

Oregon Health Authority Response to the October 14, 2025 Technical Memorandum from Oregon Business and Industry and ToxStrategies Technical Memo

Table of Contents

Introduction	3
Summary of Recommendations	3
Overarching Themes	9
Scientific uncertainty	9
Authoritative sources	9
Categories of ToxStrategies' recommendations related to specific TRVs	11
Category 1: Withdraw or change a TRV number	11
Category 2: Change the name of the TAC or applicability	11
Category 3: Other changes	11
Note of explanation of key terms	11
Silica, amorphous and other non-crystalline forms (respirable); DEQ ID 1058T.	12
<i>Chronic Noncancer TRV</i>	12
Chromium, trivalent and compounds (soluble); DEQ ID 1034T & Chromium, trivalent and compounds (insoluble particulate); 7440-48-4	18
<i>Acute Noncancer TRVs</i>	18
<i>Chronic Noncancer TRV</i>	21
<i>All Chromium, Trivalent and Compounds TRV Categories</i>	22
Cobalt and compounds (insoluble particulate); 7440-48-4 & Cobalt and compounds (soluble); DEQ ID 1011T	23
<i>All TRV Categories</i>	23

Fluoride and inorganic compounds; DEQ ID 239	27
<i>Acute Noncancer TRV</i>	27
<i>General Note</i>	28
Hydrogen chloride {hydrochloric acid}; 7647-01-0	30
<i>Acute Noncancer TRV</i>	30
<i>Chronic Noncancer TRV</i>	31
Lead and compounds; 7439-92-1	33
<i>Acute Noncancer TRV</i>	33
Naphthalene; 91-20-3	35
<i>Acute Noncancer TRV</i>	35
Nickel and compounds; 7440-02-0 & Nickel oxide; 1313-99-1	36
<i>Acute Noncancer TRVs</i>	36
Per- and Polyfluoroalkyl Substances (PFAS).....	38
<i>Acute and Chronic TRVs</i>	42
Vanadium and compounds; 7440-62-2.....	45
<i>Acute and Chronic Noncancer TRV</i>	45
<i>Cancer TRV</i>	45
Implications of OHA’s hydrogen chloride acute TRV recommendation for other acute TRVs.....	46
<i>Boron Trichloride; 10294-34-5</i>	46
<i>Other Sensory Irritants (see Table 4)</i>	46
Authors	49
References	50

Introduction

The Oregon Health Authority (OHA) is supporting a rulemaking by the Oregon Department of Environmental Quality (DEQ) to review and update the rules focused on exposure to toxic air contaminants (TACs) in the state of Oregon, and specifically to update toxicity reference values (TRVs) used to regulate TAC emissions from permitted facilities in Oregon under the Cleaner Air Oregon program.

DEQ received a letter from Oregon Business & Industry (OBI) on October 14, 2025 titled “[Scientific Issues with DEQ’s CAO TRV Rulemaking](#).” The letter includes a list of 17 TRVs proposed by DEQ and OHA for 10 TACs for which ToxStrategies (a toxicology consulting firm hired by OBI) has identified toxicological concerns. ToxStrategies’ toxicological concerns and requested changes to the agencies’ TRV adoption are detailed in a [108-page technical memorandum](#) (dated September 30, 2025) and was attached to the OBI letter sent to DEQ. Hereafter, we refer to this technical memo as the “ToxStrategies technical memo.”

In this memo, OHA toxicologists:

- Present a table showing ToxStrategies’ requested changes and OHA’s response side-by-side.
- Summarize and respond to the ToxStrategies technical memo’s overarching themes.
- Group the requested changes into categories; and
- Respond to recommendations for each individual TRV.

Many OHA responses refer to the [TRV Support Document](#) OHA prepared to assist the TRV rulemaking advisory committee (RAC) which addresses many issues raised by ToxStrategies.

Summary of Recommendations

Table 1 includes an overview of ToxStrategies’ TRV recommendations and OHA’s recommendations in response to the ToxStrategies memo compared to DEQ’s proposed TRVs as of [RAC Meeting #1](#) on 1-12-2026.

In many cases ToxStrategies provided multiple tiers or options for revising the proposed TRV; these options are summarized in the column titled “ToxStrategies’ recommendations.” For example, their recommended first choice “option 1,” would be

to have no TRV for a given TAC. Then they would offer an “option 2” or second tier recommendation if OHA recommends retaining the TRV for that TAC, often related to which forms of a TAC that TRV would be related. The first two entries in the table, amorphous silica and trivalent chromium, are good examples, where ToxStrategies’ first tier recommendation was to have no TRV, and secondarily they requested that the TRV, if retained, only be applied to certain forms of amorphous silica or trivalent chromium.

Table 1. Summary of OHA's recommendations to TRVs as of April 1, 2026

TAC	DEQ ID or CAS RN	TRV category	DEQ's proposed TRV as of 1-12-26 ($\mu\text{g}/\text{m}^3$)	ToxStrategies' recommendations (TRVs in $\mu\text{g}/\text{m}^3$)	OHA's recommended response as of 4-1-26 (TRVs in $\mu\text{g}/\text{m}^3$)
Silica, amorphous and other non-crystalline forms (respirable)	1058T	Chronic noncancer	6.6	Option 1: No TRV Option 2: TRV should only apply to fume silica	6.6 Did not change applicability
Chromium, trivalent and compounds (soluble)	1034T	Acute noncancer	0.14	Option 1: No TRV Option 2: TRV should not apply to chromium in alloy or metalloid forms	1.2 Agreed on TRV applicability
Chromium, trivalent and compounds (insoluble particulate)	16065-83-1	Acute noncancer	7	Option 1: No TRV Option 2: TRV should not apply to chromium in alloy or metalloid forms	No TRV
Chromium, trivalent and compounds (insoluble particulate)	16065-83-1	Chronic noncancer	1.4	Option 1: No TRV Option 2: TRV should not apply to chromium in alloy or metalloid forms	1.4 Agreed on TRV applicability

TAC	DEQ ID or CAS RN	TRV category	DEQ's proposed TRV as of 1-12-26 ($\mu\text{g}/\text{m}^3$)	ToxStrategies' recommendations (TRVs in $\mu\text{g}/\text{m}^3$)	OHA's recommended response as of 4-1-26 (TRVs in $\mu\text{g}/\text{m}^3$)
Cobalt and compounds (insoluble particulate)	7440-48-4	Acute noncancer	0.3	Option 1: No TRV Option 2: TRV should not apply to cobalt in alloy or metalloid forms	0.3 Agreed on TRV applicability
Cobalt and compounds (insoluble particulate)	7440-48-4	Chronic noncancer	0.1	Option 1: No TRV Option 2: TRV should not apply to cobalt in alloy or metalloid forms	0.1 Agreed on TRV applicability
Cobalt and compounds (insoluble particulate)	7440-48-4	Cancer	0.00013	Option 1: No TRV Option 2: TRV should not apply to cobalt in alloy or metalloid forms	0.00013 Agreed on TRV applicability
Fluoride and inorganic compounds	239	Acute noncancer	16	Option 1: Revise TAC name to be "hydrogen fluoride" Option 2: No TRV Option 3: Add note to rule	16 Revised TAC name

TAC	DEQ ID or CAS RN	TRV category	DEQ's proposed TRV as of 1-12-26 (µg/m³)	ToxStrategies' recommendations (TRVs in µg/m³)	OHA's recommended response as of 4-1-26 (TRVs in µg/m³)
Hydrogen chloride {hydrochloric acid}	7647-01-0	Acute noncancer	88	2100	2100
Hydrogen chloride {hydrochloric acid}	7647-01-0	Chronic noncancer	9	30	9
Boron trichloride*	10294-34-5	Acute noncancer	94	NA	2200
Phenol*	108-95-2	Acute noncancer	670	NA	2000
Lead and compounds	7439-92-1	Acute noncancer	0.15	3.9	0.15
Naphthalene	91-20-3	Acute noncancer	0.3	1.6	0.3
Nickel and compounds & Nickel oxide	7440-02-0 & 1313-99-1	Acute	0.1	11	0.1
PFAS (See Table 3 in PFAS Section)					

TAC	DEQ ID or CAS RN	TRV category	DEQ's proposed TRV as of 1-12-26 ($\mu\text{g}/\text{m}^3$)	ToxStrategies' recommendations (TRVs in $\mu\text{g}/\text{m}^3$)	OHA's recommended response as of 4-1-26 (TRVs in $\mu\text{g}/\text{m}^3$)
Vanadium and compounds	7440-62-2	Acute	0.8	Option 1: No TRV Option 2: TRV should only apply to vanadium pentoxide	0.8 Revised TAC name
Vanadium and compounds	7440-62-2	Chronic	0.1	Option 1: No TRV Option 2: TRV should only apply to vanadium pentoxide	0.1 Revised TAC name
Vanadium and compounds	7440-62-2	Cancer	0.00012	Option 1: No TRV Option 2: TRV should only apply to vanadium pentoxide	0.00012 Revised TAC name

*These changes were not proposed by ToxStrategies.

Overarching Themes

There were overarching themes in ToxStrategies' recommendations to DEQ and OHA. This section describes each theme and OHA's approach to considering ToxStrategies' recommendations for that theme.

Scientific uncertainty

There is uncertainty inherent in all scientific findings and, therefore, in all TRVs developed by all agencies generally considered to be authoritative. People and organizations will vary on how to set policy in the face of this scientific uncertainty. It is a challenge for any organization to find the right balance of health-protectiveness and practicality in addressing scientific uncertainty. For example, DEQ's definition of acute exposure is 24 hours. There are very few scientific studies in which test subjects or experimental animals are exposed for exactly 24 hours in one session. This means that DEQ and OHA must extrapolate toxicological information from studies with experimental exposures shorter or longer than 24 hours to the target 24-hour window acute TRVs are intended to protect. Agencies like the ones considered authoritative in DEQ's rules (Oregon Administrative Rules [OAR] [340-247-0300](#)) as well as DEQ and OHA develop internal guidance and policies to strive for consistency in how to make these extrapolations and address other scientific uncertainties, but they vary slightly. OHA documented its internal guidance and policies in the [TRV Support Document](#), especially Chapter 2, Chapter 5, and Appendix M.

There were several cases where ToxStrategies claimed that there was too much scientific uncertainty in the calculation of a proposed TRV or the inputs to those calculations. OHA agreed in some cases and disagreed in others, leading to some revisions to proposed TRVs.

Authoritative sources

DEQ rules ([OAR 340-247-0030](#)) establish four agencies as authoritative in terms of their reliability in generating credible TRVs. These are:

- The Agency for Toxic Substances and Disease Registry (ATSDR),
- The U.S. Environmental Protection Agency (EPA),

- The California Environmental Protection Agency (CalEPA), and
- DEQ, in consultation the Air Toxics Science Advisory Committee (ATSAC).

DEQ rules do not distinguish between these sources in terms of credibility, preferability, or authority to set TRVs.

In a few instances, ToxStrategies recommended not adopting a TRV from one authoritative source because another of the authoritative sources had declined to develop a TRV based on the same scientific information. As described above, authoritative sources vary in their degree of tolerance for scientific uncertainty, methods, their purposes, and their process for developing TRVs. Therefore, the fact that one authoritative source did not develop a TRV for a given TAC does not invalidate a TRV developed by another authoritative source for that TAC.

