Human Health Focus Group

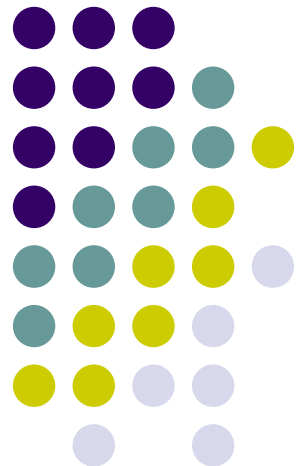
This presentation represents the work of the Human Health Focus Group members:

- Pat Cirone, PhD
- Elaine Faustman, PhD- University of Washington
- Ken Kauffman- Oregon Department of Human Services
- Joan Rothlein, PhD- Oregon Health and Science University
- Sue MacMillan- URS Corporation
- Dave McBride- Washington State Department of Health

RISK ASSESSMENT: HOW IT'S DONE

Human Health Focus Group
Fish Consumption Rate Workshop #3
July 17, 2007

Presenter:
Sue MacMillan, URS Corporation
Direct line: (503) 948-7294
Email: smacmillan@urscorp.com



RISK ASSESSMENT PROVIDES A STANDARDIZED WAY TO ASSIGN RECOGNIZED NUMBERS TO THE HEALTH DANGERS PEOPLE FACE BY THEIR POTENTIAL EXPOSURE TO CONTAMINANTS.

GIVES US A WAY TO MAKE DECISIONS.

