly identify contaminants and exposure areas of concern during remedial actions.

RBS is used to:

- **Screen out from further investigation**
  - areas of sites
  - potential chemicals of concern
  - exposure pathways
- **Limit scope of**
  - remedial investigation
  - risk assessment

Conceptual Risk Management Decisions for Soil



How Are The Screening Levels Calculated?

Noncarcinogens

"Forward" Calculation – determining risk of exposure

$$\text{Hazard Index (ratio)} = \frac{\text{Intake}\left[\frac{C \times CR \times EF \times ED}{BW} \times \frac{1}{AT}\right]}{\text{Reference Dose (RfD)}}$$

"Backward" Calculation – determining acceptable concentration

$$\text{Concentration} = \frac{BW \times AT \times RfD \times HI}{CR \times EF \times ED}$$

Standard residential exposure factors and RfD of 0.2 for toluene

C = 16,000 mg/kg for HI of 1

How Is It Done?

Compare the concentration of the COC to the generic risk-based screening level

Example: benzene in soil

$$\frac{\text{COC (mg/kg)}}{\text{Generic risk-based screening level (mg/kg)}} \sim \frac{\text{40 mg/kg (onsite concentration)}}{\text{22 mg/kg (Region 3 risk-based concentration for residential use)}}$$

$$\frac{40\ \text{mg/kg}}{22\ \text{mg/kg}} = 1.8 \sim 2$$

$2.0 > 1.0 \therefore$

Site concentration exceeds screening level concentration

Further evaluation required

Basic Risk-Based Screening

- Assess chemicals detected at site
- Assess potential magnitude of risks/issues at site
- Focus future efforts
- Potentially eliminate sites from further consideration
- Complete standard Table 2 of RAGS Part D (provide chemical screening data [COPC selection])

Risk-Based Screening

RBS Advantages

1. Allows for quick evaluation of site conditions
2. Not labor-intensive
3. Not dependent on site-specific information
4. Conservative (health-protective)

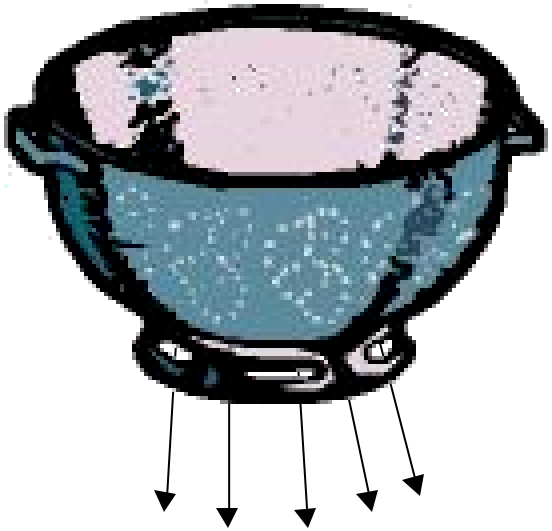
RBS Disadvantages

1. Relies upon maximum conc. (some cases 95% UCL)
2. May be abused (assume cleanup required)
3. Not site-specific
4. Overly conservative

Risk-Based Screening

Discriminatory Power

Strainer with large holes

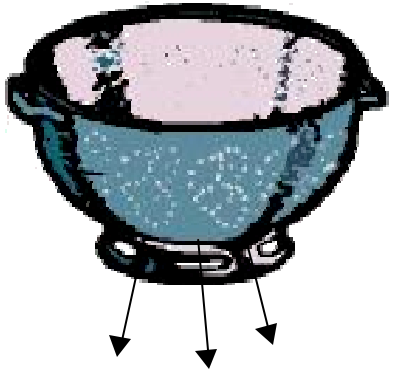


Everything falls through

↓

NO PROBLEM

Strainer with medium holes



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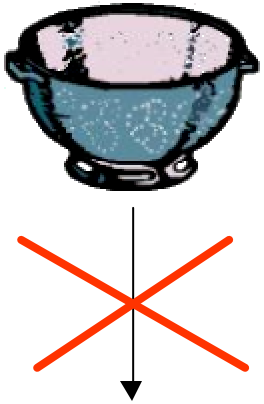
IDENTIFIES POTENTIAL CONCERNS