In some cases, ToxStrategies encouraged DEQ and OHA to strictly adhere to authoritative sources in rule. In other cases, ToxStrategies encouraged DEQ and OHA to adopt a TRV from a non-authoritative source, even though authoritative sources listed in rule already had a TRV for that TAC. This is an internal inconsistency within the ToxStrategies technical memo.

OHA recommends adhering to the framework approved by ATSAC in 2025 as described in Chapter 2 of the [TRV Support Document](#) (page 28):

“ATSAC encouraged OHA and DEQ to check alternate sources of candidate TRVs for a TAC [only] if:

- None of the other authoritative sources (EPA, ATSDR, or CalEPA) had a candidate TRV,
- The TAC was on DEQ’s Toxic Air Contaminant Priority List, and
- The alternate source:
 - had publicly available, transparent, and well documented calculation information for their candidate TRVs, and
 - applied similar calculation processes, methods, and policies as EPA, ATSDR, and CalEPA”

Categories of ToxStrategies' recommendations related to specific TRVs

This subsection summarizes the categories of ToxStrategies' recommendations related to specific TRVs and OHA's responses.

Category 1: Withdraw or change a TRV number

ToxStrategies recommended numerical changes (either revision or withdrawal) of 17 TRVs or groups of TRVs. OHA agreed in two cases and partially agreed in one case, in which OHA responded by revising rather than withdrawing a TRV.

Category 2: Change the name of the TAC or applicability

ToxStrategies recommended five changes to TAC names or changes to which forms of a given TAC the TRV is applied to. OHA agreed in four of five cases.

Category 3: Other changes

In reviewing some TRVs more closely while responding to ToxStrategies, OHA recognized the need to make some changes to TRVs not requested or recommended by ToxStrategies. This is the category with the largest number of OHA-recommended changes to TRVs, and the largest subset of TRVs in this category is PFAS (See PFAS section below). The other subset consists of only two TRV changes related to hydrogen chloride (see hydrogen chloride section below).

Note of explanation of key terms

OHA uses the term "TRV" broadly to include all similarly derived toxicity values, but in the ToxStrategies comments and OHA responses below, there are many references to other names for these values used by other agencies. Here is a list of specific names for TRVs used by other authoritative sources (more details in Chapter 2 of the TRV Support Document):

- MRL – Minimal risk level – this is the federal ATSDR name for their TRVs
- REL – Reference exposure level – this is the CalEPA name for their TRVs
- RfC – Reference concentration – this is the EPA name for their TRVs
- For the purposes of this document, any of these names are interchangeable with "TRV."

Response to ToxStrategies' recommendations by toxic air contaminant

Within this section, each subsection is specific to a particular TAC. Unless quotation marks are used, the ToxStrategies recommendations are paraphrased.

Throughout this document, OHA used consistent language to identify ToxStrategies recommendations compared to OHA's response. OHA summarized ToxStrategies' recommendations into categories titled "ToxStrategies recommendation 1", "ToxStrategies recommendation 2", and so forth for each TRV. OHA's responses to ToxStrategies' recommendations are titled as "OHA response to recommendation 1". Recommendations and OHA responses are organized by TAC and TRV category (e.g., chronic noncancer TRV).

Silica, amorphous and other non-crystalline forms (respirable); DEQ ID 1058T

Chronic Noncancer TRV

ToxStrategies recommendation 1: The Texas Commission on Environmental Quality (TCEQ) is not an authoritative source and ATSDR, an authoritative source, said there are not enough data to support a chronic noncancer TRV for amorphous silica; therefore, DEQ should not have a chronic noncancer TRV for amorphous silica.

Note: The ToxStrategies technical memo made a few references to an acute TRV for amorphous silica. As OHA is not recommending any TRV for acute exposure to amorphous silica, OHA assumed that ToxStrategies intended to reference the chronic TRV rather than an acute TRV in those instances.

OHA response to recommendation 1: While TCEQ itself is not an authoritative source under Oregon Administrative Rule (OAR), "DEQ in consultation with the Air Toxics Science Advisory Committee (ATSAC)" is an authoritative source in DEQ rule ([OAR 340-247-0030](#)). This means that DEQ, in consultation with ATSAC, can propose candidate TRVs from sources other than the EPA, ATSDR, or California EPA (CalEPA) under DEQ's own authority.

DEQ and OHA proposed TCEQ's noncancer chronic TRV for amorphous silica compounds during the ATSAC meetings in early 2025 and requested ATSAC feedback. None of the members of ATSAC raised concerns about the chronic TRV

proposed for amorphous silica compounds either during the meeting or in written responses submitted after the series of meetings. See response to Recommendation 2 below for more details on ATSAC discussion related to silica.

More broadly, ATSAC encouraged OHA and DEQ to look at alternate sources of candidate TRVs in certain circumstances (see Chapter 2 of the [TRV Support Document](#) for details). One of the reasons to look to alternate sources is when ATSDR, EPA, and CalEPA did not have a TRV. There are two reasons ATSDR, EPA, or CalEPA would not have a TRV for a given TAC:

1. The agency has not evaluated the scientific data for that TAC; or
2. The agency has evaluated the scientific data for that TAC and decided it was not appropriate to publish a TRV.

In the case of ATSDR and amorphous silica, it falls under the second reason listed above; ATSDR evaluated scientific studies on amorphous silica and concluded there was not enough evidence available for ATSDR to publish a final TRV.(1) When all agencies evaluate the scientific information on a TAC, they decide whether to put forward a final TRV by balancing factors such as their agency's need for a TRV and the amount and quality of available data. Different agencies of similar scientific expertise and skill may come to different conclusions about TRVs based on the same critical scientific studies. Therefore, it is not unusual for one of DEQ's authoritative sources to publish a final TRV while another authoritative source does not when evaluating the same scientific data.

For example, two of DEQ's authoritative sources (2–4) published chronic noncancer TRVs for chloroethane using the same 1986 critical study by Scortichini et al.(5) while ATSDR elected not to publish a chronic noncancer TRV, even though ATSDR evaluated the same Scortichini study in its review in 2025.(6)

As another example, DEQ's authoritative sources (ATSDR in 2012 and CalEPA in 2008) decided not to derive an acute TRV for manganese after a comprehensive review of all available toxicity information. Both ATSDR's (7) and CalEPA's reviews of manganese included the 2005 study by Dorman et. al.,(8) which TCEQ used as the critical study underlying its acute TRV for manganese in 2017.(9) ToxStrategies encouraged OHA and DEQ to adopt the TCEQ acute manganese TRV with some

modifications in their November 1, 2022 technical memo in support of a petition to DEQ (see [Appendix N of the TRV Support Document](#)).

In the case of amorphous silica, both ATSDR(1) and TCEQ(10) cite studies in which the health of multiple animal species in toxicology studies, including monkeys (close relatives of humans), was harmed following exposure to amorphous silica. The studies are limited in that they do not examine the potential health effects of all potential forms of amorphous silica. This creates scientific uncertainty about the degree to which different forms of amorphous silica may harm health and in what quantities. In other words, the scientific uncertainty is not about whether amorphous silica can harm health, but rather about the degree to which one form of amorphous silica is representative of other forms in terms of magnitude of toxicity.

Although not specifically about silica, ATSAC did discuss the concept of recommending TRVs with higher uncertainty when there is limited toxicology information. In the context of EPA's Provisional Peer Reviewed Toxicity Value (PPRTV) Program, ATSAC members discussed their support of recommending TRVs developed by the PPRTV program that have more uncertainty and are called "screening PPRTVs" (see Chapter 4 of the [TRV Support Document](#) for more background information on this topic). All ATSAC members supported OHA's proposal to use screening PPRTVs (see Question 6-2 in [Appendix H](#)). For example, OHA asked ATSAC members "Is the science behind PPRTV screening values sufficiently robust to use for DEQ's air quality programs, including regulatory applications, when no other toxicity information is available?" and one ATSAC member answered:

"Yes. Although they are 'screening' values, the process for development of these values is the same as for more data-intensive, higher-tier values and undergo external peer review. The development of these values utilizes well-documented methodologies and the assessment documents supporting these values are transparently presented for their intended application. **In my opinion, not having a value as a guide is considerably more uncertain in evaluating potential risk**" ([Appendix H](#)) [emphasis added].

Just as screening PPRTVs provide valuable TRV information when other TRVs are not available, OHA and DEQ followed ATSAC's recommendation to look at TRVs from alternate sources, including TCEQ, when there was no candidate TRV available for a

given TAC from EPA, ATSDR, or CalEPA. All alternate sources of TRVs (including TCEQ) had to meet the following criteria:

1. Provide publicly available, transparent, and well documented calculation information for their candidate TRVs, and
2. Apply similar calculation processes, methods, and policies as EPA, ATSDR, and CalEPA.

These criteria were developed from ATSAC feedback. See Chapter 2 of the [TRV Support Document](#) for more information on when OHA looked at alternate sources.

In summary, OHA acknowledges there is uncertainty in the amorphous silica scientific database, as is the case with many TACs with TRVs. OHA's and ATSAC's preferred approach to the scientific uncertainty in the case of amorphous silica is to recommend adoption of a TRV developed by an ATSAC-supported alternate TRV source (TCEQ) and is supported by scientific data for amorphous silica. It is important to have a TRV for amorphous silica because both ATSDR and TCEQ describe animal studies in which amorphous silica harmed health. OHA agrees with ATSAC that it is better to protect health from known hazards with a TRV, even though there is uncertainty about the degree to which one form of amorphous silica is representative of others in terms of quantitative toxicity. Finally, in the case of amorphous silica, emissions around the state indicate the need for a TRV to evaluate risk to health.

ToxStrategies recommendation 2: If DEQ continues to propose the chronic TRV for amorphous silica, the TRV should only apply to the form of amorphous silica used in the study underlying the TRV and not to other forms of amorphous silica.

OHA response to recommendation 2: OHA asked ATSAC members about silica specifically at ATSAC meeting #7 on 2-19-2025: "Do you agree that these are the right compounds within each group?"

ATSAC members responded:

- "Support the approach taken for crystalline and non-crystalline forms..."
- "Good with the approach as outlined,"
- "Agree with the two groupings."

See page 26 of 31 in [Appendix E of the TRV Support Document](#) for more details on ATSAC responses.

The critical scientific study(11) underlying TCEQ's chronic TRV for amorphous silica,(10) which OHA recommends for proposal, used 3 forms of amorphous silica: fume silica, precipitated silica, and silica gel. Related to this critical study,(11) ToxStrategies stated:

“The authors reported a lowest-observed-adverse-effect level (LOAEL) of 15 mg/m³ for pulmonary effects (i.e., respiratory impairment and histopathological changes) from fume silica (a form of amorphous silica). **These effects were not observed for silica gel nor precipitated silica.**” [emphasis added]

This is not correct. TCEQ's, ATSDR's and OHA's reviews of the study found that all three forms of amorphous silica used in the critical study led to decreased pulmonary function, as measured by decreased lung volumes and ventilatory mechanics.(1,10,11) The study also identified abnormal histopathological findings such as “large numbers of macrophage and mononuclear cell aggregates” associated with exposure to all three forms of amorphous silica tested in the lungs of monkeys, with the largest number and sizes of aggregates in the lungs of monkeys exposed to *precipitated* silica.(11) The same histopathological examination revealed that the cellular aggregates in the “respiratory bronchioles were significantly reducing the sizes of the bronchiolar lumens.”(11) The “bronchiolar lumen” is the tube through which inhaled air moves into the lungs. OHA agrees with the study authors(11) and TCEQ(10) that fume silica appeared to cause more severe effects than the other two forms under the conditions of this experiment, but all three forms caused observable adverse effects at the same dose.(11) ATSDR noted that the lowest observed adverse effect levels (LOAEL) for precipitated, fume silica, and gel amorphous silica were identified in this 1981 Groth et al. study(11) that TCEQ and OHA propose to use as the critical study for the recommended TRV for amorphous silica.(1) ATSDR also noted that there was not a no observed adverse effect level (NOAEL) for any of the three forms in the study.(1)

The particle size of the fume silica used in the study was the smallest of the three amorphous silica types.(11) Smaller particle sizes are more likely to reach the deeper parts of the lung to cause health effects. Therefore, it is possible that the greater severity of fume silica in this study was influenced by particle size as well as the specific form of amorphous silica.

