Contaminated Site Professional Development Workshops

May 31 and June 1, 2011
Workshop on Human Health and Ecological Risk Assessment
Fundamentals and beyond: Better risk assessments give better results

---

Risk Assessment Primer

Depending on your familiarity with contaminated site investigation and remediation, in BC and elsewhere; you may want to read the BC MOE documents on Contaminated Sites and Environmental Protection (Documents #1 and #2). We will review some of the concepts provided in these documents at the start of the workshop.

Once you have read those documents, or if you already are familiar with the contaminated sites process, you should review Document #3, which provides an overview of risk assessment as applied to contaminated sites in BC.

You are now ready to take Human Health primer course and test. This course was developed by Health Canada and is interactive. If you are already familiar with risk assessment concepts; run the self-test module (Module 1). Otherwise, run through modules through 7; and then take the test.

RAIS: What is Risk Assessment

What is risk?

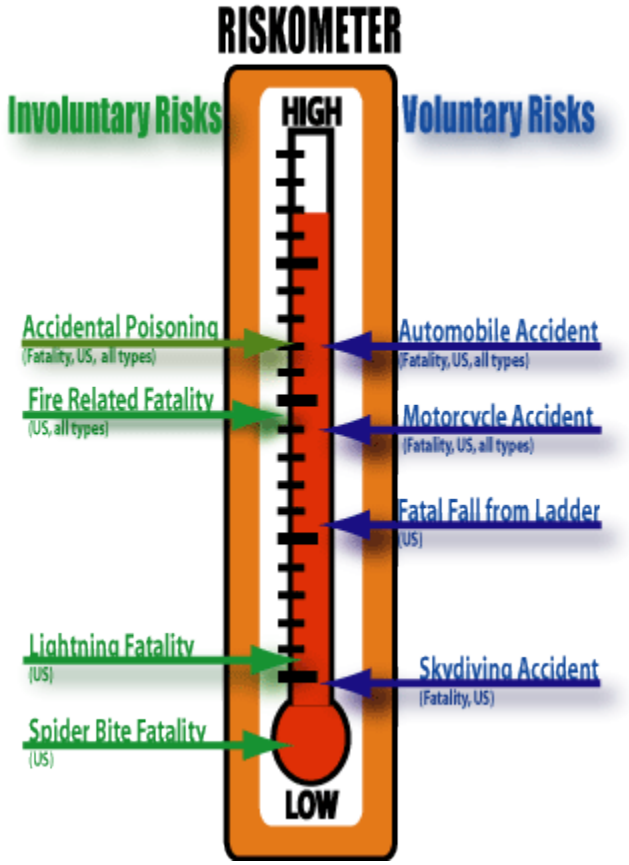
The Oxford English Dictionary (Oxford University Press, 1971) defines risk as a "hazard, danger; exposure to mischance or peril". Therefore, to put oneself "at risk" means to participate voluntarily or involuntarily in an activity or event that could lead to injury, damage, or loss.

Voluntary risks are hazards associated with activities that we decide to undertake (e.g., driving a car, riding a motorcycle, climbing a ladder, smoking cigarettes, skydiving, formula one racing).

Involuntary risks are negative impacts associated with an occurrence that happens to us without our prior consent or knowledge. Acts of nature such as being struck by lightning, fires, floods, tornados, etc., and exposure to environmental contaminants are examples of involuntary risks.

Risks may also be defined as **statistically verifiable** or **statistically nonverifiable**. Statistically verifiable risks are risks for voluntary or involuntary activities that have been determined from direct observation. These risks can be compared to each other. Statistically nonverifiable risks are risks from involuntary activities that are based on limited data sets and mathematical equations. For example, we know the risk of a meteorite hitting a person is low, but because there is no record of such an event ever happening it is statistically nonverifiable. Statistically verifiable and nonverifiable risks are similar to apples and oranges in that they are both fruits but are so different that comparisons should not be made between the two.

What are the risks of some common activities and events?



Risks associated with different activities and phenomena vary greatly. For example, as the Riskometer illustrates, one's chances of getting struck by lightning in the United States is low compared to fatality due to fire. These are involuntary risks, those that we have little control over.