Strainer with small holes



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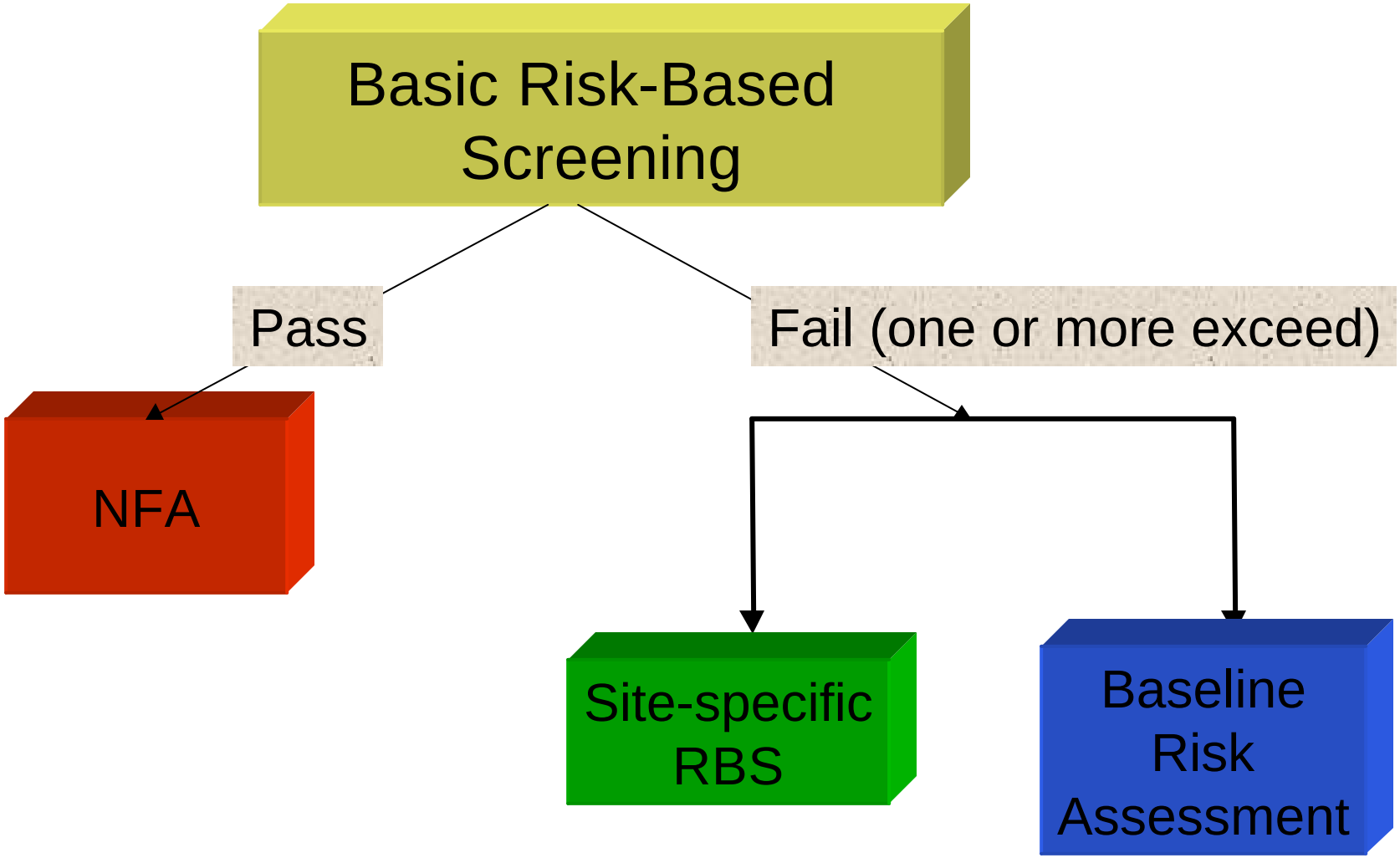
EVERYTHING A PROBLEM

RBS Decision Making



RAGS Part B

Development of Risk-based Preliminary Remediation Goals

- Designed for screening remedial alternatives
- Not designed for final clean-up level or cost estimation
- Has replaced concentration - toxicity screen in COC selection process of Baseline Risk Assessment
- Basis of tables developed by various Regions

Initial Risk-Based Screening

Basis of PRGs

- Chemical specific

- Media specific

- Health-protective

Regional Screening Numbers

Residential/Industrial

Region 3 RBCs

- **Groundwater**
  - ingestion
- **Soil**
  - ingestion
  - inhalation of volatiles
  - inhalation of particulates
- **10^{-6} risk level** *carcinogens*
- **THQ = 1** *noncarcinogens*

Region 6 PRGs

- Indoor and outdoor workers
- With and without dermal absorption

Regional Screening Numbers

Residential/Industrial

Region 9 PRGs

- **Groundwater**
  - ingestion
  - inhalation of volatiles
- **Soil**
  - ingestion
  - inhalation of volatiles
  - inhalation of particulates
  - dermal absorption
- **10^{-6} risk level** *carcinogens*
- **THQ = 1** *noncarcinogens*

  (0.1 often used for screening)

2002 PRGs – **doubled** industrial soil ingestion rate

DTSC Risk-Based Screening Guidance

October 28, 1994 DTSC Memo

Recommended Outline for Using U.S. Environmental Protection Agency Region IX Preliminary Remediation Goals in Screening Risk Assessments at Military Facilities

DTSC Guidance

- Use California Modified PRGs
  - -- Cadmium (9.0 ppm vs. 38 ppm)
  - -- Hexavalent chromium (0.2 ppm vs. 30 ppm)
  - -- Nickel (150 ppm vs. 1500 ppm)
  - -- PAHs
  - -- Lead (130 ppm vs. 400 ppm)
- Additivity of Risks and Hazards
- [Inorganics] < [Background] : Do not screen
- Use 95 % UCL of mean or maximum concentration (approval from DTSC Project Manager)
- Do not consider TPH (assess individual constituents)