"ACCEPTABLE" RISK

Science + Policy – dates back to the late 1980s

Conceptual Model

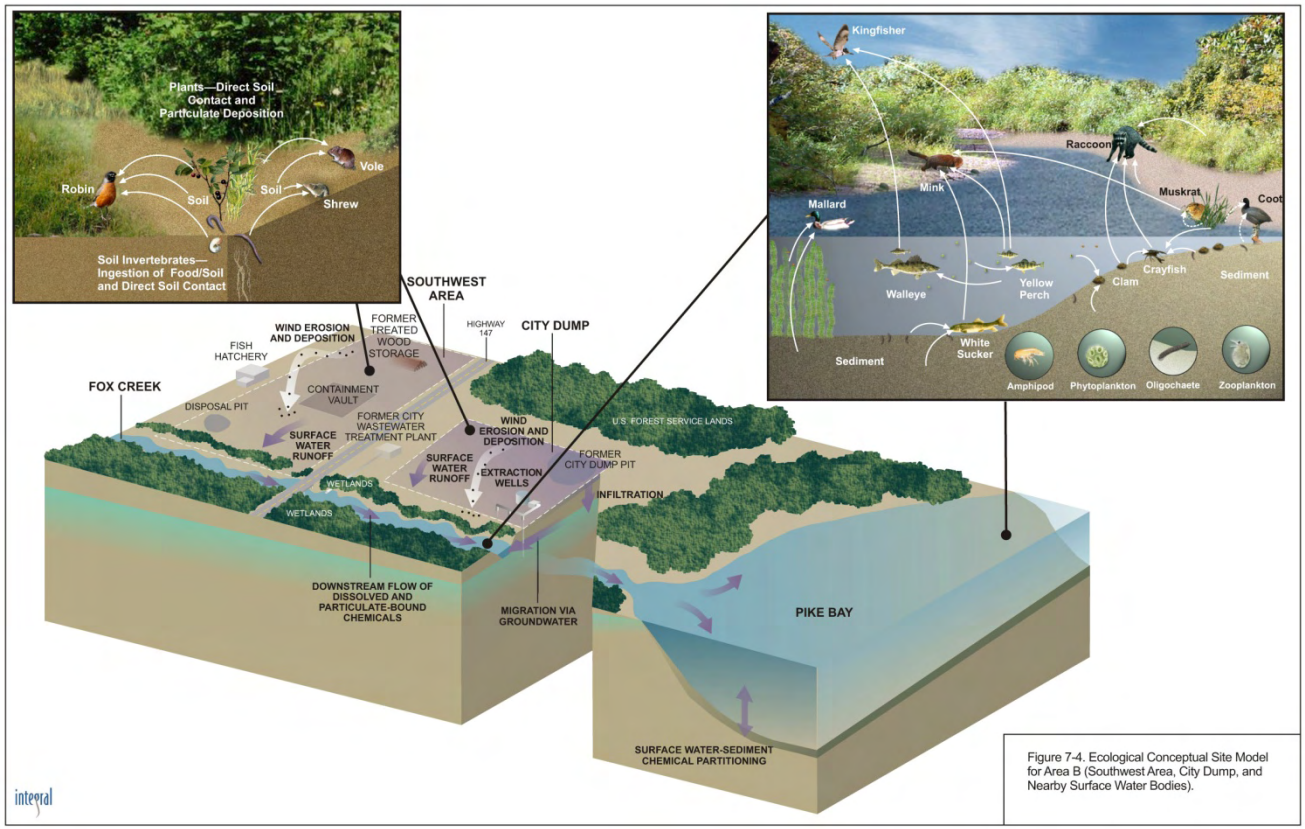
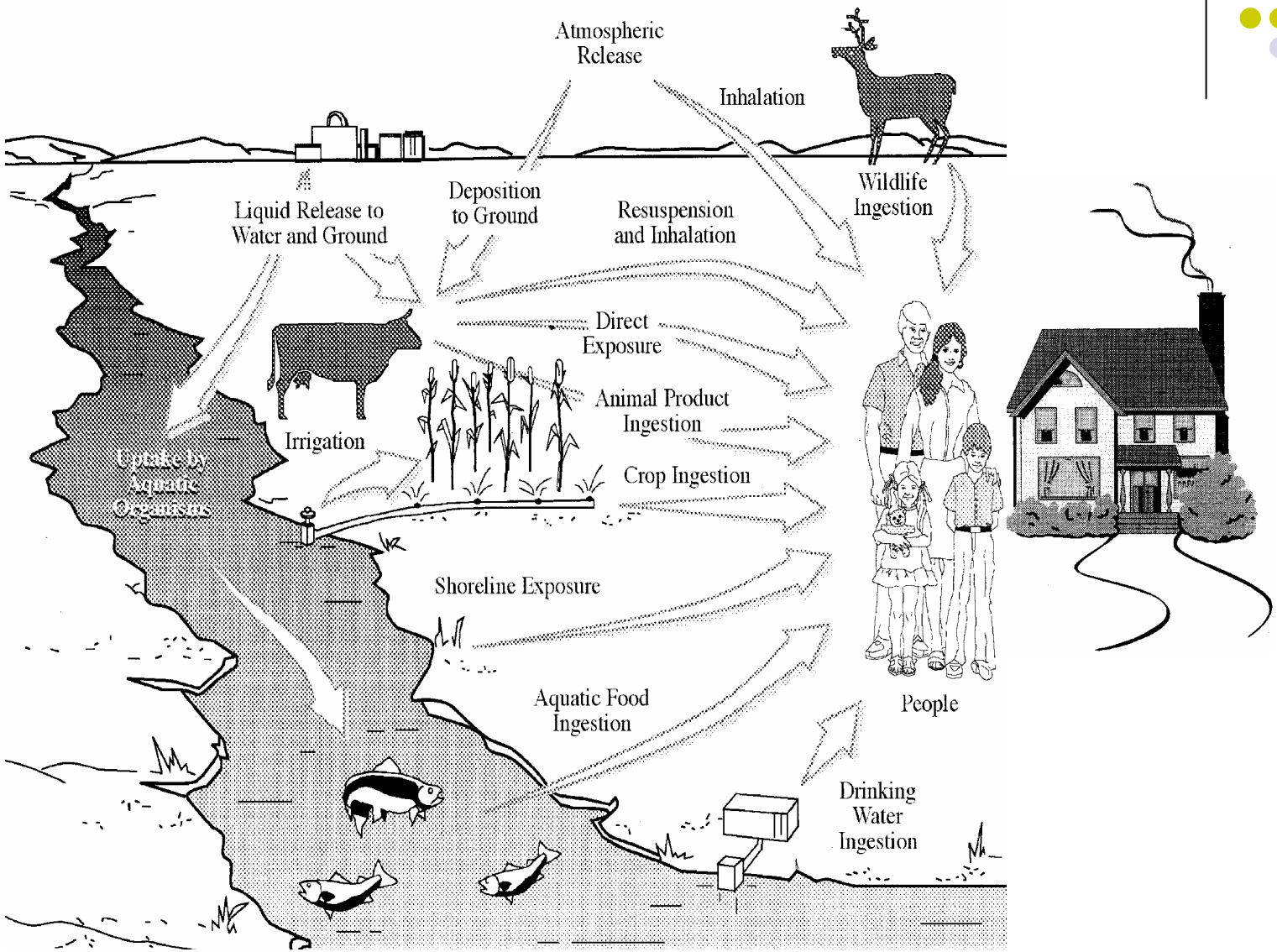
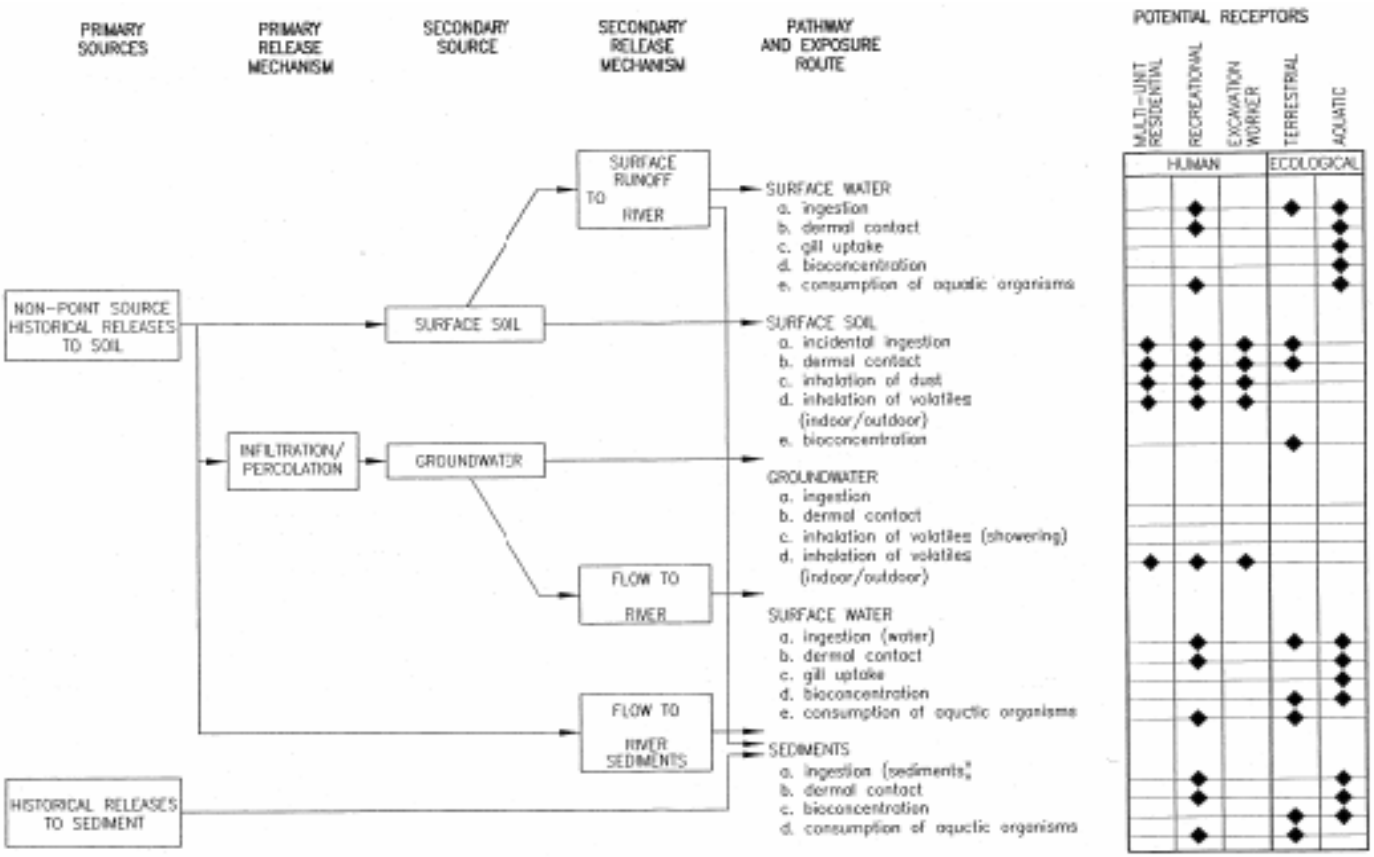


