

CAO Toxicity Reference Values and Risk-based Concentration

Explanation of Authoritative Sources of Toxicity Reference Values Used in Cleaner Air Oregon

The goal of the Cleaner Air Oregon program being developed by the Oregon Department of Environmental Quality (DEQ) and the Oregon Health Authority (OHA) is to evaluate potential toxic air contaminant risks to people near industrial and commercial facilities, and reduce those risks below action levels adopted in law or rules. The agencies use toxicity reference values, or TRVs, to calculate these risks. A TRV is the concentration of a toxic air contaminant below which health effects are not expected to occur, even in sensitive people, based on the best available science. A TRV depends on the type of health effect and whether exposure is for a long or short period of time. TRVs used for toxic air contaminants only consider health risks related to breathing in the toxic air contaminant. A toxic air contaminant could have up to three different TRVs:

- **Chronic cancer TRV** is the air concentration of a toxic air contaminant that contributes no more than 1 in 1 million additional lifetime cancer risk when that air is breathed all the time over a lifetime.
- **Chronic noncancer TRV** is the level below which no noncancer health effects are expected over a year or more of constantly breathing that air.
- **Acute noncancer TRV** is the level below which no noncancer health effects are expected over 24 hours or less of breathing that air.

How Cleaner Air Oregon selects TRVs

A number of governmental scientific agencies have developed TRVs, and they use different names for their TRVs. They do not all have TRVs for every toxic air contaminant. Sometimes, multiple authoritative scientific agencies have slightly different TRVs for the same toxic air contaminant. This is because they have different schedules for reviewing the underlying science and updating their TRVs. They also have different policies about how to interpret toxicological data. CAO draft rules propose a ranking, or hierarchy, of scientific agencies to help determine the TRV Oregon will use in Cleaner Air Oregon. A different hierarchy is proposed for chronic and acute TRVs because many of the agencies that create chronic TRVs do not create acute TRVs. DEQ and OHA will select TRVs for each toxic air contaminant from the agencies that have established values, in the order of hierarchy shown in Tables 1 and 2.

Table 1. Hierarchy of authoritative scientific agencies for chronic toxicity reference values

Hierarchy position	Name of agency	Name of TRV	TRV Available
1	Oregon Department of Environmental Quality (DEQ)	Ambient Benchmark Concentration (ABC)*	cancer and noncancer
2	U.S. Environmental Protection Agency (EPA) Integrated Risk Information System (IRIS)	Inhalation Unit Risk (IUR)	cancer
		Reference Concentration (RfC)	noncancer
3	EPA Provisional Peer Reviewed Toxicity Values (PPRTV)	IUR	cancer
		RfC	noncancer
4	U.S. Agency for Toxic Substances and Disease Registry (ATSDR)	Chronic Minimal Risk Levels (MRLs)	noncancer
5	California EPA Office of Environmental Health Hazard Assessment (OEHHA)	IUR	cancer
		Chronic Reference Exposure Level (REL)	noncancer

*Note: DEQ Ambient Benchmark Concentrations are derived from a review of existing TRVs, and generally not by a separate peer review of scientific literature.

Table 2. Hierarchy of authoritative scientific agencies for acute noncancer toxicity reference values

Hierarchy position	Name of agency	Name of TRV
1	Oregon Department of Environmental Quality (DEQ)	Short-term Guideline Concentrations
2	U.S. Agency for Toxic Substances and Disease Registry (ATSDR)	Acute Minimal Risk Levels (MRLs)
3	California EPA Office of Environmental Health Hazard Assessment (OEHHA)	Acute Reference Exposure Level (REL)
4	U.S. Agency for Toxic Substances and Disease Registry (ATSDR)	Intermediate* MRLs

**Intermediate refers to the length of time a person is assumed to breathe a contaminant in air at the level of the minimal risk level or MRL. Intermediate means longer than 2 weeks but less than 1 year. Intermediate MRLs are last in the hierarchy because their longer times make them a less ideal fit for a 24-hour TRV.*