TCEQ discussed the Groth et al. critical study(11) and applicability to multiple forms of amorphous silica in their technical support document:

“Since no subchronic or chronic studies of non-SAS [non-synthetic amorphous silica] amorphous silica were available, the developed chronic ReV and ESL [TCEQ’s TRV terms] for SAS are used for all forms of amorphous and non-crystalline silica as a policy decision. The TD [Toxicology Division], however, may develop separate chronic toxicity factors for non-SAS forms of amorphous silica if available studies become available. The TD chose the Groth et al. (1981) chronic study that evaluated different forms of SAS as the key study [critical study] because the study examined multiple pulmonary effects on multiple species with sufficient numbers of animals in each experiment group **for multiple forms of amorphous silica** exposures.”(10) [emphasis added]

Like TCEQ, OHA is open to developing TRVs for specific forms of amorphous silica if the necessary scientific data become available in the future. In the meantime, OHA recommends following TCEQ’s approach(10) of applying TCEQ’s chronic TRV to all the forms of amorphous silica listed in section 3.5.2 of the [TRV Support Document](#) in the interest of protecting public health.

ToxStrategies recommendation 3: ToxStrategies states that “the [DEQ] proposed TRV (6.6 $\mu\text{g}/\text{m}^3$) is well within the levels that may be considered background in ambient air.”

OHA response to recommendation 3: TRVs are calculated using toxicity information (i.e., what amount of exposure leads to health effects), and they are not based on environmental factors such as how much of the contaminant is normally in the ambient air. DEQ does not consider background ambient levels when evaluating air concentrations resulting from facility emissions but would consider ambient levels in air monitoring studies.

Chromium, trivalent and compounds (soluble); DEQ ID 1034T & Chromium, trivalent and compounds (insoluble particulate); 7440-48-4

Note: The DEQ proposed TRVs listed in Table 1 of the ToxStrategies Chromium (III) memo are incorrect (soluble and insoluble numbers are switched). The correct TRV proposals are listed above in Table 1 of this OHA Response document.

Acute Noncancer TRVs

ToxStrategies recommendation 1: DEQ should withdraw the proposed acute TRV for “chromium, trivalent and compounds (soluble);” hereafter, referred to as “soluble chromium III”.

1. ATSDR did not develop an acute TRV for soluble chromium III using the data in the critical study (Derelanko et al. 1999)(12). ATSDR used it to support the intermediate MRL derivation and cited inadequate data for an acute TRV. OHA based their proposed acute TRV on the intermediate MRL.
2. The 5-day exposure in Derelanko et al. did not show same results reported after 13 weeks of exposure.(12)

OHA response to recommendation 1: Regarding situations where one authoritative source declined to develop a TRV candidate while another did develop one, please see response to Recommendation 1 for amorphous silica and discussion on authoritative sources in the “Overarching Themes” section.

The Derelanko et al. study included an evaluation of bronchoalveolar lavage fluid (BALF) following 5 days of exposure to soluble chromium III.(12) Five days is an exposure length that ATSDR, on of DEQ’s authoritative sources, typically uses to generate their acute MRLs, which is OHA’s preferred source for acute TRVs. The results of the 5-day exposure component of the study were indicative of tissue damage and inflammation, such as "statistically reduced total nucleated cell counts" and "increased amounts of cell debris and lysed cells..." along with other changes that were noted but did not reach statistical significance.(12) OHA derived an acute TRV using the 5-day exposure.

First, OHA adjusted the LOAEL (3 mg chromium(III)/m³) identified by ATSDR(13) to account for intermittent exposure (6/24 hours of exposure per day for 5 days):

$$3 \text{ mg chromium(III)/m}^3 \times 6 \text{ hours/24 hours} = 0.75 \text{ mg chromium(III)/m}^3$$

Next, OHA applied a thoracic regional deposited dose ratio (RDDR) representative of the alveolar regions of the lungs (represented by BALF) to convert the exposure time-adjusted LOAEL of 0.75 mg chromium(III)/m³ to a human equivalent concentration. ATSDR listed the thoracic RDDR for male rats to be 0.47.(13) Therefore:

$$0.75 \text{ mg chromium(III)/m}^3 \times 0.47 = 0.3525 \text{ mg chromium(III)/m}^3$$

OHA chose the RDDR for male rats rather than females because it was the lower of the two and resulted in the lowest time-adjusted human equivalent concentration. ATSDR applied the same rationale in deriving their intermediate MRL.

OHA then applied the same total uncertainty factor as ATSDR applied to their intermediate MRL of 300 (3 for animal to human extrapolation with dosimetric adjustment, 10 for human variability, and 10 for LOAEL to NOAEL extrapolation) to the time-adjusted human equivalent LOAEL (0.3525 mg chromium(III)/m³) and rounded to two significant figures as a final step:

$$\begin{aligned} \text{Time-adjusted human equivalent LOAEL} / 300 &= 0.3525 \text{ mg chromium(III)/m}^3 / \\ 300 &= 0.001175 \text{ mg chromium(III)/m}^3 = 1.175 \text{ } \mu\text{g chromium(III)/m}^3 \approx 1.2 \text{ } \mu\text{g} \\ &\text{chromium(III)/m}^3 \end{aligned}$$

In summary, OHA agreed with ToxStrategies that it was inappropriate to use the 13-week exposure in the Derelanko study to develop an acute TRV, particularly when a 5-day exposure was available from the same study. However, OHA did not agree with the suggestion to withdraw the value. Rather OHA recommends using a revised value based on the 5-day exposure portion of the study.

Therefore, OHA recommends that DEQ propose an acute TRV for soluble chromium III of 1.2 µg/m³.

Supporting Evidence from Another Authoritative Source

While ATSDR, one of DEQ's authoritative sources, did not develop a candidate acute TRV for soluble chromium III, another of DEQ's authoritative sources, CalEPA (in 2022), developed an acute TRV 1-hour reference exposure level (REL) candidate of

0.48 $\mu\text{g}/\text{m}^3$.(14) This acute REL is within an order of magnitude of OHA's recommended TRVs (now 1.2 $\mu\text{g}/\text{m}^3$, earlier 0.14 $\mu\text{g}/\text{m}^3$). If OHA were to withdraw the recommended acute TRV adapted from ATSDR's intermediate MRL, OHA would select the CalEPA 1-hour REL with an adjustment for exposure time. In its derivation, CalEPA applied an exposure time adjustment of 0.5 using "Haber's Law" to make the 30-minute exposure period in the critical study(15) fit their 1-hour REL exposure time [i.e., dividing the point of departure (POD) a no observable adverse effect level (NOAEL) of 0.55 mg/m^3 by 2]. A member of ATSAC explicitly stated that this 1-hour REL developed by CalEPA would need to be adjusted for exposure time to fit DEQ's 24-hour acute TRV application on page 12 [Appendix E](#) to the TRV Support Document.

To adapt this 30-minute experimental exposure time to fit DEQ's 24-hour TRV definition, OHA would need to apply a factor of 0.5 hours/24 hours, resulting in an OHA-recommended acute TRV of 0.02 $\mu\text{g}/\text{m}^3$.

OHA's general approach to adjusting ATSDR intermediate MRLs to acute TRVs

Chapter 2 of the [TRV Support Document](#) explains, under the "Step 5" section, OHA's approach to selection of acute TRVs from authoritative sources, including ATSDR intermediate MRLs. Section 5.2.3 of Chapter 5 of the [TRV Support Document](#) also describes ATSAC's support for OHA's general approach to adjusting ATSDR intermediate MRLs and other subchronic candidate TRVs to acute TRVs.

ToxStrategies recommendation 2: DEQ should withdraw the proposed acute TRV for "chromium, trivalent and compounds (insoluble);" hereafter, referred to as "insoluble chromium III". ToxStrategies' justifications for this recommendation were substantively the same as those used for soluble chromium III (see Recommendation 1).

OHA response to recommendation 2: In the case of insoluble chromium III, OHA agrees with ToxStrategies. CalEPA did not develop a candidate acute TRV for insoluble chromium III, and the results of the 5-day BALF component of the Derelanko et al. study showed no statistically significant changes in BALF parameters.(12) OHA had originally adapted ATSDR's intermediate MRL for insoluble chromium III based on the general TRV selection process outlined in Step 5 of Chapter 2 of the [TRV Support Document](#). The TRV selection process was intended to lean upon the expertise of authoritative sources and, when there are mismatches in

exposure time in scientific studies with Oregon TRV policy, provide selection criteria for the agency toxicologists. Upon further technical review in the case of insoluble chromium III prompted by ToxStrategies' memo, **OHA recommends that DEQ withdraw the acute TRV for insoluble chromium III**, because the 5-day portion of the critical study underlying ATSDR's intermediate MRL for insoluble chromium III did not show any statistically significant effects.

Chronic Noncancer TRV

ToxStrategies recommendation 3: DEQ should withdraw the proposed chronic TRV for "chromium, trivalent and compounds (insoluble);" hereafter, referred to as "insoluble chromium III" because two of DEQ's authoritative sources (CalEPA and ATSDR) chose to not develop a chronic REL for insoluble chromium III from the Derelanko et al. study.(12)

OHA response to recommendation 3: While ATSDR did not develop a chronic MRL for insoluble chromium III from Derelanko et al. 1999,(12) ATSDR did develop an intermediate MRL for this TAC from this study.(13) This means that at least one of DEQ's authoritative sources in rule found that insoluble chromium III poses a health hazard for exposures lasting more than two weeks but less than 1 year. In the interest of protecting public health, OHA cannot ignore a potential hazard from intermediate-duration exposure. It is not reasonable to assert that a chronic exposure hazard for a TAC is unlikely when an authoritative source recognizes a hazard from shorter term exposure.

The Derelanko et al. study on which ATSDR's intermediate MRL for insoluble chromium III is based is a 13-week rodent study.(12) Thirteen weeks in a rodent study is on the boundary between what EPA and CalEPA guidance consider a chronic study, though EPA states that a 13-week rodent study counts as subchronic (shorter than chronic).(16,17) In such a case, OHA policy (taken from CalEPA) is to apply an uncertainty factor of 3 to a 13-week rodent study to adjust to a chronic TRV (see Section 2.4 of [Appendix M](#) of TRV Support Document). This is the policy OHA used to adapt ATSDR's intermediate MRL (based on the Derelanko et al. 13-week rodent study) to a chronic TRV for insoluble chromium III.