Figure 7-4. Ecological Conceptual Site Model for Area B (Southwest Area, City Dump, and Nearby Surface Water Bodies).

Conceptual Model



Conceptual Site Model Flow Chart Example



TWO TYPES OF RISK ARE ASSESSED IN REGARD TO HUMAN HEALTH:

Cancer risk

Single carcinogen (for example, benzene) = 1 x 10-6.
Multiple carcinogens = 1 x 10-5.

Non-cancer risk

Single non-carcinogen: Hazard Quotient (HQ) of 1.0.
(Toluene)
Multiple non-carcinogens with same health endpoint:
Hazard Index (HI) of 1.0.
(Toluene and ethylbenzene both have harmful effects on the liver.)

WHAT DOES A 1 X 10^{-6} CANCER RISK MEAN?

The 1-in-a-million (1E-06) carcinogenic risk limits refers to the fact that an individual chemical is not allowed to cause one or more additional occurrences of cancer in a population of 1,000,000 people. ("Additional" refers to the fact that there is a background incidence of cancer in the general population due to everyday exposure to common materials).

So, if even 1 additional incidence of cancer occurs in a population of 1 million people that is due to exposure to a particular chemical, then some type of action is needed to protect human receptors.

SO, HOW ARE CANCER AND NON-CANCER RISKS CALCULATED?

Typically, through use of:

- Standard exposure (daily intake) formulas for specific kinds of human receptors.
- Standard (aka DEFAULT) exposure parameters in the exposure formulas.
- Peer-reviewed toxicity factors for carcinogenic and non-carcinogenic health effects.

CALCULATION OF AWQC PROTECTIVE LEVEL FOR HUMAN RECEPTORS BASED ON EXCESS NON-CANCER RISK THROUGH "FISH INGESTION ONLY"

AWQC (ug/L) = RfD * RSC * (THQ *BW / [FI * BCF]) * CF

EXPOSURE PARAMETERS

AWQC (ug/L) = ambient water quality criteria in units of micrograms per liter.
RfD = reference dose (milligrams chemical per kilogram body weight per day [mg/kg/day]).
RSC = Relative Source Contribution.
THQ = Target Hazard Quotient of 1.0.
BW = adult body weight (70 kg).
FI = fish ingestion rate (kg/day).
BCF = bioconcentration factor in units of L/kg (from surface water to fish tissue).
CF = conversion factor (1,000 ug/kg)
--- a microgram is 1,000 times smaller than a kilogram.

