



Incremental Cancer Risk Level

Human Health Criteria Technical Workgroup Meeting #6

Alaska Department of Environmental Conservation
Division of Water
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How are HHC derived?

- The HHC formula determines the degree of risk to humans from exposure to certain pollutants
 - Risk = Toxicity * Exposure * Uncertainty
- Science provides us with basic information
- Policy tells us how to apply that information
- Risk Management is a matter of publicly weighing options and making a decision

4 Equations to Calculate Human Health Criteria

Input Variables (2015 recommended)

BW = Human Body Weight (adult = 80 kg = 176 lbs)

DI = Drinking Water Rate (2.4 liters/day)

CSF = Cancer Slope Factor (mg/Kg-day) AKA (RSD)

FCR = Fish Intake Rate (? grams/day)

BCF/BAF = Bioconcentration v. bioaccumulation factor (L/Kg, chemical specific)

RfD = Reference Dose, Non-Carcinogens (mg/Kg-day)

RL = Risk Level (10^{-5}) in Alaska

RSC = Relative Source Contribution

	Freshwater Criteria (Consumption of Organisms and Water)	Marine Criteria (Consumption of Organisms Only)
Criteria for Carcinogens	$\frac{RL \times BW}{CSF \times [(FCR \times BCF) + DI]}$	$\frac{RL \times BW}{CSF \times FCR \times BCF}$
Criteria for Non- Carcinogens	$\frac{RfD \times RSC \times BW}{(FCR \times BCF) + DI}$	$\frac{RfD \times RSC \times BW}{FCR \times BCF}$

Slide Images and Inspiration courtesy of Washington Ecology



HHC Formula for Carcinogens

Freshwater Criteria
(Consumption of Organisms
and Water)

Marine Criteria
(Consumption of
Organisms **Only**)

RL: Risk Level (10^{-5})