OHA recommends that DEQ continue to propose 1.4 µg/m³ as the chronic TRV for insoluble chromium III.

All Chromium, Trivalent and Compounds TRV Categories

ToxStrategies recommendation 4: DEQ should exclude metallic chromium III alloys from "chromium, trivalent and compounds" because CalEPA exempts them, stating that CalEPA's RELs for chromium III are not applicable to chromium alloys (e.g., alloyed with iron, copper, or cobalt) and other chemicals comprised of chromium III and other heavy metal (e.g., chromium-nickel eutectics) or metalloid because they often exhibit different toxicities when compared to other inorganic compounds containing chromium III as the sole metal."

OHA response to recommendation 4: DEQ agrees that "chromium, trivalent and compounds" should not include alloys. This is consistent with CalEPA's stated applicability.

Cobalt and compounds (insoluble particulate); 7440-48-4 & Cobalt and compounds (soluble); DEQ ID 1011T

Note: The DEQ proposed cancer TRVs listed in Table 1 of the ToxStrategies cobalt memo are incorrect (soluble and insoluble numbers are switched). The correct TRV proposals are listed above in Table 1 of this OHA Response document.

All TRV Categories

ToxStrategies recommendation 1: ToxStrategies recommends that DEQ define cobalt solubility as being soluble in lung biological fluids (inhalation bioaccessibility) rather than water.

OHA response to recommendation 1: OHA agrees that solubility should be defined. OHA also agrees that being soluble in water is not the same as being soluble in lung biological fluid. OHA recommends that DEQ and OHA define solubility the same as the authoritative source from which a TRV comes.

In the case of cobalt, the cancer TRVs are adopted from CalEPA's Office of Environmental Health Hazard Assessment (OEHHA),(18) an authoritative source in DEQ rules, and CalEPA uses water solubility as the definition. ToxStrategies made nearly identical comments on CalEPA's cancer TRVs. Here is [CalEPA's response to this line of comments from ToxStrategies](#):

"...Categorization based on water solubility works well because insoluble cobalt metal and compounds appear to be largely internalized by cells as particles... Keeping the classification information simple, based on water solubility (less or greater than 100 mg/L), is adequate for determining which cobalt IUR to use."

OHA recommends agreement with CalEPA's response to ToxStrategies. In response to ToxStrategies recommendations, OHA recommends clarifying that "solubility" in this context refers to solubility in water. OHA recommends adding "water" to the names of relevant TACs in rule, workbooks, and TRV Support Document. OHA will also define solubility in the [TRV Support Document](#).

ToxStrategies recommendation 2: Withdraw cancer TRV for insoluble cobalt

1. The soluble and insoluble cobalt cancer TRVs are very similar

2. The forms of cobalt used in studies that CalEPA referenced to develop the soluble and insoluble cobalt TRVs (cobalt sulfate and cobalt metal) were both soluble in biological lung fluids, while only cobalt sulfate is soluble in water

OHA response to recommendation 2: OHA adopted the cancer TRVs for soluble and insoluble cobalt directly from CalEPA,(18) one of DEQ's authoritative sources. The groupings of cobalt compounds by solubility in water came directly from CalEPA along with the TRVs. When a TRV candidate is available from one of DEQ's authoritative sources in rule, OHA recommends adopting them with as few modifications as possible. Regarding definitions of solubility and similarity between IURs for soluble and insoluble cobalt, see "response to recommendation 1" above.

ToxStrategies recommendation 3: Withdraw acute TRV for insoluble cobalt

The form of cobalt used in the critical study that ATSDR used to develop their acute MRL for "cobalt and compounds" was a freely soluble cobalt form (cobalt sulfate heptahydrate), and so ATSDR's acute MRL should not be applied to insoluble cobalt compounds.

OHA response to recommendation 3: OHA recommends using ATSDR's acute MRL for "cobalt and compounds" as the acute TRV for both water soluble and water insoluble cobalt compounds. ATSDR's label for their acute MRL is for "cobalt and compounds" - not "cobalt sulfate" or "cobalt and soluble compounds." The MRL value is adjusted by molecular weight to the cobalt ion - not cobalt sulfate or any other salt or compounded form of cobalt.(19)

In the worksheet where ATSDR documented the derivation of their acute MRL for cobalt and compounds, they included toxicological studies that used both water soluble forms like cobalt sulfate heptahydrate as well as water insoluble forms like cobalt metal in the same summary table of candidate PODs [Table A-1].(19) In the narrative text they made direct comparisons between PODs from studies using cobalt sulfate and cobalt metal:

*"Based on these findings, the study by Viegas et al. (2022a, 2022b), [(20)] which identified an early key event for respiratory toxicity following exposure to a cobalt compound belonging to the "high acute toxicity" group (**cobalt sulfate heptahydrate**), appears to be an appropriate, health-protective study on which to base the acute-duration inhalation MRL. While the administered NOAEL is higher*

*than the LOAEL identified by Kusaka et al. (1986a)[(21)] [exposure was to cobalt metal dust], the NOAEL_{HEC} of 0.03 mg Co/m³ is below the human LOAEL (see Human Equivalent Concentration section for calculations below)." **Bold** and **□** added.(19)*

ATSDR's direct comparison of candidate PODs from studies using different forms of cobalt implies that ATSDR did not intend for cobalt metal and cobalt sulfate heptahydrate to be considered differently for developing an acute MRL.

ToxStrategies recommendation 4: Withdraw chronic noncancer TRV for insoluble cobalt

The proposed chronic TRV for insoluble cobalt comes from ATSDR's chronic MRL for cobalt and compounds. ATSDR's chronic MRL is based on a study in which people were exposed to cobalt metal dust, which is soluble in biological lung fluids.

OHA response to recommendation 4: Regarding the differentiation between water solubility and solubility in biological lung fluids, see OHA's response to ToxStrategies' recommendation 1. **Cobalt metal powder is soluble in lung fluid. However, it is insoluble in water, which is how OHA and CalEPA define it.** OHA recommends continuing to use ATSDR's chronic MRL for cobalt and compounds for both water soluble and water insoluble forms of cobalt.

ToxStrategies recommendation 5: Allow in vitro testing of solubility in simulated lysosomal fluid

DEQ response to recommendation 5: Currently, DEQ does not support the use of in vitro tests for inhalation relative bioavailability (RBA) values. The use of in vitro relative bioaccessibility (IVBA) study results to develop RBA values has been used for a small number of inorganics for oral exposure. EPA has guidance for developing oral RBAs for arsenic and lead. However, the sampling and analysis procedures for inhalation IVBA are more complicated and EPA does not have standard guidance.

A review paper on inhalation RBA highlighted the following general concerns:

- Methods for assessing metal(loid) inhalation bioaccessibility lack consistency.
- Simulated lung fluids (SLF) vary considerably.
- Particle sizes utilized are often not relevant for human inhalation exposure.
- Comparative studies illustrating the extraction efficiency of SLF are lacking.
- In vitro assays require in vivo correlation to determine predictive performance.(22)

Their conclusion was: “As a consequence, the lack of in-vivo - in-vitro correlation for multiple elements of concern in varying matrices is a knowledge gap for the application of inhalation bioaccessibility data for refining exposure assessment.”(22)

ToxStrategies recommendation 6: Exempt cobalt metal alloy from the regulation because cobalt in alloys is not soluble in simulated lung lysosomal fluids and does not release cobalt ions in vivo upon exposure.

OHA response to recommendation 6: CalEPA states that “The cobalt IURs do not apply to steel and metal alloys that contain cobalt. In addition, the alloy-like hard metals, particularly cobalt-tungsten carbide hard metal, are not included”. However, CalEPA adds that “Although cobalt-tungsten carbide dust is a probable human carcinogen,(23) the physicochemical properties of hard metals are different from that of cobalt compounds, which warrant their own IURs.”(18) Because IURs are not available for cobalt-tungsten, potential risks from exposure to cobalt-tungsten emissions may be underestimated.

OHA recommends applying CalEPA's policy to cobalt metal alloys and this would cover both noncancer and cancer endpoints. OHA agrees that solubility in biological lung fluids is a likely prerequisite to cobalt toxicity, so cobalt metal alloys should be exempt from both soluble and insoluble cobalt compound groups in terms of TRV application.

Fluoride and inorganic compounds; DEQ ID 239

Acute Noncancer TRV

ToxStrategies recommendation 1: ToxStrategies recommends that it is not appropriate to apply the acute TRV from ATSDR for hydrogen fluoride ($16 \mu\text{g}/\text{m}^3$) to a broad category referencing all inorganic fluorides. ToxStrategies suggests that DEQ address this recommendation by either:

1. Renaming the TAC name to be "hydrogen fluoride" instead of "fluorides and inorganic compounds" for this acute TRV,
2. Withdrawing the proposed acute TRV for acute noncancer effects for "fluorides and inorganic compounds, OR
3. If one of the first two options is not taken, then add a note to any final rule where this acute TRV appears to clarify the limited applicability of this acute TRV to hydrogen fluoride.

OHA response to recommendation 1: OHA already intended for the acute TRV for "fluoride and inorganic compounds" to only be applied to hydrogen fluoride, modified hydrogen fluoride, and selenium hexafluoride (measured as the fluoride ion), and not all "fluoride and inorganic compounds." OHA's note follows the approach from CalEPA, one of DEQ's authoritative sources.(24) As ToxStrategies points out, OHA already included a note on the acute TRV applicability to [Workbook 2: TRV Derivation](#).

OHA recommends following ToxStrategies suggestions. OHA agrees with ToxStrategies that OHA's intent to apply the acute TRV to only hydrogen fluoride, modified hydrogen fluoride, and selenium hexafluoride should be clearer, and not just located in a note in Workbook 2. Specifically, OHA recommends:

- Adding a row to the TRV proposal table with the TAC name of "hydrogen fluoride." For historical context, a "hydrogen fluoride" row was in the original 2018 TRV rule table but was combined with "fluoride and inorganic compounds" in the proposals for the rulemaking. The "hydrogen fluoride" row will include the acute TRV from ATSDR ($16 \mu\text{g}/\text{m}^3$) and will also include the same chronic TRV as "fluoride and inorganic compounds."
- Retaining the TAC category "fluoride and inorganic compounds" on a separate row in the TRV table because the chronic TRV applies to this wider range of

fluoride-containing compounds (applies to the fluoride ion). The “fluoride and inorganic compounds” row will **not include an acute TRV**; this approach matches ToxStrategies’ recommendation.

- Including a note on the acute TRV applicability in the rule-related workbooks.
- Updating Section 3.4.2 of the [TRV Support Document](#) to reflect these fluoride grouping updates.

General Note

ToxStrategies included the following footnote (#2 on page 3 of the fluoride memorandum):

“ODEQ also published an acute TRV for fluorine but used the hydrogen fluoride MRL (0.016 mg/m³) rather than the specified acute MRL for fluorine (0.01 ppm or 0.008 mg/m³).”

OHA did **not** use the hydrogen fluoride MRL as the acute TRV proposal for fluorine gas (CAS RN 7782-41-4) as ToxStrategies states. The acute TRV proposal for “fluorine gas” and the acute TRV proposal for “fluoride and inorganic compounds” are both 16 µg/m³. Both proposed TRVs come from different ATSDR MRLs and have different ppm to mg/m³ conversion factors (see Table 2) due to differences in molecular weights between fluorine gas and hydrogen fluoride.(25) Using the conversion factor in Table 2, OHA does not agree with ToxStrategies’ statement that the ATSDR acute MRL for fluorine gas is 0.008 mg/m³; rather, OHA calculates an ATSDR MRL of 0.016 mg/m³ (16 µg/m³) for fluorine gas.