NATIONAL RECOMMENDED WATER QUALITY CRITERIA FOR PRIORITY TOXIC POLLUTANTS

	Priority Pollutant	CAS Number	Freshwater CMC (* µg/L)	Freshwater CCC (* µg/L)	Saltwater CMC (* µg/L)	Saltwater CCC (* µg/L)	Human Health For Consumption of: Water + Organism (* µg/L)	Human Health For Consumption of: Organism Only (* µg/L)	FR Cite/ Source
1	Antimony	7440360					5.6 h	640 h	65FR66443
2	Arsenic	7440382	340 A,D,K	150 A,D,K	69 A,D,bb	36 A,D,bb	0.018 C,M,h	0.14 C,M,h	65FR31682 57FR60848
3	Beryllium	7440417					z		65FR31682
4	Cadmium	7440439	2.0 D,E,K,bb	0.25 D,E,K,bb	40 D,bb	8.8 D,bb	z		EPA-822-R-01-001 65FR31682
5a	Chromium (III)	16065831	570 D,E,K	74 D,E,K			z Total		EPA822-R-01-001 65FR31682
5b	Chromium (VI)	18540299	16 D,E,K	11 D,E,K	1,100 D,bb	50 D,bb	z Total		65FR31682
6	Copper	7440508	13 D,E,K,aa	9.0 D,E,K,aa	4.8 D,aa,ff	3.1 D,aa,ff	1,300 U		65FR31682
7	Lead	7439921	65 D,E,A,aa	2.5 D,E,M,aa,gg	210 D,bb	8.1 D,bb			65FR31682
8a 8b	Mercury Methylmercury	7439976 22967926	1.4 D,E,bb	0.77 D,E,bb	1.8 D,aa,bb	0.94 D,aa,bb		0.3 mg/kg f	62FR42160 EPA823-R-01-001
9	Nickel	7440020	470 D,E,K	52 D,E,K	74 D,bb	8.2 D,bb	610 h	4,600 h	65FR31682
10	Selenium	7782492	1.0 J	5.0 J	290 D,M,bb	71 D,M,bb	170 z	4200	62FR42160 65FR31682 65FR66443
11	Silver	7440224	3.2 D,E,O		1.9 D,O				65FR31682

TOXICITY FACTORS: WHERE DO WE FIND THEM?

USEPA Integrated Risk Information System (IRIS) database

Website: http://www.epa.gov/iris/

_I.A. Reference Dose for Chronic Oral Exposure (RfD)

Substance Name — Toluene
CASRN — 108-88-3
Section I.A. Last Revised — 09/23/2005

The RfD is an estimate of an oral exposure, for a given duration, to the human population (including susceptible subgroups) that is likely to be without an appreciable risk of adverse health effects over a lifetime. It is derived from a statistical lower confidence limit on the benchmark dose (BMDL), a no-observed-adverse-effect level (NOAEL), a lowest-observed-adverse-effect level (LOAEL), or another suitable point of departure, with uncertainty/variability factors applied to reflect limitations of the data used. The RfD is intended for use in risk assessments for health effects known or assumed to be produced through a nonlinear (possibly threshold) mode of action. It is expressed in units of mg/kg-day. Please refer to the guidance documents at http://www.epa.gov/iriswebp/iris/backor-d.htm for an elaboration of these concepts. Since RfDs can be derived for the noncarcinogenic health effects of substances that are also carcinogens, it is essential to refer to other sources of information concerning the carcinogenicity of this chemical substance. If the U.S. EPA has evaluated this substance for potential human carcinogenicity, a summary of that evaluation will be contained in Section II of this file.

The previous IRIS assessment utilized the NTP (1990) 13-week rat gavage study as the principal study and changes in liver and kidney weights as the critical effect for derivation of the RfD (0.2 mg/kg-day). The NOAEL was identified as 223 mg/kg-day. A composite UF of 1000 was applied to account for interspecies and intraspecies extrapolations, subchronic-to-chronic extrapolation, and limited reproductive and developmental toxicity data. The current assessment differs due to newer methodologies and consideration of additional data.