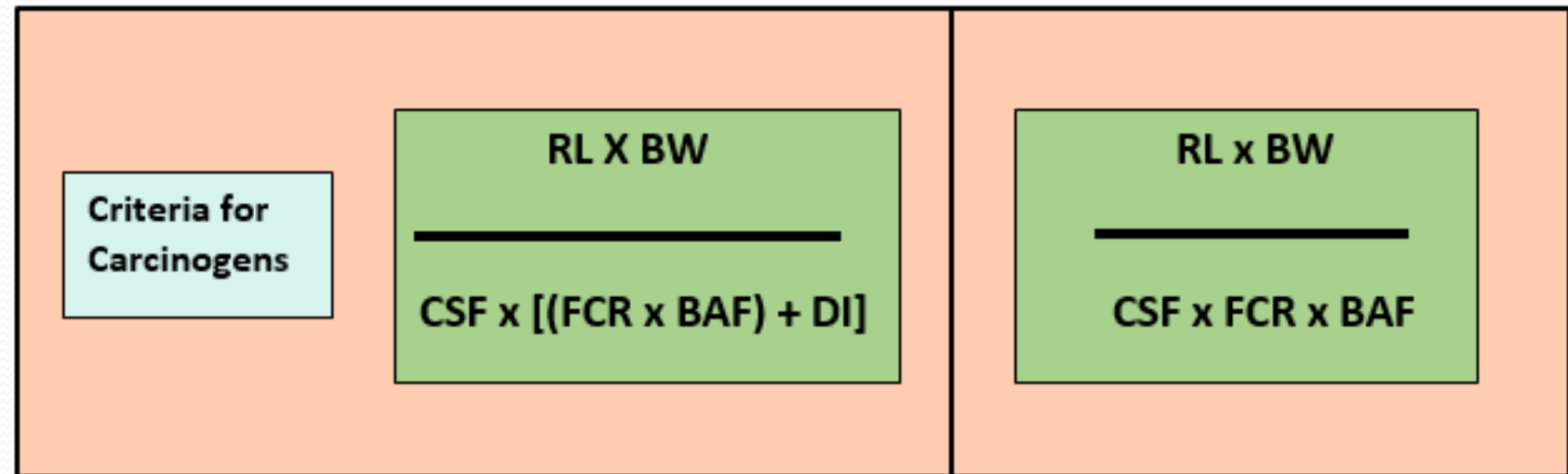
BW: Body Weight

CSF: Cancer Slope Factor

FCR: Fish Consumption Rate

BAF: Bioaccumulation

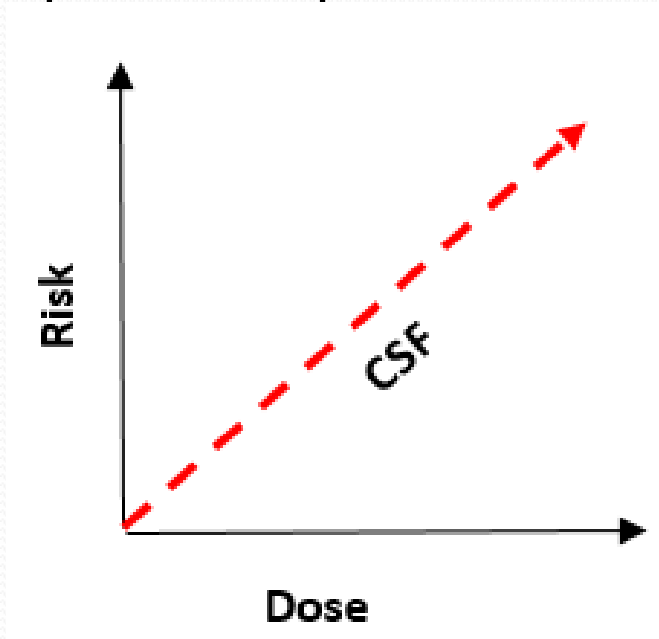
DI: Drinking Water Intake



$HHC = Toxicity * Exposure * Uncertainty$

- Cancer Slope Factor (toxicity)

- CSF is a toxicity value derived by EPA and published in the IRIS catalogue.
- Doesn't consider a toxicity threshold or point of departure



- Cancer Risk Factor (exposure)

- Risk Management Decision
- Used in different regulatory programs
 - Air quality regulations
 - Food Quality Protection
 - Drinking water
 - Contaminated sites

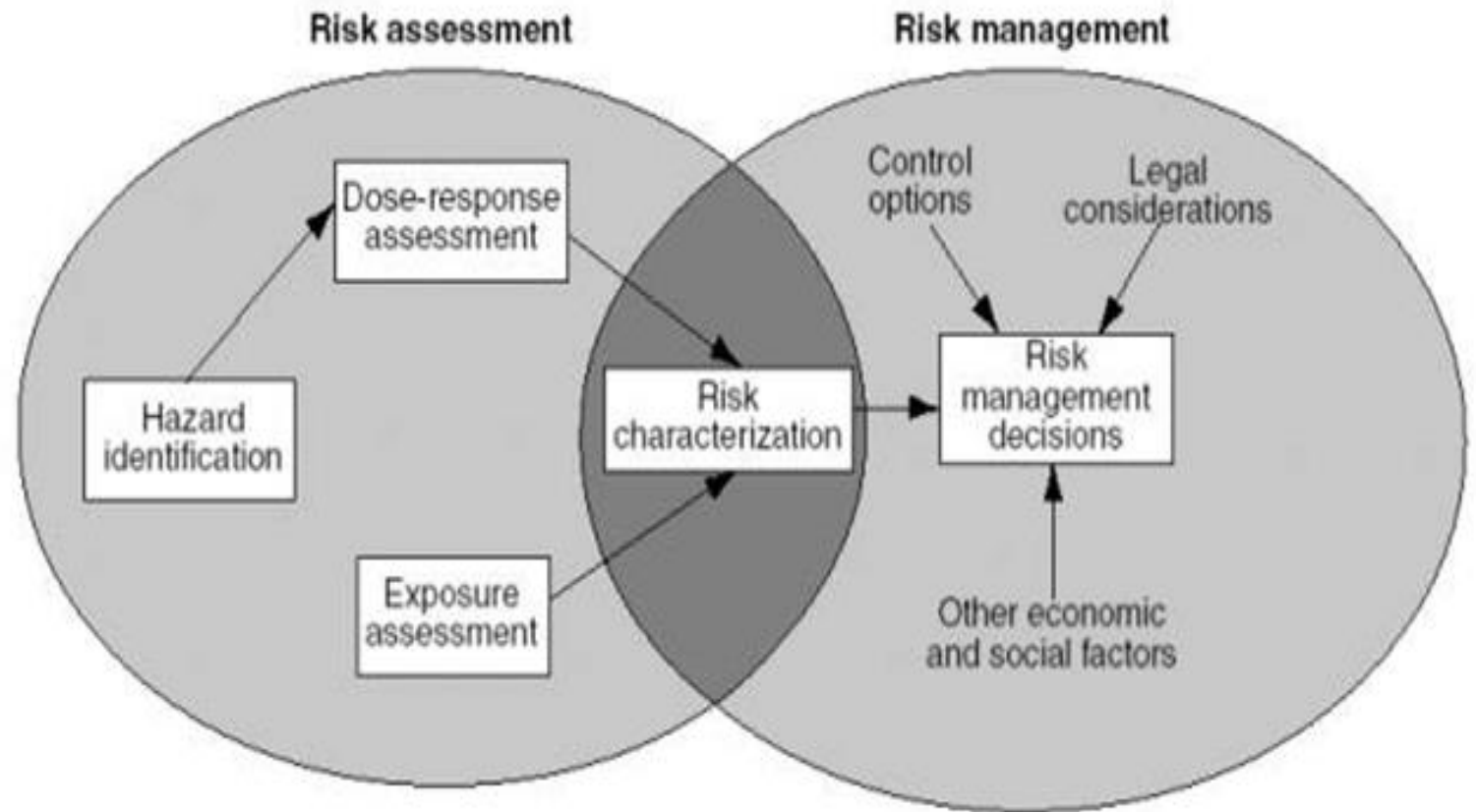
Risk Assessment & Risk Management

Cancer Slope Factor: Risk Assessment

- Considers existing studies
- Relationship to humans
- Includes uncertainty factors

Cancer Risk Level: Risk Management

- Considers range of influences and outcomes



Source: EPA Office of Research and Development.