Table 2. ATSDR MRLs and unit conversion factors

TAC	DEQ ID or CAS RN	TRV Category	ATSDR MRL in ppm	ppm to mg/m ³ conversion factor	ATSDR MRL in mg/m ³ (rounded)	ATSDR MRL in µg/m ³
Fluorine gas	7782- 41-4	Acute Noncancer TRV	0.01 ppm	1 ppm = 1.55 mg/m ³ (NIOSH reference)	0.016 mg/m ³	16 µg/m ³
Hydrogen fluoride	7664- 39-3	Acute Noncancer TRV	0.02 ppm	1 ppm = 0.82 mg/m ³ (NIOSH reference)	0.016 mg/m ³	16 µg/m ³

Hydrogen chloride {hydrochloric acid}; 7647-01-0

Acute Noncancer TRV

ToxStrategies recommendation 1: ToxStrategies recommends that DEQ maintain the acute hydrogen chloride (HCl) TRV of 2,100 µg/m³ in current rule (which was directly adopted from CalEPA's OEHHA) rather than change the TRV to 88 µg/m³ as DEQ has proposed in this rulemaking. DEQ should not apply "Haber's Law" to adjust OEHHA's acute HCl TRV for exposure time because HCl is a sensory irritant, so the effect of HCl is concentration dependent rather than time dependent.

OHA response to recommendation 1: OHA agrees with ToxStrategies that HCl is a sensory irritant and the irritation from HCl exposure in this concentration range appears to be solely concentration dependent rather than time dependent. OEHHA describes sensory irritation in their 2008 noncancer guidance document:

“Response to mild sensory irritants is detected through binding to the trigeminal nerve receptors. In humans, this results in a complex response including a burning sensation of the eyes, nose, and throat. Other notable symptoms are coughing, nasal congestion, rhinorrhea, sinus and Eustachian tube dysfunction, and worsening of lower airway function in some asthmatics”(16)

The OEHHA HCl acute REL was developed in 1999 and is based on a human sensory irritation endpoint (upper respiratory symptoms of sore throat and nasal discharge).(26) The critical study did not find exposure-related increases in severity of upper respiratory or other symptoms reported by study participants.(27) The National Institute for Occupational Safety and Health (NIOSH) finalized their immediately dangerous to life or health (IDLH) value profile on HCl in 2025, which also provides evidence that HCl is a sensory irritant. The NIOSH IDLH states that HCl is a respiratory and eye irritant gas that has corrosive properties at higher concentrations.(28)

OHA originally included a “Haber’s Law” time adjustment to HCl in the TRV proposal because OEHHA applied it in their 1999 derivation when going from 45 minutes in the critical study to their 1-hour REL.(26) OHA wrote in the [TRV Support Document](#),

“Generally, OHA followed the lead of the authoritative sources from which the original reference value came. If they applied “Haber’s Law”, then so did OHA. If the original source did not, then neither did OHA.”

However, OEHHA's adjustment in their 1999 acute REL was over a very narrow time frame (45 minutes to 1 hour) compared to the time adjustment DEQ/OHA is proposing to do (1 hour to 24 hours). Upon closer look, OHA thinks that OEHHA would not apply "Haber's Law" to go from a 1-hour REL to a 24-hour TRV (DEQ’s acute TRV definition) today.

OHA agrees with OEHHA’s 2008 guidance and ToxStrategies that in cases where the critical effect is mucosal membrane irritation triggered by the activation of the trigeminal nerve in the absence of other health effects or evidence of cumulative damage over time, “Haber’s Law” should not be applied to adjust exposure time. This concept and more information about “Haber’s Law” is described in Section 5.2.1 of the [TRV Support Document](#) and is consistent with OEHHA 2008 guidance.(16)

Acrolein is an example of another TAC where the critical effect is sensory irritation, and OEHHA did not apply “Haber’s Law.” In the case of acrolein, OHA is proposing to use OEHHA’s REL as DEQ’s TRV. OEHHA developed the acrolein REL in 2008 and followed their 2008 guidance. OEHHA did not apply “Haber’s Law” because the critical effect was solely sensory irritation.(29)

OHA recommends the removal of the “Haber’s Law” exposure time adjustment from the TRV proposal for acute HCl, which results in a TRV of 2,100 $\mu\text{g}/\text{m}^3$. This TRV is consistent with OEHHA’s acute REL for HCl (1999) and DEQ’s current acute TRV for HCl.

Note that this OHA recommendation has implications for other TACs that are either chemically related or that have similar mechanisms of toxicity. See the section “Implications of OHA’s hydrogen chloride acute TRV recommendation for other acute TRVs” on page 46 for more details.

Chronic Noncancer TRV

ToxStrategies recommendation 2: ToxStrategies recommends that DEQ change its chronic HCl TRV proposal from 9 $\mu\text{g}/\text{m}^3$ (CalEPA’s OEHHA value) to 30 $\mu\text{g}/\text{m}^3$ to address issues with uncertainty factors and animal to human adjustment factors.

ToxStrategies states that the OEHHA chronic REL was developed using methods for interspecies dosimetric adjustments that have been updated in more recent guidance by the EPA in 2012. ToxStrategies' proposal of 30 µg/m³ uses the same critical study, point of departure, and uncertainty factors that OEHHA used but incorporates EPA's more recent guidance on interspecies dosimetric adjustments for chemicals with an extra-thoracic critical effect.

OHA response to recommendation 2: 9 µg/m³ is the current chronic REL developed by CalEPA's OEHHA for HCl, which was developed in 2000 by OEHHA.(4) DEQ and OHA are proposing to adopt this value without any modification as DEQ's TRV. OEHHA's chronic REL was more recently developed and published than the other available TRV candidate from the EPA. EPA's value of 20 µg/m³ was developed in 1995.(31)

CalEPA is an authoritative source listed in DEQ rule, which encompasses toxicity values developed by OEHHA. Though the methods OEHHA used to adjust the dose from animals to humans have since been updated by EPA, OEHHA continues to use the 9 µg/m³ chronic TRV as their official chronic REL. OHA's policy is to only modify TRVs from CalEPA, ATSDR, and EPA for exposure time adjustment reasons. Otherwise, OHA relies on unmodified TRVs from these authoritative sources. As described in Chapter 2 of the [TRV Support Document](#), DEQ and OHA rely on CalEPA, EPA, and ATSDR for TRVs because of those authoritative sources' scientific rigor and capacity to develop TRVs. The overall process these agencies use is lengthy and requires a substantial investment in resources.

Although not specific to HCl, ATSAC discussed modifying the chronic TRV for 1-methylnaphthalene from EPA's PPRTV program. In the case of 1-methylnaphthalene, OHA agreed with the ATSAC member who expressed their preference of following the authoritative sources' TRV calculation decisions (Chapter 6 of the [TRV Support Document](#)).

When one of DEQ's authoritative sources updates their chronic value for HCl, OHA will consider it for the next round of TRV updates. **OHA recommends continuing to propose CalEPA's chronic REL of 9 µg/m³ as the chronic TRV for HCl.**

Lead and compounds; 7439-92-1

Acute Noncancer TRV

ToxStrategies recommendation 1: ToxStrategies recommends that DEQ, in consultation with ATSAC, propose $3.9 \mu\text{g}/\text{m}^3$ as the acute TRV for lead, which ToxStrategies calculated using the most current EPA blood lead model, the All-Ages Lead Model (AALM; v. 3.1). ToxStrategies states in the memorandum,

“We are concerned that ODEQ has not taken the opportunity, while proposing other new and revised TRVs, to develop a more appropriate acute TRV for lead; rather ODEQ has proposed to continue to use the National Ambient Air Quality Standards (NAAQS) for lead ($0.15 \mu\text{g}/\text{m}^3$) as the acute TRV. The NAAQS is intended to be applied to a 3-month average concentration and is not appropriate for the 24-hour duration of an acute TRV under Cleaner Air Oregon. The NAAQS is also used as the chronic TRV, which is a more relevant application of the NAAQS.”

OHA response to recommendation 1: OHA agrees that ToxStrategies’ memorandum highlights a gap in available TRV candidates for lead. There is an exposure time mismatch between the NAAQS that EPA intends to be applied to a 3-month rolling average and DEQ’s 24-hour definition of acute exposure. No authoritative or alternate source has a candidate acute TRV with a better matched exposure time.

ToxStrategies’ approach to developing a new acute TRV proposal for lead is novel and may have utility. However, OHA is not aware of any governmental regulatory agency that has adopted ToxStrategies’ approach.

As explained in Chapter 5 of the [TRV Support Document](#), OHA only made relatively simple calculation adjustments to TRVs developed by other organizations (either authoritative sources or ATSAC-recommended alternate sources) to follow OHA and DEQ policy decisions. Examples of those adjustments include uncertainty factors, exposure time, or molecular weight adjustments (see Chapter 5 of TRV support document for additional details). In many cases, OHA applied “Haber’s Law” to adjust exposure time for acute TRVs from authoritative sources to better match DEQ’s 24-hour exposure definition. However, OHA agrees with CalEPA’s policy(16) not to make

such exposure time adjustments when the critical effect is developmental in nature, as is the case with lead (See Chapter 2 of TRV Support Document).

Adopting ToxStrategies' proposal would mean reviewing, and potentially performing, primary research to validate their proposed, novel approach. OHA has not done this kind of primary research for any other TRV proposed in this rulemaking. For these reasons, **OHA recommends that DEQ maintain the current acute TRV for lead, which is 0.15 µg/m³.** This TRV was included during Cleaner Air Oregon program adoption in 2018, and OHA and DEQ have not proposed any changes to this TRV since then. **The current acute lead TRV of 0.15 µg/m³ protects human health.**

Usually, acute TRVs are higher than a chronic TRV for the same contaminant because it takes more of a contaminant to harm health if the exposure is short compared to long exposure. Applying the same TRV intended to be protective for a longer time (in this case 3 months) will also be health protective for a shorter time (24 hours).

OHA will continue to monitor authoritative sources for updated acute TRVs for lead for future rounds of TRV updates.

Naphthalene; 91-20-3

Acute Noncancer TRV

ToxStrategies indicates that OHA 1) adopted a TRV based on the acute MRL that ATSDR developed using older EPA guidance (1994) for dosimetric adjustment for the extrathoracic region (RGDR_{ET}) rather than newer guidance from 2012 and 2) did not use the best fitting benchmark dose model.

ToxStrategies recommendation: In consultation with ATSAC, DEQ should propose an alternate acute TRV of 1.6 µg/m³ based on the same critical study that ATSDR used. ToxStrategies proposes 1) following newer EPA guidance for dosimetric adjustment (RGDRET) from 2012 and 2) selecting a different benchmark dose model. The same time adjustments and uncertainty factors would be maintained.