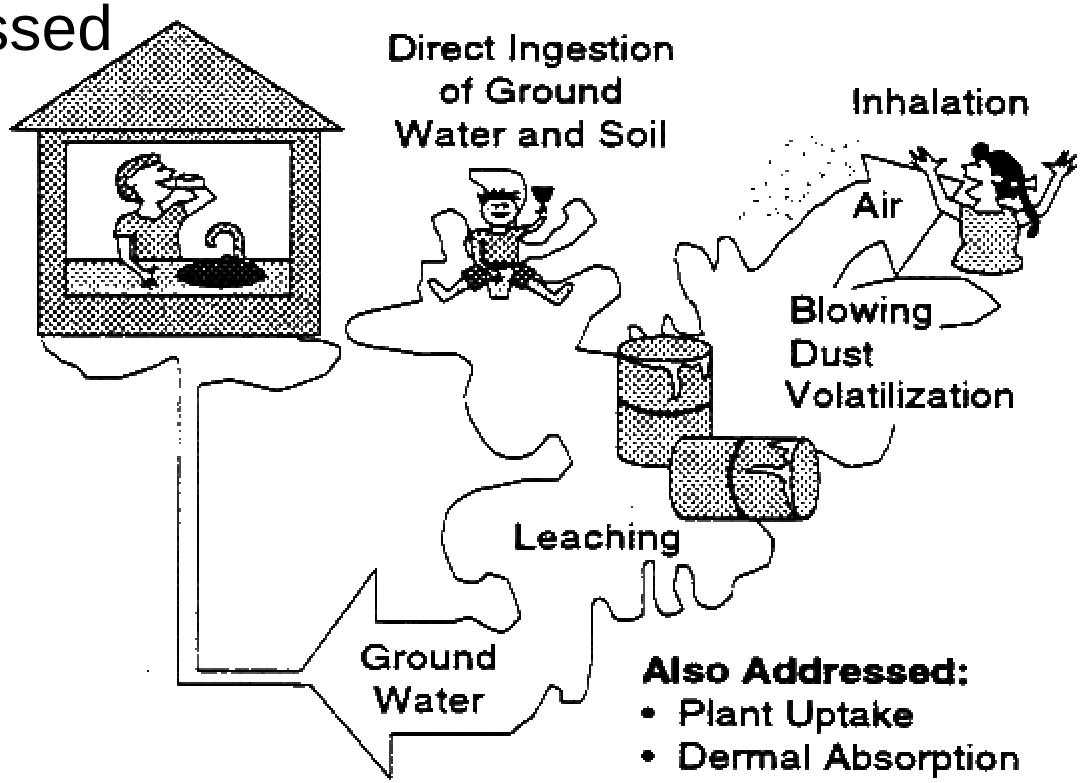
EPA Soil-Screening Guidance

- Developed for residential land use
- CERCLA or RCRA, state voluntary cleanup programs
- 110 chemicals most commonly found at CERCLA sites
- Inhalation models, equations and assumptions supercede RAGS Part B equations for inhalation
- 95% UCL of mean or maximum concentration of composite samples compared to 2x SSL

Revised 2001- now has industrial land use as well

EPA Soil-Screening Guidance

- 10^{-6} risk level for carcinogens
- HI of 1 for noncarcinogens
- Pathways assessed



Risk Levels

Screening should be "conservative" to ensure adequate protection of human health.

- 10^{-6} generally used for carcinogens
- 10^{-5} may be used with agency approval
- Cumulative (total site) risk in range of 10^{-4} to 10^{-6}
- HI of 1 generally used for noncarcinogens
- Some states/regions require use of 0.1 HI for each constituent
- Cumulative HI for constituents *with the same target organ* ≤ 1

Risk Screening Process

Develop Table 2.1 of RAGS D -- Occurrence, Distribution and Selection of Chemicals of Potential Concern

RAGS D revised December 2001

RAGS D Table 2.1

- CAS number
- Chemical name
- Minimum detected concentration
- Maximum detected concentration
- Units
- Location of maximum
- Detection frequency
- Range of detection limits
- Concentration used for screening
- Background value
- Screening toxicity value
- Rationale for inclusion or exclusion

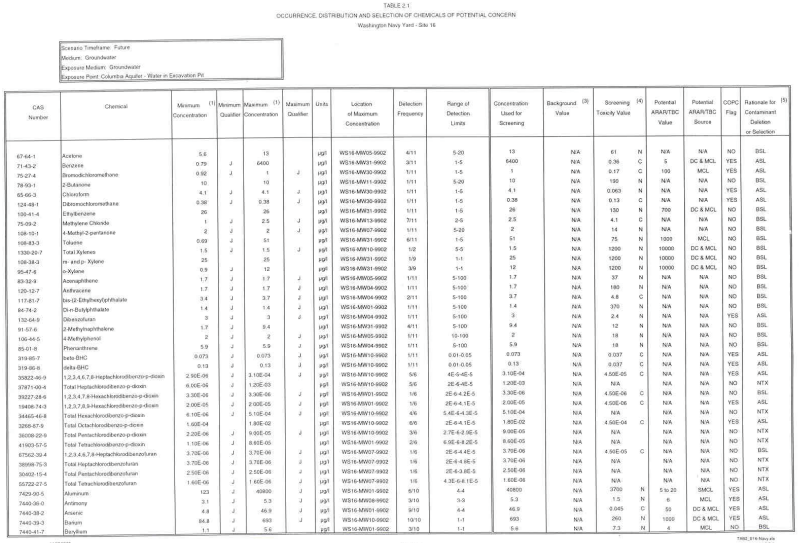


TABLE 2.1
OCCURRENCE, DISTRIBUTION AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN
Washington Navy Yard - Site 16

Scenario Timeframe: Future
Medium: Groundwater
Exposure Medium: Groundwater
Exposure Point: Columbia Aquifer - Water in Excavation Pit