Risk Management:

Incremental Cancer Risk Level for HHC

- Allowable cancer risk level range from
 - 1 in 100,000 (10^{-5}) or 1 in 1,000,000 (10^{-6})
 - And must not exceed 1 in 10,000 (10^{-4}) for those who eat more fish than others
- Additional (aka incremental) risk over a 70-year lifetime for the incidence of cancer
- *“EPA understands that fish consumption rates vary considerably, especially among subsistence populations, and it is such great variation among these population groups that may make either 10^{-6} or 10^{-5} protective of those groups at a 10^{-4} risk level.”*

EPA (2000) P. 2-6

Cancer Risk Factors

- Environmental risk factors are one of many

Risk Factor	Percentage of Total Cancer Deaths
Tobacco	30
Adult diet/obesity	25
Sedentary lifestyle	10
Occupational factors	5
Family history of cancer	5
Viruses/other biological events	5
Perinatal factors/growth	5
Reproductive factors	5
Alcohol	3
Socioeconomic status	*
Environmental pollution	2
Ionizing/ultraviolet radiation	2
Prescription drugs/medical procedures	2
Salt/other food additives/contaminants	1

* An important underlying factor operating through other specific causes



Incidence Rate of Cancer in Alaska

If HHC allow an additional cancer risk, what is the existing background risk from all sources?

- Annual cancer incidence rate
 - 455 per 100,000 people Nationally
 - 472 per 100,000 people in Alaska (DHSS, 1996-2012)
 - 496 per 100,000 Alaska Natives (ANTHC, 1994-2008)
- Annual cancer mortality rate is
 - 171 per 100,000 people Nationally
 - 185 per 100,000 people in Alaska
 - 241 per 100,000 Alaska Natives



Cancer Risk Management in HHC

Total cancer risk in Alaska

- 3,477 people contract cancer on average each year in AK
- 33,040 per 100,000 (or **33%**) of people in Alaska can be expected to develop some type of cancer during a 70 year period.
- Nationally, 40% of men and women will be diagnosed with cancer during a 70-year period

Additional cancer risk allowed in HHC for each pollutant

- Alaska's current incremental lifetime risk level is 1 per 100,000 (10^{-5}) or an **increase of 0.001 %**
- Assumes continuous 70-year exposure to a carcinogenic chemical in a concentration likely to produce an effect.
- Very few carcinogens are found in actual wastewater discharges in Alaska (oil & gas and municipal discharges)



Cancer Risk Management in HHC

Decreasing the risk level to 1 per 1,000,000 (10^{-6}) in HHC formula

- Would allow an increase of **0.0001% above the 33%** background level of cancer
- Provides no significant decline in the total cancer incidence rate
- Reduces human health criteria for carcinogens by **factor of 10**
- Makes permit limits difficult (or impossible) to measure with little or no treatment options for such low levels

Given the fact that environmental pollution is much less of risk factor when compared to smoking and other contributors, **is the change justified?**

Key Points to Take Away

- Setting human health criteria is complex
 - Lots of decisions
 - Mix of science (risk assessment) and policy (risk management)
 - Science should inform policy
 - Lots of uncertainty
- Of the two issues presented today (BCF/BAF and Cancer Risk Level) focusing our attention to the BCF/BAF issue may provide more protection
 - Note that BAFs apply in some carcinogens as well as some non-carcinogens

Key Points to Take Away

Risk assessment is driven by

- CSF (cancer toxicity)
- RfD (noncancer toxicity)
- BAF (multiplier for toxicity)

Risk assessment is done by EPA

Risk management is driven by

- Cancer risk level (how much risk is acceptable)
- RSC (modifies exposure)
- Fish Consumption Rate (environmental justice)

Risk management is done by state

“Less -protective” decision-bucket

Criteria inputs and risk management decisions that result in **lesser** levels of protection

“More protective” decision-bucket

Criteria inputs and risk management decisions that result in **greater** levels of protection

**“Reasonable”
level of
protection**

This teeter-totter represents the balancing point between “over-protection” and “under-protection.”

“Under-protection”

“Over-protection”



Questions?
Thank you for your time!

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