OHA response to recommendation: ATSDR developed the MRL for naphthalene in 2025 with knowledge of EPA's dosimetric adjustment guidance from both 2012 and 1994.(32) In addition, ATSDR chose a benchmark dose model output that was among those deemed viable by the software. Considering the options, ATSDR still chose to follow the 1994 guidance after their extensive review process in developing MRLs. **In line with using authoritative sources, OHA recommends keeping the current proposed TRV based on ATSDR's acute MRL for naphthalene of 0.3 µg/m³.**

Nickel and compounds; 7440-02-0 & Nickel oxide; 1313-99-1

Acute Noncancer TRVs

ToxStrategies posits that the ATSDR value for nickel has been removed from their website to reevaluate and was not a good fit for a 24-hour timeframe because it was based on a study with five days of exposure.

ToxStrategies recommendation 1: Wait for ATSDR to finish revision, use ToxStrategies proposed acute TRV (11 $\mu\text{g}/\text{m}^3$, based on Buxton et al. 2021 study with nickel chloride), or use CalEPA's or TCEQ's acute TRV. Immunotoxicity is a more sensitive endpoint than respiratory effects for nickel. Extrapolation from a 5-day, 30-hour exposure study is not optimal for a 24-hour TRV.

OHA response to recommendation 1: OHA recognizes that ATSDR is revising items in the nickel Tox Profile. However, it is not clear if the MRL will be any different upon revision. If ATSDR revises their acute MRL for nickel in the future, OHA will consider that revision. See section 4.2.4 of Chapter 4 of the [TRV Support Document](#).

Chapter 2 of the TRV Support Document (Section "Step 5") describes OHA's general policy on selection of acute TRVs. ATSDR acute MRLs are favored over other sources because their intended exposure time applicability is "up to two weeks," which includes the 24-hour window relevant to DEQ's acute TRVs. This means that OHA does not need to make exposure time adjustments to acute TRVs adopted from ATSDR's acute MRLs.

ATSDR's exposure time adjustment for nickel (6 hours a day for 5 days or 30 hours total)(33) is standard for ATSDR's approach to acute MRLs. For antimony (study of 17 days of exposure at 6 hours/day), ATSDR adjusted both hours/day and days/week.(34) Similarly, for benzene (study of 6 hours/day for 6 consecutive days), ATSDR adjusted for intermittent exposure with the 6/24 hour adjustment.(35) ATSDR developed those MRLs in 2019 and 2024, respectively, indicating it is a current practice. In this context, ATSDR's approach to deriving their acute MRL for nickel does not stand out as atypical from their standard and current approach to developing acute MRLs generally.

OHA does not recommend adopting ToxStrategies' alternative acute TRV of 11 $\mu\text{g}/\text{m}^3$ based on Buxton et al. 2021.(36) In this rulemaking, **there were no instances where**

OHA calculated a new candidate TRV from primary research studies, as ToxStrategies is proposing (See Chapters 2 and 5 of [TRV Support Document](#)). As explained in Chapter 5 of the [TRV Support Document](#), OHA only made relatively simple calculation adjustments to TRVs developed by other organizations (either authoritative sources or ATSAC-recommended alternate sources) to follow OHA and DEQ policy decisions. Examples of those adjustments includes uncertainty factors, exposure time, or molecular weight adjustments (see Chapter 5 of [TRV support document](#) for additional details).

As described in Chapter 2 of the [TRV Support Document](#) (section “Step 5”) OHA prioritizes authoritative sources (e.g., ATSDR and CalEPA) over alternative sources (e.g., TCEQ) and therefore does not consider the TCEQ value when values are available from both ATSDR and CalEPA.(33,37) In addition, OHA recommends continuing to propose the 2024 ATSDR acute MRL over CalEPA’s 2012 1-hour REL because:

1. It is more recently published
2. It is based on a more recent study (2017 for ATSDR vs. 1978 for CalEPA)
3. ATSDR’s acute MRLs are a closer match to DEQ’s 24-hour TRVs (See Chapter 2 of [TRV Support Document](#))

With respect to endpoint sensitivity, the existing CalEPA 1-hour REL (0.2 µg/m³) is based on immune effects and is very similar to ATSDR’s acute MRL (0.1 µg/m³). This gives OHA confidence that ATSDR’s acute MRL, which is based on respiratory effects, is also protective against immune effects.

OHA recommends that DEQ continue to propose the acute TRV based on ATSDR’s acute MRL (0.1 µg/m³).

Per- and Polyfluoroalkyl Substances (PFAS)

The ToxStrategies memo on PFAS prompted OHA to look closer at proposals for PFAS and ensure they were consistent with ATSAC guidance.

Ideally, a TRV for CAO is derived from a study that specifically examined health outcomes associated with inhalation exposures. Such studies are largely lacking for PFAS. The sources that DEQ, in consultation with ATSAC, used for TRVs for PFAS (Michigan, Minnesota, New Jersey, and Texas) mostly developed their candidate TRVs by extrapolating inhalation toxicity values from oral toxicity values, a process called route-to-route extrapolation. Often, those oral toxicity values came from DEQ's authoritative sources, like EPA and ATSDR. In the case of one PFAS, perfluorodecanoic acid (PFDA), ATSAC specifically and unanimously recommended the use of route-to-route extrapolation from EPA's oral reference dose (2024) for that chemical. Not all PFAS TRVs OHA recommended prior to January 12, 2026, were extrapolated from authoritative sources like EPA. To bring the rest of the PFAS TRVs into alignment with this ATSAC-supported approach, OHA now recommends calculating chronic TRVs for PFAS following a three-tiered hierarchy.

Tier 1: OHA calculated a chronic TRV by route-to-route extrapolation directly from oral reference doses developed in recent years by EPA, one of DEQ's rule-listed authoritative sources.

Tier 2: OHA adopted a chronic TRV for PFBE from the Michigan Department of the Environment, Great Lakes, and Energy. Michigan developed this chronic TRV from an inhalation study, so no route-to-route extrapolation was necessary. This TRV was part of the proposal already reviewed and approved by ATSAC.

Tier 3: OHA adopted another chronic TRV from Michigan for 6:2 fluorotelomer sulfonic acid (6:2 FTS). In this case, Michigan developed their own chronic oral reference dose and then applied route-to-route extrapolation to calculate an inhalation TRV. This TRV was part of the proposal already reviewed and approved by ATSAC.

OHA found that the chronic TRV previously proposed for PFDoA from TCEQ was derived using a total uncertainty factor greater than 3,000, which is inconsistent with OHA's policy on uncertainty factors (See [Appendix M](#) of TRV Support Document).

Therefore, OHA recommends withdrawing the chronic TRV previously proposed for PFDoA.

This overall updated recommended approach to PFAS results in the withdrawal of a chronic TRV for one PFAS (PFDoA), creation of chronic TRVs for three PFAS for which oral RfDs are newly available from EPA, and an updated chronic TRV for one PFAS that was previously extrapolated from an oral RfD from another state that will now be extrapolated from an oral RfD from EPA instead. See Table 3 for updated proposed TRVs.

OHA is recommending this **Tier 1** route-to-route extrapolation approach because:

- It is consistent with the approach used by states that have been dealing with PFAS for decades (Michigan, Minnesota, New Jersey, and Texas).
- It was recommended by ATSAC (See [Appendix R](#) of TRV Support Document, email on PFDA)
- It is recommended and used by Monnot et al. (2022) to develop reference concentrations for PFOA and PFOS stating "...current knowledge of PFAS toxicokinetics indicates that there is nothing that would preclude employing route-to-route extrapolation in the derivation of provisional inhalation toxicological screening levels for individual PFAS when acceptable health-based ingestion standards are available."(38)

Chronic oral reference doses from EPA are derived from epidemiology studies, which ATSAC members cited as a strength of this approach (See [Appendix R](#) of the TRV Support Document). However, many PFAS have long half-lives, in the order of years. This suggests that when using epidemiology studies for deriving TRVs, the resulting measured exposure is likely from long term exposure, even for developmental outcomes (i.e., the mother's PFAS body load likely reflects the accumulation of years, and exposures from one day, for most of the population, do not appreciably change the body load). From this perspective, OHA finds epidemiology studies and nonacute animal studies to be good candidates for route-to-route extrapolation for **chronic** TRVs. However, when considering the lack of data on acute inhalation toxicity in epidemiology studies and the uncertainties and challenges in extrapolating from PFAS animal studies to humans for acute periods, **OHA recommends withdrawing proposals for acute TRVs for PFAS until better data and methods are available.**

Table 3. Recommended updates to TRVs for PFAS and information about oral RfDs from which they are extrapolated.

PFAS Name	CAS RN	1/12/2026 Proposed Chronic TRV ($\mu\text{g}/\text{m}^3$)	3/16/2026 Proposed Chronic TRV ($\mu\text{g}/\text{m}^3$)	EPA Chronic Oral RfD ($\text{mg}/\text{kg}/\text{day}$)	Publication Date of EPA's Chronic Oral RfD	1/12/2026 Proposed Acute TRV ($\mu\text{g}/\text{m}^3$)	3/16/2026 Proposed Acute TRV ($\mu\text{g}/\text{m}^3$)
<i>6:2 Fluorotelomer sulfonic acid (6:2 FTS)</i>	27619-97-2	1	1	0.00039 (Michigan)	September 2020	No TRV	No TRV
<i>Hexafluoropropylene oxide dimer acid (HFPO-DA/Gen-X)</i>	13252-13-6	0.01	0.01	0.000003	October 2021	No TRV	No TRV
<i>Perfluorobutanesulfonic acid (PFBS)</i>	375-73-5	No TRV	1.1	0.0003	April 2021	0.3	No TRV
<i>Perfluorobutanoic acid (PFBA)</i>	375-22-4	3.5	3.5	0.001	December 2022	10	No TRV
<i>Perfluorobutylethylene (PFBE)</i>	19430-93-4	2,600	2,600	Not Applicable** (Michigan)	None available	No TRV	No TRV
<i>Perfluorodecanoic acid (PFDA)</i>	335-76-2	0.000007	0.000007	2×10^{-9}	July 2024	No TRV	No TRV
<i>Perfluorododecanoic acid (PFDoA)</i>	307-55-1	0.042	No TRV	None available	None available	No TRV	No TRV

PFAS Name	CAS RN	1/12/2026 Proposed Chronic TRV (µg/m ³)	3/16/2026 Proposed Chronic TRV (µg/m ³)	EPA Chronic Oral RfD (mg/kg/day)	Publication Date of EPA's Chronic Oral RfD	1/12/2026 Proposed Acute TRV (µg/m ³)	3/16/2026 Proposed Acute TRV (µg/m ³)
<i>Perfluorohexanesulfonic acid (PFHxS)</i>	355-46-4	No TRV	0.0000014	4x10 ⁻¹⁰	January 2025	0.034	No TRV
<i>Perfluorohexanoic acid (PFHxA)</i>	307-24-4	0.5	1.8	0.0005	April 2023	1	No TRV
<i>Perfluorononanoic acid (PFNA)</i>	375-95-1	No TRV	0.000025	7x10 ⁻⁹	March 2024 (Draft)	0.047	No TRV
<i>Perfluorooctanesulfonamide (PFOSA)</i>	754-91-6	0.0001	0.00011	See PFOA*	See PFOA*	0.063	No TRV
<i>Perfluorooctanesulfonic acid (PFOS)</i>	1763-23-1	0.0004	0.00035	1x10 ⁻⁷	April 2024	0.011	No TRV
<i>Perfluorooctanoic acid (PFOA)</i>	335-67-1	0.0001	0.00011	3x10 ⁻⁸	April 2024	0.063	No TRV

*Following TCEQ's approach to use PFOA as a surrogate for PFOSA (See Table 5-3 in [TRV Support Document](#))

**The recommended chronic TRV for PFBE is based on an inhalation study so no route-route-extrapolation applied.

Note: Inhalation TRVs are calculated from oral RfDs:

$$\text{TRV } (\mu\text{g}/\text{m}^3) = \text{Oral RfD } (\text{mg}/\text{kg}/\text{day}) \times (70 \text{ kg} \div 20 \text{ m}^3/\text{day}) \times 1,000 \mu\text{g}/\text{mg}$$

ToxStrategies had several recommendations that OHA addressed below:

Acute and Chronic TRVs

ToxStrategies recommendation 1: ToxStrategies recommends that DEQ not develop acute and chronic TRVs at this point.