CAS Number	Chemical	Minimum Concentration (1)	Minimum Qualifier	Maximum Concentration (1)	Maximum Qualifier	Units	Location of Maximum Concentration	Detection Frequency	Range of Detection Limits	Concentration Used for Screening	Background Value (2)	Screening Toxicity Value (4)		Potential ARAR/TBC Value	Potential ARAR/TBC Source	COPC Flag	Rationale for Contaminant Deletion or Selection (5)
67-64-1	Acetone	5.6		13		µg/l	WS16-MW05-9902	4/11	5-20	13	N/A	61	N	N/A	N/A	NO	BSL
71-43-2	Benzene	0.79	J	6400		µg/l	WS16-MW31-9902	3/11	1-5	6400	N/A	0.36	C	5	DC & MCL	YES	ASL
75-27-4	Bromodichloromethane	0.92	J	1	J	µg/l	WS16-MW30-9902	1/11	1-5	1	N/A	0.17	C	100	MCL	YES	ASL
78-93-1	2-Butanone	10		10	J	µg/l	WS16-MW11-9902	1/11	5-20	10	N/A	180	N	N/A	N/A	NO	BSL
67-66-3	Chloroform	4.1	J	4.1	J	µg/l	WS16-MW30-9902	1/11	1-5	4.1	N/A	0.063	N	N/A	N/A	YES	ASL
124-48-1	Dibromochloromethane	0.38	J	0.38	J	µg/l	WS16-MW30-9902	1/11	1-5	0.38	N/A	0.13	C	N/A	N/A	YES	ASL
100-41-4	Ethylbenzene	26		26		µg/l	WS16-MW31-9902	1/11	1-5	26	N/A	130	N	700	DC & MCL	NO	BSL
75-09-2	Methylene Chloride	1	J	2.5	J	µg/l	WS16-MW13-9902	7/11	2-5	2.5	N/A	4.1	C	N/A	N/A	NO	BSL
108-10-1	4-Methyl-2-pentanone	2	J	2	J	µg/l	WS16-MW07-9902	1/11	5-20	2	N/A	14	N	N/A	N/A	NO	BSL
108-83-3	Toluene	0.69	J	51		µg/l	WS16-MW31-9902	6/11	1-5	51	N/A	75	N	1000	MCL	NO	BSL
1330-20-7	Total Xylenes	1.5	J	1.5	J	µg/l	WS16-MW10-9902	1/2	3-5	1.5	N/A	1200	N	10000	DC & MCL	NO	BSL
108-38-3	m- and p- Xylene	25		25		µg/l	WS16-MW31-9902	1/9	1-1	25	N/A	1200	N	10000	DC & MCL	NO	BSL
95-47-6	o-Xylene	0.9	J	12		µg/l	WS16-MW31-9902	3/9	1-1	12	N/A	1200	N	10000	DC & MCL	NO	BSL
83-32-9	Acenaphthene	1.7	J	1.7	J	µg/l	WS16-MW05-9902	1/11	5-100	1.7	N/A	37	N	N/A	N/A	NO	BSL
120-12-7	Anthracene	1.7	J	1.7	J	µg/l	WS16-MW04-9902	1/11	5-100	1.7	N/A	180	N	N/A	N/A	NO	BSL
117-81-7	bis-(2-Ethylhexyl)phthalate	3.4	J	3.7	J	µg/l	WS16-MW04-9902	2/11	5-100	3.7	N/A	4.8	C	N/A	N/A	NO	BSL
84-74-2	Di-n-Butylphthalate	1.4	J	1.4	J	µg/l	WS16-MW01-9902	1/11	5-100	1.4	N/A	370	N	N/A	N/A	NO	BSL
132-64-9	Dibenzofuran	3	J	3	J	µg/l	WS16-MW04-9902	1/11	5-100	3	N/A	2.4	N	N/A	N/A	YES	ASL
91-57-6	2-Methylnaphthalene	1.7	J	9.4		µg/l	WS16-MW31-9902	4/11	5-100	9.4	N/A	12	N	N/A	N/A	NO	BSL
106-44-5	4-Methylphenol	2	J	2	J	µg/l	WS16-MW05-9902	1/11	10-100	2	N/A	18	N	N/A	N/A	NO	BSL
85-01-8	Phenanthrene	5.9	J	5.9	J	µg/l	WS16-MW04-9902	1/11	5-100	5.9	N/A	18	N	N/A	N/A	NO	BSL