__I.A.1. Oral RfD Summary

Critical Effect	Experimental Doses*	UF	RfD
Increased kidney weight	BMDL: 238 mg/kg-day NMH: 441 mg/kg-day	3000	0.08 mg/kg-day
13-week gavage study in rats (NTP, 1990)			

* Conversion Factors and Assumptions - BMDL- 95% lower confidence limit on the maximum likelihood estimate of the dose corresponding to a one standard deviation change in the mean.
BMD - Maximum likelihood estimate of the dose corresponding to a one standard deviation change in the mean.

__I.A.2. Principal and Supporting Studies (Oral RfD)

No studies examining the chronic or subchronic effects of oral exposure to toluene in humans are available. A lifetime gavage study in rats (Maltoni et al., 1997) reported only carcinogenic endpoints and is, therefore, not suitable for use as the principal study for derivation of an RfD. One subchronic study (NTP, 1990) examining oral exposure to toluene in rodents (rats and mice) is available and was chosen as the principal study. The critical effect chosen is increased kidney weight. NTP (1990) exposed both sexes of F-344 rats and both sexes of B6C3F1 mice to toluene by gavage for 13 weeks. In male rats, absolute and relative weights of both the liver and kidney were significantly increased ($p \leq 0.05$) at doses greater than or equal to 446 mg/kg-day. Absolute kidney weights were 100, 107, 112, 119, and 113% of controls; relative kidney weights were 100, 100, 106, 114, and 146% of controls for 0, 223,

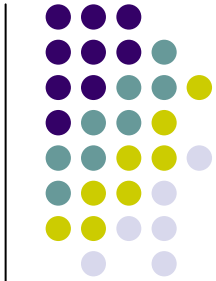
RESULTS OF A HUMAN HEALTH RISK ASSESSMENT:

- CANCER RISK FOR **SINGLE** CARCINOGEN (**1 X 10^{-6}**).
- CUMULTATIVE CANCER RISK FOR **MULTIPLE** CARCINOGENS (**1 X 10^{-5}**).

- **HQ** VALUE FOR **SINGLE** NON-CARCINOGEN (**1.0**).

- **HI** (CUMULATIVE) VALUE FOR **MULTIPLE** NON-CARCINOGENS WITH SIMILAR ENDPOINTS (**1.0**).

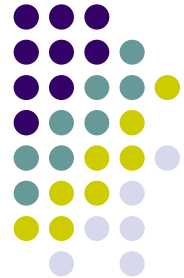
Average **and** reasonable worst-case **human health exposure scenarios.**



In risk assessment, these scenarios are referred to as the central tendency exposure (CTE) **and the** reasonable maximum exposure (RME) **scenario, respectively.**

Must protect not only the typical case of exposure, but also exposure of more sensitive populations.

RISK ASSESSMENT VERSUS RISK MANAGEMENT

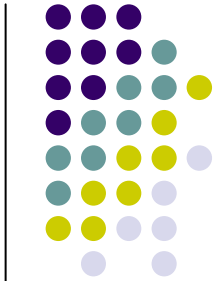


- Risk assessment: assign a number to exposure risk.

- Risk management: decide what to do based on risk assessment results.

Most risk management decisions are driven by RME risk estimates.

GENERAL ASSUMPTIONS USED IN RISK ASSESSMENT:



- Collected environmental data used in a risk assessment are representative of what human receptors are actually exposed to.
- Acceptable risk levels (as defined above) are protective of the majority of human receptors.
- Default exposure parameters accurately represent actual exposure parameters, or are more protective.

GENERAL ASSUMPTIONS USED IN RISK ASSESSMENT:

- Chemicals with available assigned toxicity factors (or other usable toxicity information) can be quantified; chemicals that do not have this information cannot be quantified, and so are not taken into account in the final risk numbers.

- In the calculation of AWQC, adults are assumed to be the primary receptor.

- In the calculation of AWQC, only individual chemicals are considered. Potential risk from multiple chemicals is not considered.

SO WHAT?

- AWQC are calculated to be protective of people eating fish.

- When Fish Ingestion (FI) Rate (i.e., Fish Consumption Rate) increases, the resulting AWQC decreases – it becomes more stringent.