1. There are no inhalation studies of PFAS toxicity (except for PFNA). DEQ didn't adapt the acute TRV for PFNA from TCEQ correctly.
2. Inhalation studies are preferred to route-to-route extrapolation methods for deriving TRVs.
3. CAO authoritative sources have not developed PFAS inhalation reference criteria.

OHA response to recommendation 1:

See introduction to PFAS section above for rationale for postponing the proposal of acute TRVs for PFAS for the time being.

OHA agrees that there is a lack of inhalation toxicology studies for PFAS and that those would have been preferable to use instead of performing route-to-route extrapolation from oral studies or serum concentrations in humans. The current methods have uncertainty, which is inherent to setting TRVs in general. Despite these uncertainties ATSAC explicitly supported this approach. See introduction section for PFAS above for more detailed rationale.

See response to recommendation 1 under “Silica, amorphous and other non-crystalline forms of silica” regarding CAO authoritative sources and DEQ, in consultation with ATSAC, as an authoritative source.

ToxStrategies recommendation 2: Oral toxicity values are uncertain and rapidly changing. Therefore, OHA should not calculate TRVs based on them as this would lock the regulated community into TRVs for several years based on potentially changing values.

1. Authoritative sources have changed their oral values as recently as 2024.

2. There has been scrutiny and criticism around using the epidemiology studies related to vaccine effectiveness that EPA used to establish the most recent oral toxicity values. Also, there are legal challenges about these oral toxicity values

OHA response to recommendation 2: ATSDR and many states have been developing reference doses for a long time for various PFAS. This activity has increased during the last 5 years. The current EPA RfDs for PFOS and PFOA have spanned two federal administrations, and EPA provides no indication that these will be changed. OHA determined, with concurrence from ATSAC members, that it is preferable to set TRVs than to not. DEQ rules are subject to review and updating that allows the agencies to reflect new scientific information as it develops.

Epidemiology studies have uncertainties (confounding, etc.) and so do animal studies (e.g., not conducted in humans). ATSAC members John Budroe and John Vandenberg specifically highlighted the strengths of EPA-derived oral reference doses from epidemiological studies and reasons to select them over RfDs generated by other agencies based on animal studies. John Vandenberg wrote [in [Appendix R](#) of TRV Support Document],

“The newer studies include recent results in ~1500 infants (Wikstrom et al, 2020 - abstract attached below) plus studies showing effects in children (Grandjean et al. 2012; Budtz Jørgensen and Grandjean, 2018) and the resulting RfD based on effects in infants and children is much lower than that derived by TCEQ.

Based on the consideration of more recently published studies I conclude that the IRIS (2024) document should be used as the authoritative source for TRV derivation.

Please note that the Wikstrom et al study included similar results for **several PFAS that may affect other TRVs.**

I agree with the proposal by OHA and DEQ to use route-to-route extrapolation to derive an RfC from the IRIS (2024) RfD for PFDA.” [**Bold** added]

OHA relies on authoritative sources and alternative agency toxicity determinations and proceeds reasonably and with precaution in setting TRVs.

ToxStrategies recommendation 3: Derivation of inhalation TRVs requires consideration of the toxicity of individual PFAS compounds and relevant endpoints.

1. Development of TRVs requires in-depth understanding of underlying toxicity data, PODs, toxicokinetics by route, and compound-specific data.
2. Derivation of acute TRVs based on acute inhalation studies does not require interspecies adjustments that are typically applied in chronic TRVs because steady state pharmacokinetics are unlikely to play a role in acute toxicity. Example of this is PFNA.

OHA response to recommendation 3: OHA relies on authoritative sources for the development of oral RfDs. Also, see above for rationale for route-to-route extrapolation justification and postponement of acute TRV development for PFAS.

ToxStrategies recommendation 4: Regulating exposures to PFAS compounds in air will not reduce overall exposures to PFAS in the population under current conditions.

OHA response to recommendation 4: Historically PFAS exposures have focused primarily on drinking water levels; more recently there has been an increasing focus on air emissions of PFAS in the regulatory and research community. For example, recent studies suggest that air emissions of PFAS at landfills exceed those in the leachate, or liquid, from these sources. Thus, it is important to understand the risks that inhalation exposure of PFAS pose to the public from air emission sources, and establishing TRVs is a critical first step. There is scientific inquiry underway to understand air emissions; in some cases, they may be more significant than liquid emissions.

Vanadium and compounds; 7440-62-2

Acute and Chronic Noncancer TRV

ToxStrategies recommendation 1: Specify that acute and chronic TRVs apply only to vanadium pentoxide or withdraw them.

OHA response to recommendation 1: OHA agrees that acute and chronic TRVs should apply to vanadium pentoxide only since the values developed by authoritative sources such as EPA and ATSDR are based largely on health studies of exposure to vanadium pentoxide and not to other forms. For example, ATSDR's acute and chronic TRVs are based on exposure to "vanadium pentoxide dust".(39) **OHA proposes changing the name of the TAC to vanadium pentoxide as recommended by ToxStrategies.**

Cancer TRV

ToxStrategies recommendation 2: Withdraw cancer TRV because EPA specifies that it only applies to vanadium pentoxide.

OHA response to recommendation 2: OHA recommends keeping the cancer TRV as is. However, **OHA recommends changing the name of the TAC to "vanadium pentoxide."** This is consistent with the EPA PPRTV document language from which the recommended IUR comes.(40)

Moreover, ToxStrategies recommends postponing setting TRVs for vanadium and compounds until EPA or other authoritative source develops TRV candidates for compounds other than vanadium pentoxide. This is addressed by changing the TAC name to "vanadium pentoxide". OHA will revise if authoritative sources set TRVs for any forms of vanadium other than vanadium pentoxide. The TRVs would not apply to vanadium alloys.

Implications of OHA's hydrogen chloride acute TRV recommendation for other acute TRVs

This section is related to changes recommended to the acute TRV for hydrogen chloride {hydrochloric acid}; 7647-01-0 or HCl. The acute TRV for HCl is the basis for the acute TRV for boron trichloride, which dissociates to three molecules of HCl in biological tissues. While the other TACs (i.e., not boron trichloride) discussed in this section are not chemically related to HCl, they could be sensory irritants like HCl is. Therefore, OHA considered whether the recommendations applied to the acute TRV for HCl should be applied to any of the other sensory irritants.

Boron Trichloride; 10294-34-5

As described in Table 5-5 of the TRV Support Document, the boron trichloride noncancer TRVs are based on the HCl noncancer TRVs. This is because each molecule of boron trichloride hydrolyzes to three molecules of HCl. To calculate proposed noncancer TRVs for boron trichloride, OHA multiplied the proposed TRVs for HCl by the ratio of the molecular weight for boron trichloride to three times the molecular weight of HCl. Given that OHA is recommending a different acute TRV proposal for HCl (2,100 $\mu\text{g}/\text{m}^3$ rather than 88 $\mu\text{g}/\text{m}^3$), OHA also recommends updating the acute TRV proposal for boron trichloride to be 2,200 $\mu\text{g}/\text{m}^3$ instead of 94 $\mu\text{g}/\text{m}^3$ ($2,100 \mu\text{g}/\text{m}^3 \times 1.07$ [molecular weight adjustment] = 2,247 $\mu\text{g}/\text{m}^3 \approx 2,200 \mu\text{g}/\text{m}^3$).

Other Sensory Irritants (see Table 4)

OHA also looked at other acute TRV proposals where DEQ/OHA applied "Haber's Law" time adjustments for contaminants where one of the critical effects was sensory irritation. This was the case for four contaminants: acrylic acid, benzyl chloride, phenol, and hydrogen selenide. OHA closely reviewed the critical effects for each of these four as described by OEHHA and the authors of the critical studies themselves (Table 4). Where OHA determined that sensory irritation was the only critical effect, OHA recommends not applying "Haber's Law" to adjust exposure time. Where OHA determined that there were other effects besides sensory irritation at the critical dose, OHA recommends continuing to apply "Haber's Law" to adjust exposure time.

Table 4. OHA’s review of the critical effects for acrylic acid, benzyl chloride, phenol, and hydrogen selenide and OHA’s recommendation for applying “Haber’s Law” as a result

TAC	DEQ ID or CAS RN	Effects described at lowest effect concentration	OHA recommending “Haber’s Law” application?
Acrylic acid	79-10-7	Sensory irritation, lethargy, reduced weight gain(26)	Yes
Benzyl chloride	100-44-7	Sensory irritation, decreased respiratory rate(26); potentially reduced weight gain, persistent nasal discharge for a week after exposure, reduced neuromuscular transduction(30)	Yes
Phenol	108-95-2	Sensory irritation(26)	No
Selenide, hydrogen	7783-07-5	Sensory irritation and persistent cough for several days after exposure(26)	Yes

OHA concluded that phenol was the only one of those four where sensory irritation was the only critical effect. Therefore, in alignment with OHA’s recommendation for the HCl acute TRV proposal, OHA also recommends removing the "Haber's Law" time adjustment for the phenol acute TRV proposal (Table 5).