319-85-7	beta-BHC	0.073	J	0.073	J	µg/l	WS16-MW10-9902	1/11	0.01-0.05	0.073	N/A	0.037	C	N/A	N/A	YES	ASL
319-86-8	delta-BHC	0.13	J	0.13	J	µg/l	WS16-MW10-9902	1/11	0.01-0.05	0.13	N/A	0.037	C	N/A	N/A	YES	ASL
35822-46-9	1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin	2.50E-06	J	3.10E-04	J	pg/l	WS16-MW10-9902	5/6	4E-6-4E-5	3.10E-04	N/A	4.50E-05	C	N/A	N/A	YES	ASL
37871-00-4	Total Heptachlorodibenzo-p-dioxin	6.00E-06	J	1.20E-03		pg/l	WS16-MW10-9902	5/6	2E-6-4E-5	1.20E-03	N/A	N/A		N/A	N/A	NO	NTX
39227-28-6	1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin	3.30E-06	J	3.30E-06	J	pg/l	WS16-MW01-9902	1/6	2E-6-4.2E-5	3.30E-06	N/A	4.50E-06	C	N/A	N/A	NO	BSL
19408-74-3	1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin	2.00E-05	J	2.00E-05	J	pg/l	WS16-MW01-9902	1/6	2E-6-4.1E-5	2.00E-05	N/A	4.50E-06	C	N/A	N/A	YES	ASL
34465-46-8	Total Hexachlorodibenzo-p-dioxin	6.10E-06	J	5.10E-04	J	pg/l	WS16-MW10-9902	4/6	5.4E-6-4.3E-5	5.10E-04	N/A	N/A		N/A	N/A	NO	NTX
3268-87-9	Total Octachlorodibenzo-p-dioxin	1.60E-04		1.80E-02		pg/l	WS16-MW10-9902	6/6	2E-6-4.1E-5	1.80E-02	N/A	4.50E-04	C	N/A	N/A	YES	ASL
36088-22-9	Total Pentachlorodibenzo-p-dioxin	2.20E-06	J	9.90E-05	J	pg/l	WS16-MW10-9902	3/6	2.7E-6-2.9E-5	9.90E-05	N/A	N/A		N/A	N/A	NO	NTX
41903-57-5	Total Tetrachlorodibenzo-p-dioxin	1.10E-06	J	8.60E-05		pg/l	WS16-MW01-9902	2/6	6.9E-6-8.2E-5	8.60E-05	N/A	N/A		N/A	N/A	NO	NTX
67562-39-4	1,2,3,4,6,7,8-Heptachlorodibenzofuran	3.70E-06	J	3.70E-06	J	pg/l	WS16-MW07-9902	1/6	2E-6-4.4E-5	3.70E-06	N/A	4.50E-05	C	N/A	N/A	NO	BSL
38998-75-3	Total Heptachlorodibenzofuran	3.70E-06	J	3.70E-06	J	pg/l	WS16-MW07-9902	1/6	2E-6-4.4E-5	3.70E-06	N/A	N/A		N/A	N/A	NO	NTX
30402-15-4	Total Pentachlorodibenzofuran	2.50E-06	J	2.50E-06	J	pg/l	WS16-MW07-9902	1/6	2E-6-3.8E-5	2.50E-06	N/A	N/A		N/A	N/A	NO	NTX
55722-27-5	Total Tetrachlorodibenzofuran	1.60E-06	J	1.60E-06	J	pg/l	WS16-MW07-9902	1/6	4.3E-6-6.1E-5	1.60E-06	N/A	N/A		N/A	N/A	NO	NTX
7429-90-5	Aluminum	123	J	40800		µg/l	WS16-MW01-9902	9/10	6.4	40800	N/A	3700	N	5 to 20	SMCL	YES	ASL
7440-36-0	Antimony	3.1	J	3.3	J	µg/l	WS16-MW04-9902	3/10	3-5	3.3	N/A	1.5	N	6	MCL	YES	ASL
7440-38-2	Arsenic	4.8	J	46.9	J	µg/l	WS16-MW01-9902	9/10	4-4	46.9	N/A	0.045	C	50	DC & MCL	YES	ASL
7440-39-3	Barium	84.8	J	693	J	µg/l	WS16-MW10-9902	10/10	1-1	693	N/A	260	N	1000	DC & MCL	YES	ASL
7440-41-7	Beryllium	1.1	J	5.6		µg/l	WS16-MW01-9902	3/10	1-1	5.6	N/A	7.3	N	4	MCL	NO	BSL