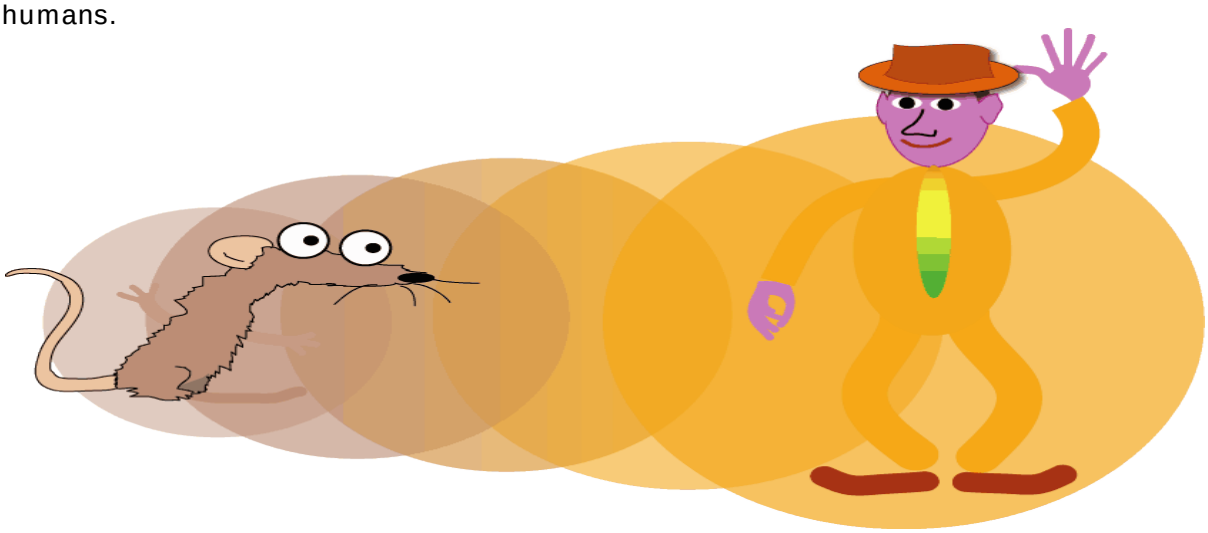
Voluntary risks on the other hand are associated with activities which are largely controllable. Risk is part of living; consequently,we are constantly evaluating the risks which face us on a daily basis. You may not be conscious of this assessment as it is often ingrained in our thought processes; however you **are** considering risks, especially as they relate to voluntary activities, to ensure that you and those close to you are out of harm's way. For example, when leaving the house in the morning one may consider if there is a chance of rain. The risk of getting soaked on the way to work is a risk you could avoid by carrying an umbrella.

Of course, there are many common activities that present more serious potentially life threatening risks. Transportation may be one of the most serious voluntary risks that we take on a regular basis. Driving a car or a motorcycle has a relatively high risk of injury due to accidents.

Many of us may depend on driving a car to get to work among other destinations, we are willing to take the risk in order to support our families and for the convenience it provides. To reduce the risk of accident and injury safe guards such as air bags and antilock brakes are standard features on most vehicles. In addition, we can take risk precautions such as reducing speed and increasing following distance in poor driving conditions as well as wearing seat belts.

How are risks measured?

Risks to the public are measured by **direct observation** or by applying **mathematical models** and a series of assumptions to animal risk study results to infer potential risk to humans.



How are risks expressed?

No matter how risks are defined or quantified, they are usually expressed as a **probability** of effects associated with a particular activity. Risk/probability is expressed as a fraction, without units, from 0 to 1.0. A probability of 1.0 indicates an absolute certainty that an event or outcome will occur. Scientific notation is generally used to present quantitative risk information.

Actual Number	Scientific Notation		Read As
1/10	$1x10^{-1}$	1E-01	One in ten
1/100	$1x10^{-2}$	1E-02	One in a hundred
1/1,000	$1x10^{-3}$	1E-03	One in a thousand
1/10,000	$1x10^{-4}$	1E-04	One in ten thousand
1/100,000	$1x10^{-5}$	1E-05	One in a hundred thousand
1/1,000,000	$1x10^{-6}$	1E-06	One in a million
1/10,000,000	$1x10^{-7}$	1E-07	One in ten million

What are the steps of a risk assessment?

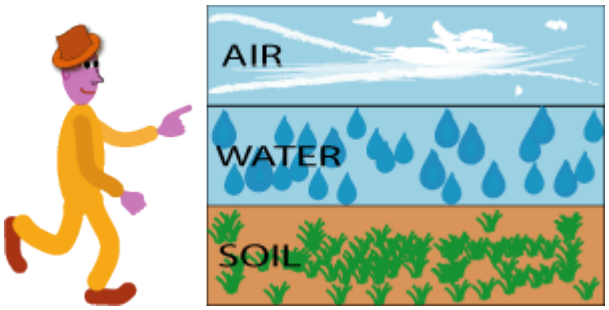
A risk assessment is typically performed in four steps:

1. **Data Compilation and Evaluation**
2. **Exposure Assessment**
3. **Toxicity Assessment**
4. **Risk Characterization**

Step 1: Data Compilation and Evaluation

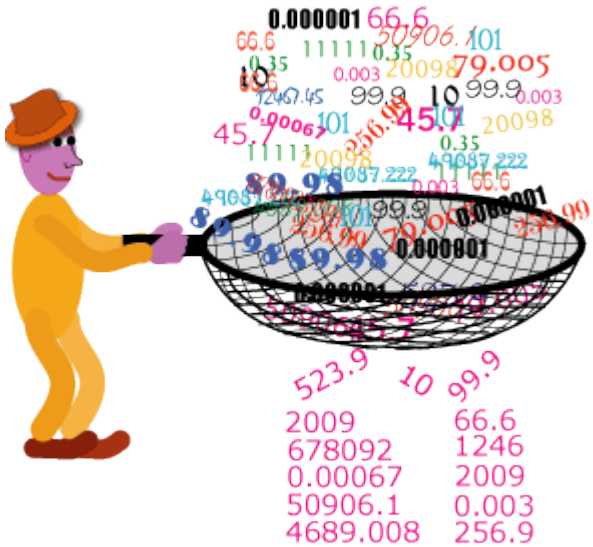
Objective: To verify that the data are appropriate for use and are considered to be representative of current conditions.