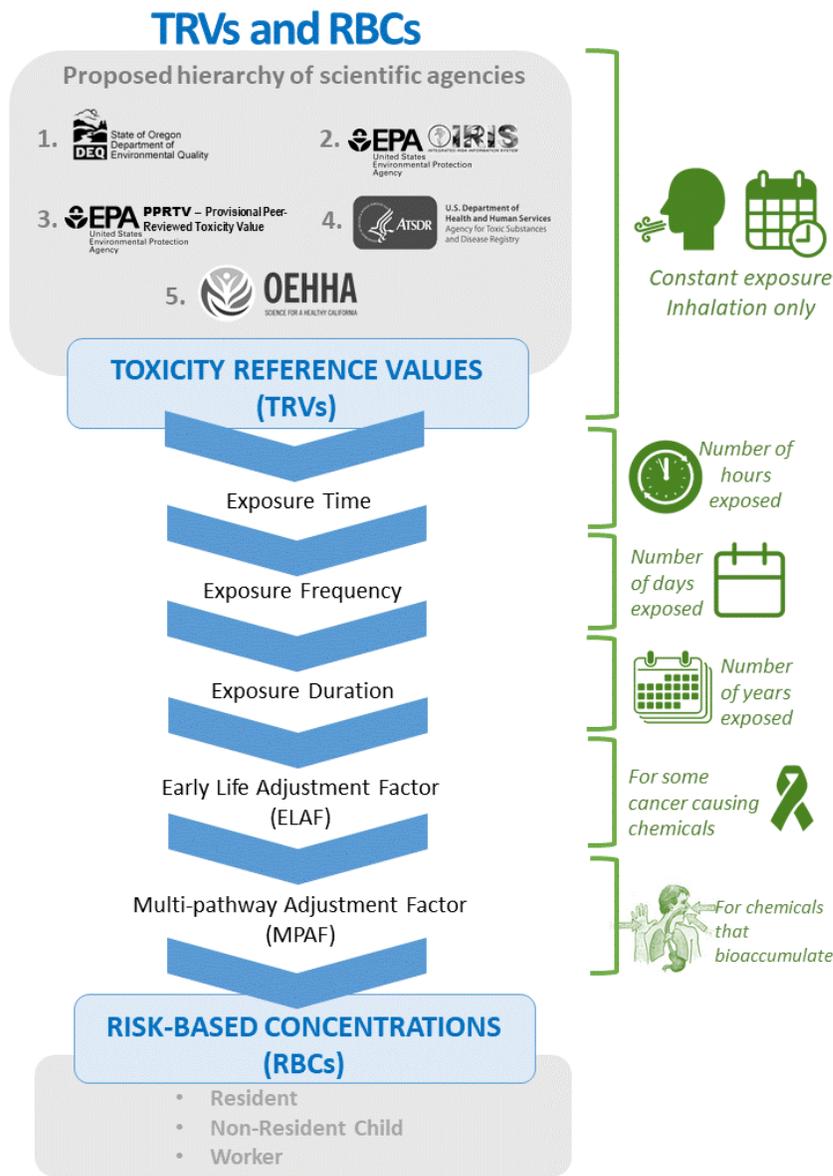
The order of both hierarchies places DEQ first. Through an existing technical advisory committee to DEQ, the Air Toxics Science Advisory Committee (ATSAC), DEQ has established a set of Ambient Benchmark Concentrations. These are the values that DEQ would consider first. It is important to note that the ATSAC only considers values from the other authoritative sources shown in Tables 1 and 2. Through extensive evaluation, the ATSAC may find that a TRV developed by an agency lower in the hierarchy is more appropriate than one developed by an agency higher in the hierarchy. In this case, DEQ will use the results of the ATSAC review and select that value. DEQ does not intend to develop its own TRVs for the reasons described below.

Rationale for using TRVs from authoritative agencies

- The agencies included in the hierarchy tables go through extensive peer-reviewed processes** to establish health-based TRVs using the best available science and research. They convene panels of scientists with expertise in the chemicals being evaluated. For each chemical, these expert panels spend years reviewing hundreds of scientific studies to evaluate the weight of scientific evidence. The evaluations are then shared for public comment. This public process is lengthy and resource intensive and reflects substantial investments of federal tax dollars.
- Establishing new TRVs is beyond the capacity of agencies in Oregon.** In order to establish new TRVs, Oregon would have to undergo a rigorous and resource intensive process, similar to the one mentioned above. That kind of work is far beyond the current capacity of state agencies and would result in state tax dollars being spent to do work that is already being done at the federal level. The results of a state level review would likely confirm the conclusions of other authoritative sources.
- Other states confidently rely on agency TRVs** as the basis for health-based industrial toxic air contaminant programs. Programs in New Jersey, Washington, Rhode Island, Massachusetts, New Hampshire, New York, Georgia, Minnesota, Michigan, and North Carolina all rely primarily on TRVs from federal agencies (EPA and ATSDR). The hierarchy of authoritative scientific agencies proposed in the draft CAO rules for chronic TRVs is the same one used by US EPA's Superfund clean-up program and Oregon DEQ's existing risk-based clean-up program.