Use Table 2.1 for Screening

Occurrence, Distribution and Selection of Chemicals of Potential Concern

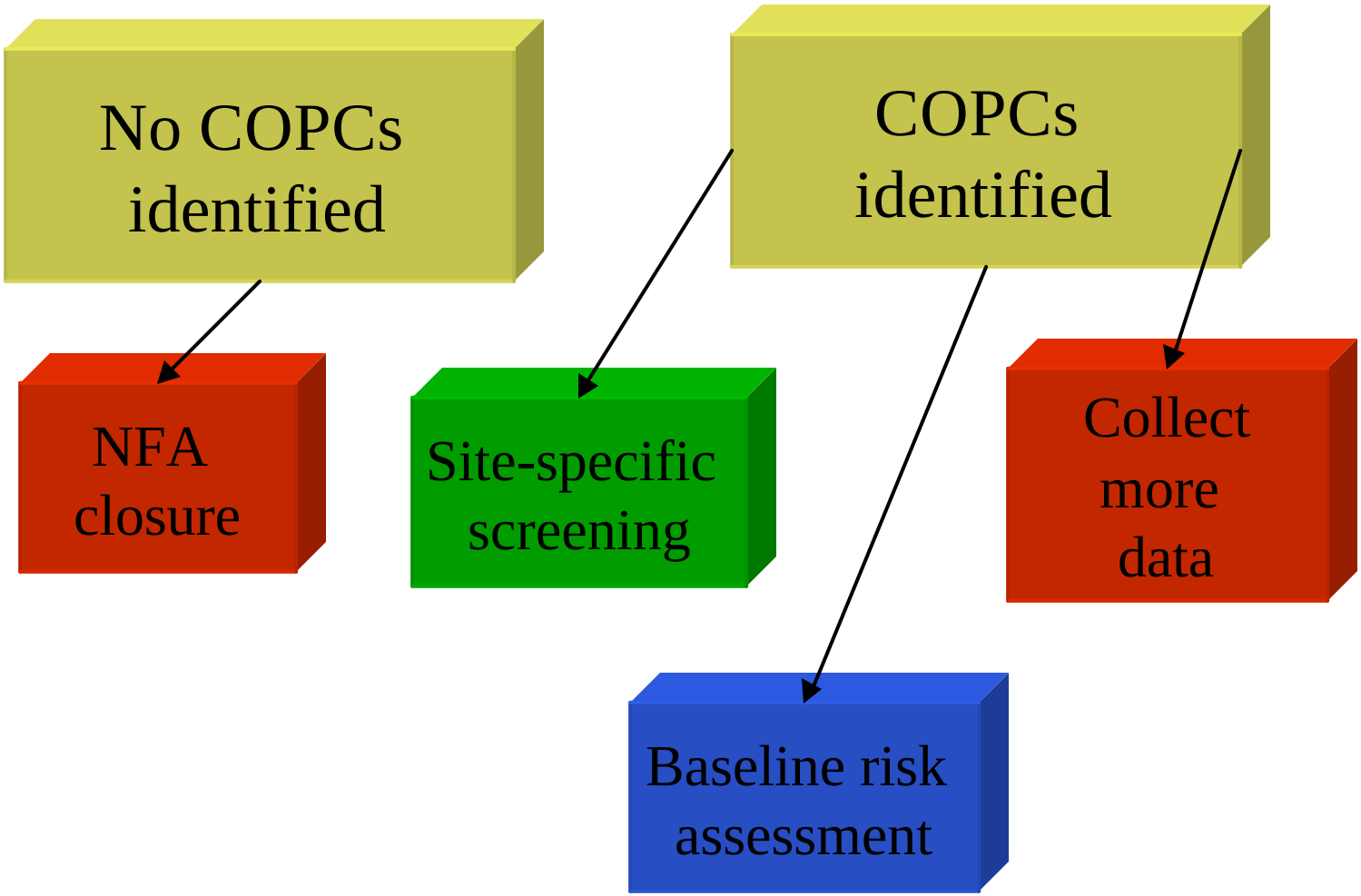
- Efficient table format
- Consistent with EPA guidance
- May be used in Baseline Risk Assessment or Interim Deliverable

  Complaints about table format (number of tables required)

  Region 4 requested we use a different format

Now What?

Basic screening analysis complete



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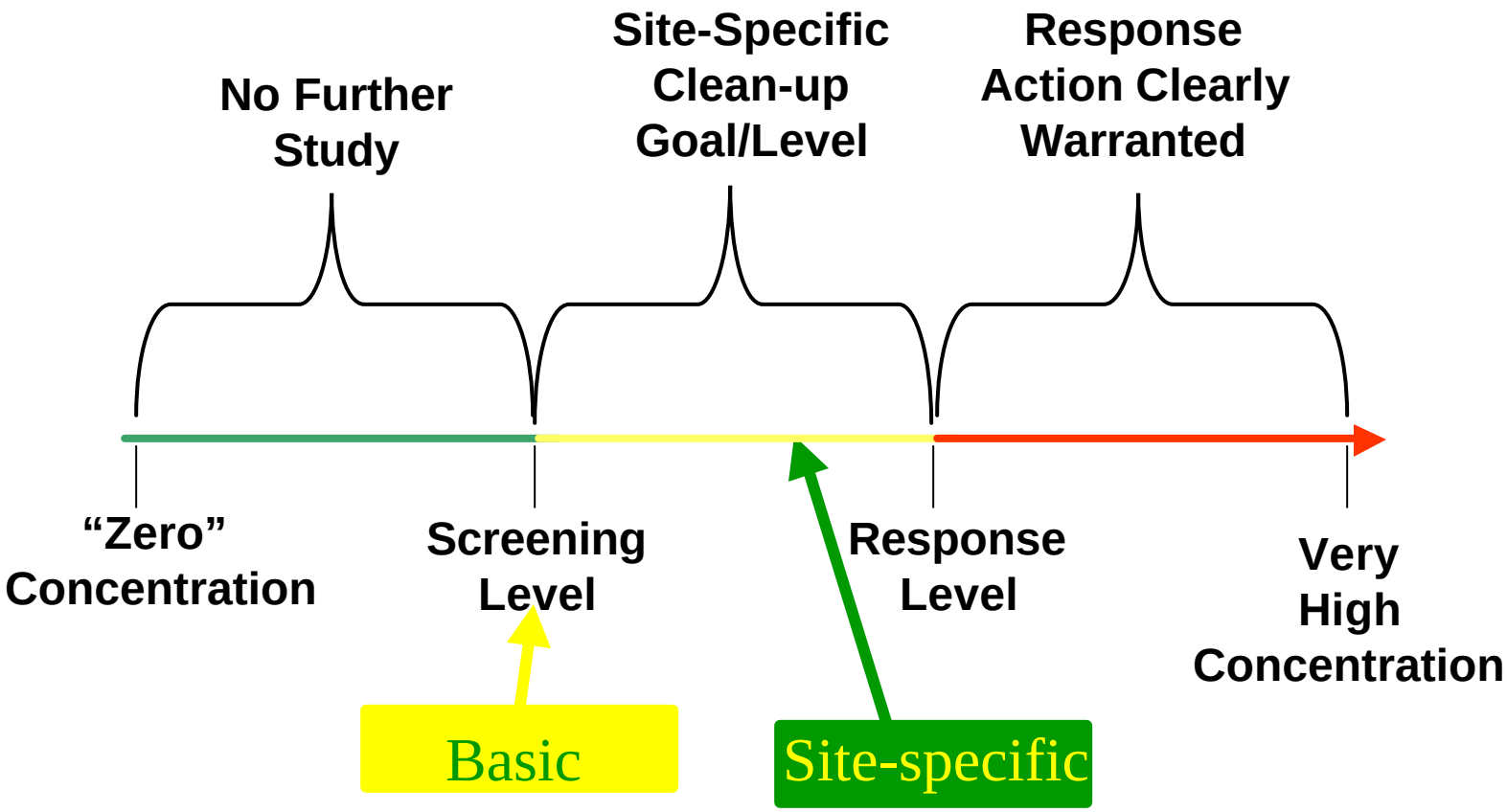