Compile all available data



Sort data by environmental medium

Evaluate data relative to established criteria

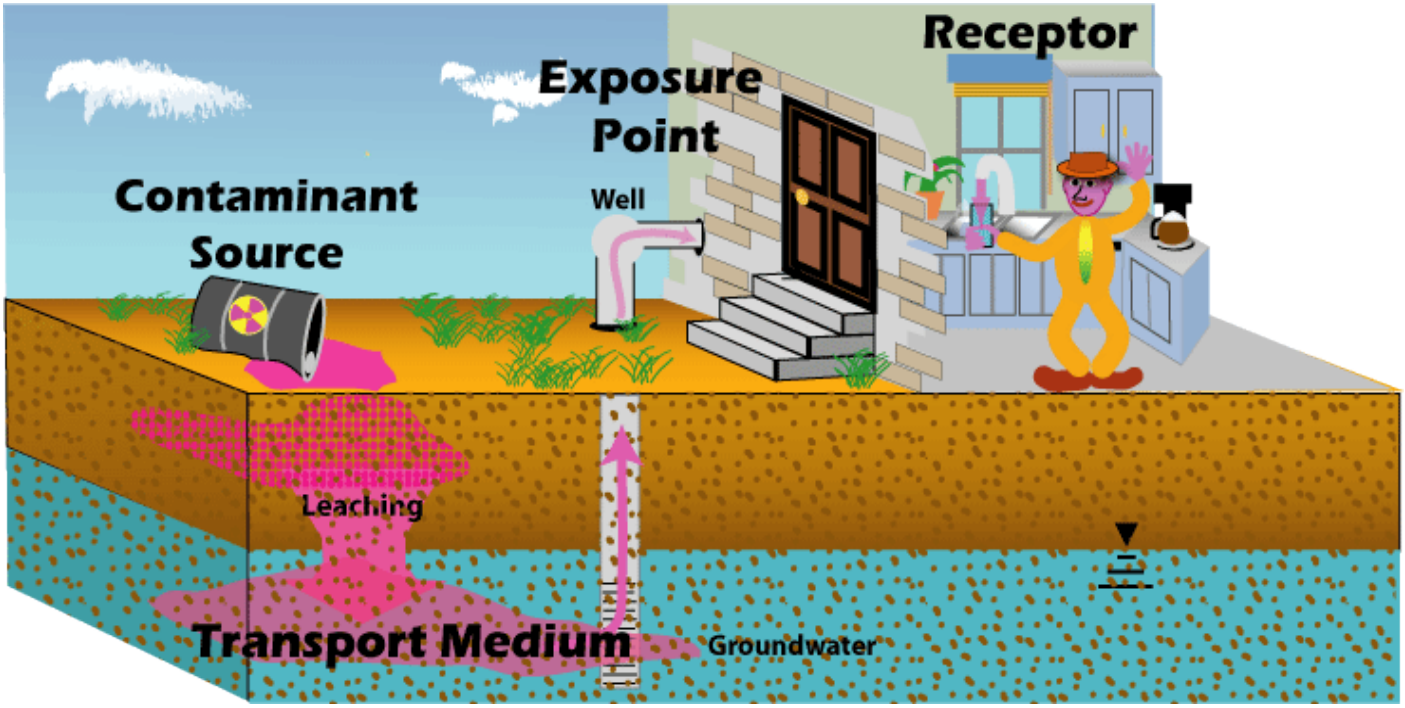


Step2: Exposure Assessment

Objective: To estimate the type and magnitude of exposures from the chemicals of potential concern that are present at or migrating from a site/facility.

- **Characterization of the Exposure Setting**
  - Characterizing the physical environment
  - Identifying potential landuse scenarios
- **Identification of Exposure Pathways**

Components of an Exposure Pathway



- **Quantification of Exposure**

Step 3: Toxicity Assessment

Hazard Identification

determines whether exposure to a chemical can increase the incidence of a particular adverse health effect and determines the likelihood of occurrence in humans.

Dose-response assessment

presents the relationship between the magnitude of exposure and adverse effects. For example, the length of time (magnitude of exposure) you stay in the sun without protection is directly related to the severity of sunburn (adverse health effect) you receive.

Step 4: Risk Characterization

The risk characterization step synthesizes all the information gathered in the three previous steps to estimate the likelihood that a hypothetical exposure may adversely impact human health.

- Review toxicity and exposure assessment output
- Quantify risks
- Combine risks across all pathways
- Assess & present uncertainties
- Consider site-specific human studies, if available
- Summarize & present baseline risk assessment characterization results