DEQ and OHA used TRVs from the authoritative sources in the tables above to calculate risk-based concentrations, or RBCs, as a tool for evaluating health risks from individual facility toxic air contaminant emissions. Graphic 1 shows how selection of TRVs result in identified risk-based concentration levels.

Graphic 1. Process to identify Risk-Based Concentrations



How Cleaner Air Oregon’s Proposed Risk-Based Concentrations Are Developed from Toxicity Reference Values

The goal of the Cleaner Air Oregon program being developed by the Oregon Department of Environmental Quality and the Oregon Health Authority is to evaluate potential risks from toxic air contaminants to people near industrial and commercial facilities, and reduce those risks below action levels adopted in law or rules. A risk-based concentration (RBC) is a tool Cleaner Air Oregon uses to make it easier to calculate risk of a toxic air contaminant, and determine whether the risk is above a level requiring a facility to take some action.

Risk is a combination of how harmful a contaminant is (toxicity), and how and for how long a person might come into contact with the contaminant (exposure):

Toxicity. To evaluate toxicity, the agencies use a toxicity reference value, or TRV. A TRV is the concentration of a toxic air contaminant below which health effects are not expected to occur, even in sensitive people, based on the best available science. The two types of toxic health effects are cancer and noncancer. Noncancer effects can be chronic, based on long-term exposure (generally a year or more), or acute, based on short-term exposure (generally a day or less). Chronic noncancer and cancer TRVs are developed assuming a person is constantly breathing the toxic air contaminant over a lifetime. Acute TRVs are generally developed assuming 24-hour exposure.

TRVs are developed by authoritative scientific agencies, such as the Environmental Protection Agency (EPA), based on a comprehensive review of available science. DEQ already relies on TRVs from these authoritative bodies, in consultation with the agency's Air Toxics Science Advisory Committee, to establish Oregon TRVs called Ambient Benchmark Concentrations (ABCs). For more information on TRVs, see the separate TRV factsheet.

Exposure. To complete a risk evaluation, the agencies consider not only how toxic an air contaminant is (using the TRV), but also how much contact, or exposure, someone has with the contaminant. These exposure assumptions are applied as adjustment factors, and are used to convert TRVs to RBCs. DEQ and OHA will then assess health risks using the RBC.

Approach used to calculate Cleaner Air Oregon RBCs

DEQ and OHA developed RBCs in the proposed Cleaner Air Oregon rules for each toxic air contaminant using TRVs as baseline values, or starting points. The agencies then used standard adjustment factors appropriate for calculating risks as shown in Graphic 1. Separate RBCs were calculated for cancer risk, chronic noncancer risk, and acute noncancer risk.

Adjustment Factors

DEQ and OHA used the following adjustment factors to calculate cancer and chronic noncancer RBCs. Adjustment factors are not appropriate or necessary for acute RBCs, which are concerned with health effects that may occur from short periods of exposure (generally less than one day).

- **Exposure time, frequency and duration.** Exposure time is the number of hours per day exposed. Exposure frequency is the number of days per year exposed and exposure duration is the number of years exposed. The amount of risk often depends on how often and for how long a person is exposed to a toxic air contaminant. For example, a worker exposed to a toxic air contaminant for 8 hours/day for 25 years has less exposure, and therefore less risk than a resident exposed for 24 hours/day for 70 years.
- **Early-life exposure.** An early-life adjustment factor (ELAF) is used for some cancer-causing (carcinogenic) contaminants. These carcinogens may have greater toxicity to infants or children than is reflected in the related TRV.
- **Multi-pathway exposure.** A multi-pathway adjustment factor (MPAF) for exposure considers other ways people could be exposed to a contaminant. Some toxic air contaminants can be deposited on soil where someone may be exposed to the contaminants by routes other than inhalation. MPAFs are only used for contaminants that can build up in the body (bioaccumulate) and contaminants that can stay a long time in the environment.

Using RBCs in Cleaner Air Oregon

The approach DEQ and OHA are using to calculate RBCs is consistent with other state and federal programs, and with DEQ's existing Cleanup Program. The agencies will use RBCs to calculate risks for an individual facility. Calculated risks for a facility would then be compared with Risk Action Levels (RALs), the levels at which facilities must take action. Table 1 of the Cleaner Air Oregon rules provides RALs for new and existing facilities.