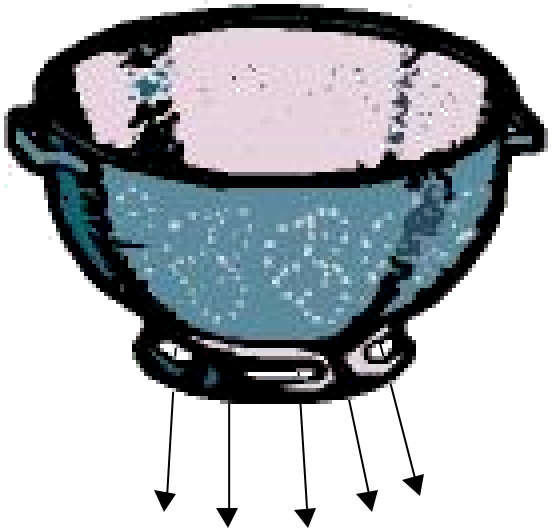
Why Perform a Site-Specific Screen?

- Further refinement of the basic screening
- Use this in a step-wise fashion to determine areas of potential concern
- Utilizes readily available information
- Some agencies allow this refinement in lieu of performing complete baseline risk assessment

Risk-Based Screening

Discriminatory Power

Strainer with large holes



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NO PROBLEM

Strainer with medium holes

Site-specific provides more discrimination

Some fall through

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IDENTIFIES POTENTIAL CONCERNS

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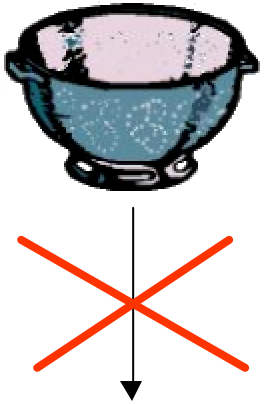

Nothing falls through

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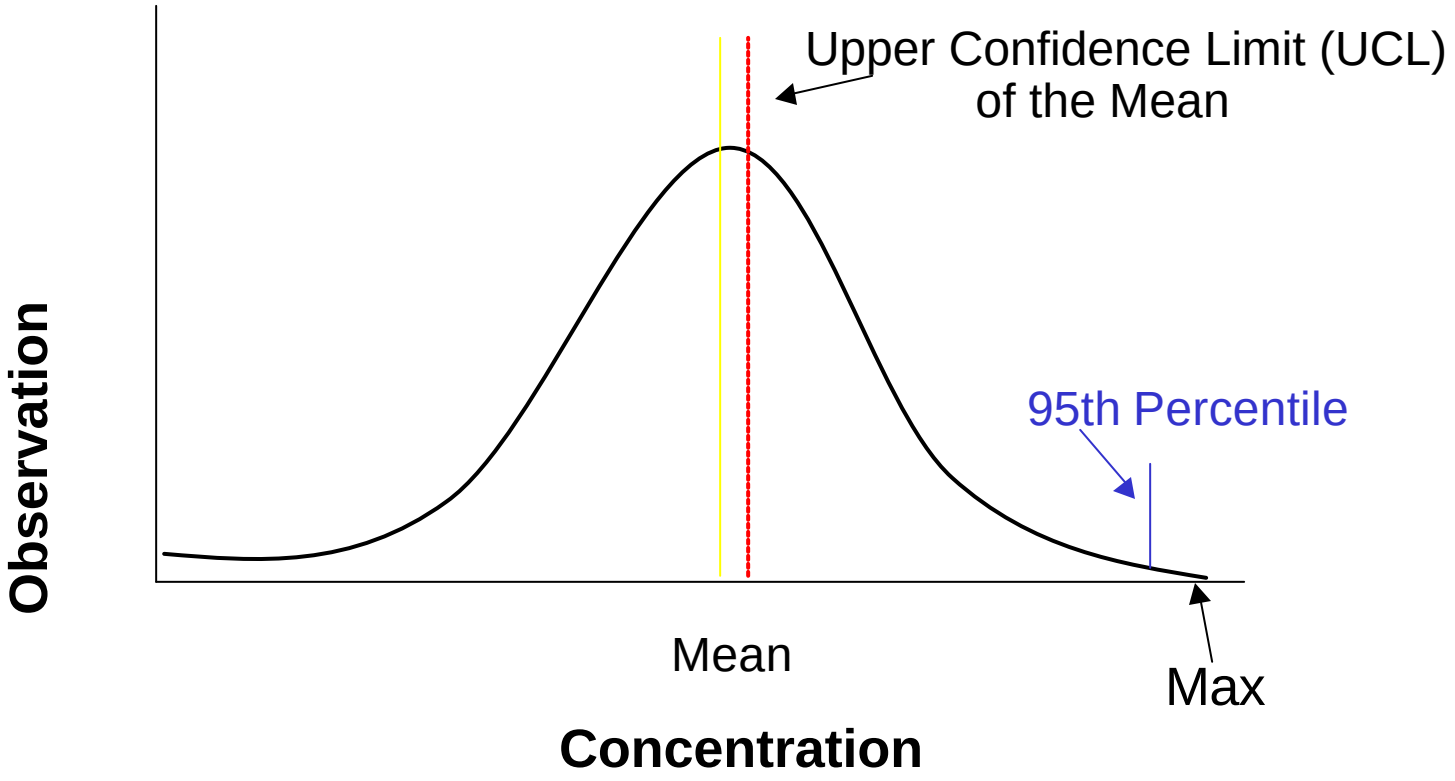
EVERYTHING A PROBLEM

Before You Initiate Site-Specific Screening...

- Were PRGs exceeded by orders of magnitude?
- Were the default assumptions representative of site activity?
- Have future land use plans been determined?
- Are cleanup costs prohibitive?
- Are there regulations, policy or guidance that apply to the site?

DTSC Guidance

Use 95 % UCL of mean or maximum concentration (approval from DTSC Project Manager)



Alternate Land Use

- Regions provide industrial RBCs (Region 3) and PRGs (Region 9)
- Industrial criteria may be used for site-specific screening
- Evaluate potential impact of using the industrial criteria

Residential v Industrial Criteria

Constituent	Residential	Industrial
Benzene	0.63	1.4
Butylate	3300	34000
Cadmium	9.0	850
TCE	3.2	7.0

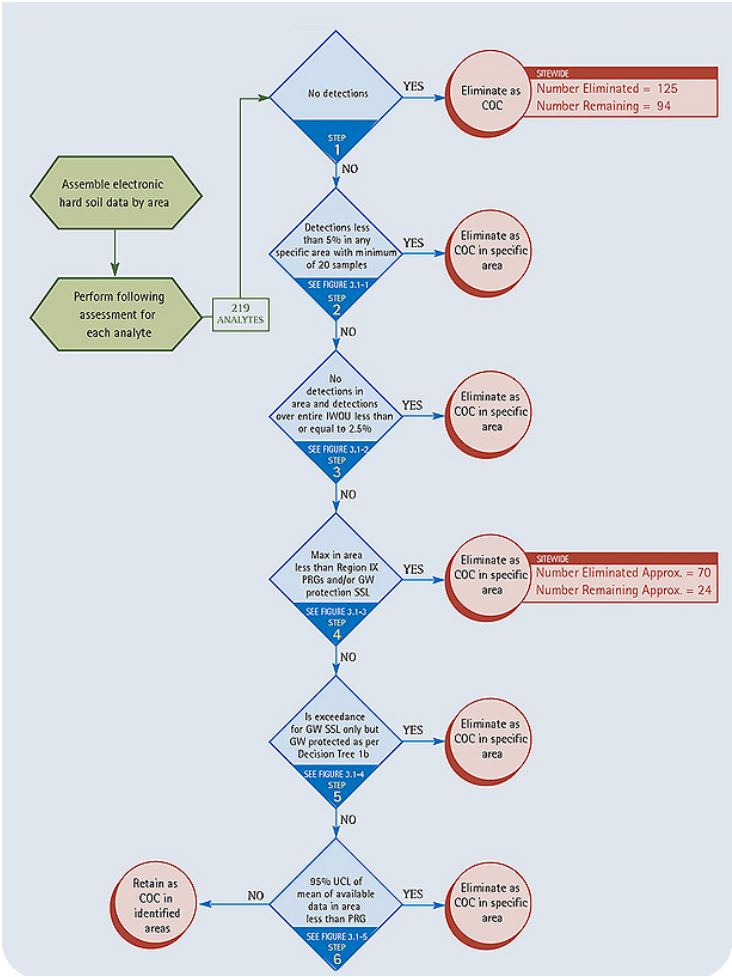
Site-Specific Issues

Consider the following when evaluating site-specific conditions

- Groundwater potability
  - salinity
  - pump rates
- Institutional controls
- Automatic exposure restrictions
  - wetland regulations
  - Coastal Water Act
- Zoning requirements
  - lot size
  - use restrictions

Site-Specific Screening Example

- What are site conditions
  - Industrial use
  - 6 months/year exposure to soil
    - Snow/frozen
    - Rain/wet conditions



General Equation

$$C = \frac{THI \times BW \times AT \times 365}{ED \times \underset{250}{EF} \times [((1/RfD_o) \times 10^{-6} \times IR)]}$$

- variable
- constant

$$C = \frac{THI \times BW \times AT \times 365}{ED \times \underset{130}{EF} \times [((1/RfD_o) \times 10^{-6} \times IR)]}$$

850 ppm	250 days
1632 ppm	130 days

Site-Specific Screening Example

Cadmium (non-carcinogen) - screening criteria

Residential- 365 d/y – 9 ppm

Industrial- 250 d/y – 850 ppm

Site-specific- 130 d/y –1632 ppm

Advantages of Site-Specific Screening

- Health protective
- Achieve closure/transfer earlier in process
- Saves costs
  - investigation
  - document preparation (risk assessment)

Screening Summary

- Efficient evaluation of existing data
- Screening may be sufficient for closure
- Interim deliverable in baseline risk assessment process
- Conservative approach