Table 5. Comparison of the TRV proposals from before the RAC meetings (as of 1-12-26) with OHA's recommended TRV as of 3-16-2026 for the two acute noncancer TRVs based on sensory irritation effects and were originally derived from OEHHA's 1-hour RELs by adjusting exposure time using "Haber's Law"

TAC	DEQ ID or CAS RN	DEQ's proposed TRV as of 1-12-26 ($\mu\text{g}/\text{m}^3$)	OEHHA 1-hour REL ($\mu\text{g}/\text{m}^3$)	OHA's recommended TRV as of 3-16-26 ($\mu\text{g}/\text{m}^3$)
Hydrogen chloride	7647-01-0	88	2,100	2,100
Phenol	108-95-2	670	5,800	2,000

Authors

David Farrer, PhD

Holly Dixon, PhD

Ali Hamade, PhD, DABT

References

1. ATSDR. Toxicological Profile for Silica [Internet]. Atlanta, GA: U.S. Department of Health and Human Services, Public Health Service; 2019 [cited 2026 Apr 6]. Available from: <https://wwwn.cdc.gov/TSP/ToxProfiles/ToxProfiles.aspx?id=1483&tid=290>
2. EPA. Provisional Peer Reviewed Toxicity Values for Chloroethane. Cincinnati, OH: U.S. Environmental Protection Agency; 2007.
3. EPA. Chemical Assessment Summary: Ethyl Chloride (CASRN 75-00-3). Washington, DC: U.S. Environmental Protection Agency; 1991.
4. OEHHA. TSD for Noncancer RELs – Appendix D.3: Chronic RELs and Toxicity Summaries Using the Previous Version of the Hot Spots Risk Assessment Guidelines. Sacramento, CA: California Environmental Protection Agency, Office of Environmental Health Hazard Assessment; 2008.
5. Scortichini B, Johnson K, Momany-Pfruender J, Hanley T. Ethyl chloride: Inhalation teratology study in CF-1 mice. Midland, MI: Dow Chemical; 1986. Report OTS0517038. 86-870002248. TSCATS/309650.
6. ATSDR. Toxicological Profile for Chloroethane [Internet]. Atlanta, GA: U.S. Department of Health and Human Services, Public Health Service; 2025 [cited 2026 Apr 6]. Available from: <https://wwwn.cdc.gov/TSP/ToxProfiles/ToxProfiles.aspx?id=827&tid=161>
7. ATSDR. Toxicological profile for Manganese [Internet]. Atlanta, GA: U.S. Department of Health and Human Services, Public Health Service; 2012 [cited 2026 Apr 6]. Available from: <https://wwwn.cdc.gov/TSP/ToxProfiles/ToxProfiles.aspx?id=102&tid=23>
8. Dorman DC, Struve MF, Gross EA, Wong BA, Howroyd PC. Sub-chronic inhalation of high concentrations of manganese sulfate induces lower airway pathology in rhesus monkeys. *Respir Res*. 2005 Oct 21;6(1):121. doi:10.1186/1465-9921-6-121 PubMed PMID: 16242036; PubMed Central PMCID: PMC1283983.
9. TCEQ. Manganese and Inorganic Manganese Compounds [Internet]. Texas Commission on Environmental Quality (TCEQ); 2017 [cited 2026 Apr 6]. Available from: <https://www.tceq.texas.gov/downloads/toxicology/dsd/final/mn.pdf>
10. Quality (TCEQ) TC on E. Development Support Document: Silica, amorphous and other noncrystalline forms [Internet]. 2011. Available from: https://www.tceq.texas.gov/downloads/toxicology/dsd/final/silica_amorphous.pdf
11. Groth DH, Moorman WJ, Lynch DW, Stettler LE, Wagner WD, Hornung RW. Chronic Effects of Inhaled Amorphous Silicas in Animals. In: *Health Effects of Synthetic Silica Particulates* [Internet]. ASTM International; [cited 2026 Apr 6]. p. 118–43. Available from: <https://store.astm.org/stp38672s.html> doi:10.1520/STP38672S

12. Derelanko M, Rinehart W, Hilaski R, Thompson R, Löser E. Thirteen-week subchronic rat inhalation toxicity study with a recovery phase of trivalent chromium compounds, chromic oxide, and basic chromium sulfate. *Toxicol Sci.* 1999;52(2):278–88. doi:10.1093/toxsci/52.2.278
13. ATSDR. Toxicological profile for Chromium [Internet]. Atlanta, GA: U.S. Department of Health and Human Services, Public Health Service; 2012 [cited 2026 Apr 6]. Available from: <https://wwwn.cdc.gov/TSP/ToxProfiles/ToxProfiles.aspx?id=62&tid=17>
14. OEHHA. Air Toxics Hot Spots Program Chromium, Trivalent (Inorganic Water-Soluble Compounds) Reference Exposure Levels [Internet]. Sacramento, CA: California Environmental Protection Agency, Office of Environmental Health Hazard Assessment; 2022 [cited 2026 Apr 6]. Available from: <https://oehha.ca.gov/sites/default/files/media/downloads/air/document/finalcriiirel083122.pdf>
15. Henderson RF, Rebar AH, Pickrell JA, Newton GJ. Early damage indicators in the lung. III. Biochemical and cytological response of the lung to inhaled metal salts. *Toxicol Appl Pharmacol.* 1979 Aug 1;50(1):123–36. doi:10.1016/0041-008X(79)90500-3
16. OEHHA. Technical Support Document for the Derivation of Noncancer Reference Exposure Levels [Internet]. Sacramento, CA: California Environmental Protection Agency, Office of Environmental Health Hazard Assessment; 2008 [cited 2026 Apr 6]. Available from: <https://oehha.ca.gov/sites/default/files/media/downloads/crnrr/noncancertsdfinal.pdf>
17. EPA. Methods for Derivation of Inhalation Reference Concentrations (RfCs) and Application of Inhalation Dosimetry [Internet]. Washington, DC: U.S. Environmental Protection Agency, Office of Health and Environmental Assessment; 1994 [cited 2026 Apr 6]. Available from: <https://cfpub.epa.gov/ncea/risk/recordisplay.cfm?deid=71993>
18. OEHHA. Air Toxics Hot Spots Program Cobalt and Cobalt Compounds Cancer Inhalation Unit Risk Factors [Internet]. Sacramento, CA: California Environmental Protection Agency, Office of Environmental Health Hazard Assessment; 2023 [cited 2026 Apr 7]. Available from: <https://oehha.ca.gov/sites/default/files/media/downloads/crnrr/finalcobalt080423.pdf>
19. ATSDR. Toxicological Profile for Cobalt [Internet]. Atlanta, GA: U.S. Department of Health and Human Services, Public Health Service; 2024 [cited 2026 Apr 7]. Available from: <https://wwwn.cdc.gov/TSP/ToxProfiles/ToxProfiles.aspx?id=373&tid=64>
20. Viegas V, Burzlaff A, Brock TO, Danzeisen R. A tiered approach to investigate the inhalation toxicity of cobalt substances. Tier 3: Inflammatory response following acute inhalation exposure correlates with lower tier data. *Regul Toxicol Pharmacol RTP.* 2022 Apr;130:105127. doi:10.1016/j.yrtph.2022.105127 PubMed PMID: 35124137.

21. Kusaka Y, Ichikawa Y, Shirakawa T, Goto S. Effect of hard metal dust on ventilatory function. *Br J Ind Med*. 1986 Jul;43(7):486–9. doi:10.1136/oem.43.7.486 PubMed PMID: 3718896; PubMed Central PMCID: PMC1007688.
22. Kastury F, Smith E, Juhasz AL. A critical review of approaches and limitations of inhalation bioavailability and bioaccessibility of metal(loid)s from ambient particulate matter or dust. *Sci Total Environ*. 2017 Jan 1;574:1054–74. doi:10.1016/j.scitotenv.2016.09.056
23. IARC. Cobalt in Hard Metals and Cobalt Sulfate, Gallium Arsenide, Indium Phosphide and Vanadium Pentoxide [Internet]. Vol. 86. Lyon, France: World Health Organization, International Agency for Research on Cancer; 2006 [cited 2026 Apr 8]. (IARC Monographs on the Evaluation of Carcinogenic Risks to Humans). Available from: <https://publications.iarc.who.int/Book-And-Report-Series/Iarc-Monographs-On-The-Identification-Of-Carcinogenic-Hazards-To-Humans/Cobalt-In-Hard-Metals-And-Cobalt-Sulfate-Gallium-Arsenide-Indium-Phosphide-And-Vanadium-Pentoxide-2006>
24. OEHHA. Consolidated Table of OEHHA/ARB Approved Risk Assessment Health Values [Internet]. Sacramento, CA: California Environmental Protection Agency, Office of Environmental Health Hazard Assessment; 2023 [cited 2026 Apr 7]. Available from: <https://ww2.arb.ca.gov/sites/default/files/classic/toxics/healthval/contable10062023.pdf>
25. ATSDR. Toxicological profile for Fluorides, Hydrogen Fluoride, and Fluorine [Internet]. Atlanta, GA: U.S. Department of Health and Human Services, Public Health Service; 2003 [cited 2026 Apr 7]. Available from: <https://wwwn.cdc.gov/TSP/ToxProfiles/ToxProfiles.aspx?id=212&tid=38>
26. OEHHA. Appendix D.2 Acute RELs and Toxicity Summaries Using the previous Version of the Hot Spots Risk Assessment Guidelines (OEHHA 1999) [Internet]. Sacramento, CA: California Environmental Protection Agency, Office of Environmental Health Hazard Assessment; 1999 [cited 2026 Apr 7]. Available from: <https://oehha.ca.gov/sites/default/files/media/downloads/crn/appendixd2final.pdf>
27. Stevens B, Koenig JQ, Rebolledo V, Hanley QS, Covert DS. Respiratory effects from the inhalation of hydrogen chloride in young adult asthmatics. *J Occup Med Off Publ Ind Med Assoc*. 1992 Sep;34(9):923–9. PubMed PMID: 1447599.
28. NIOSH. Immediately Dangerous to Life or Health [IDLH] Value Profile: Hydrogen Chloride (CAS No. 7647-01-0) [Internet]. Cincinnati, OH: U.S. Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health; 2025 [cited 2026 Apr 7]. Available from: <https://www.cdc.gov/niosh/docs/2025-110/pdfs/2025-110revised062025.pdf?id=10.26616/NIOSH PUB2025110>
29. OEHHA. Appendix D. Individual Acute, 8-Hour, and Chronic Reference Exposure Level Summaries [Internet]. Sacramento, CA: California Environmental Protection Agency, Office of Environmental Health Hazard Assessment; 2008 [cited 2026 Apr 7]. Available from: <https://oehha.ca.gov/sites/default/files/media/downloads/crn/appendixd1final.pdf>

30. Mikhailova TV. Comparative toxicity of chloride derivatives of toluene: benzyl chloride, benzal chloride and benzotrichloride. *Fed Proc Transl Suppl Sel Transl Med-Relat Sci.* 1965;24(5):877–80. PubMed PMID: 5214599.
31. EPA. Hydrogen chloride (CASRN 7647-01-0) | IRIS | US EPA [Internet]. Washington, DC: U.S. Environmental Protection Agency, Integrated Risk Information System; 1995 [cited 2026 Apr 7]. Available from: https://iris.epa.gov/static/pdfs/0396_summary.pdf
32. Substances A for T, Registry (ATSDR) D. Toxicological Profile for Naphthalene, 1-Methylnaphthalene, and 2-Methylnaphthalene [Toxicological Profile] [Internet]. U.S. Department of Health and Human Services, Public Health Service; 2025. Available from: <https://www.atsdr.cdc.gov/ToxProfiles/tp67.pdf>
33. ATSDR. Toxicological Profile for Nickel. Atlanta, GA: U.S. Department of Health and Human Services, Public Health Service; 2024.
34. ATSDR. Toxicological profile for Antimony. Atlanta, GA: U.S. Department of Health and Human Services, Public Health Service; 2019.
35. ATSDR. Toxicological Profile for Benzene (Draft for Public Comment). Atlanta, GA: U.S. Department of Health and Human Services, Public Health Service; 2024.
36. Buxton S, Taylor MD, Weinberg JT, Randazzo JM, Peachee VL, Oller A. A T-dependent antibody response evaluation in CD-1 mice after an acute whole-body inhalation exposure to nickel (II) chloride hexahydrate. *J Immunotoxicol.* 2021 Jan 1;18(1):144–53. doi:10.1080/1547691X.2021.1984618 PubMed PMID: 34644513.
37. OEHHA. Nickel Reference Exposure Levels [Internet]. Sacramento, CA: California Environmental Protection Agency, Office of Environmental Health Hazard Assessment; 2012. Available from: <https://oehha.ca.gov/media/downloads/crn/032312nirelfinal.pdf>
38. Monnot AD, Massarsky A, Garnick L, Bandara SB, Unice KM. Can oral toxicity data for PFAS inform on toxicity via inhalation? *Risk Anal Off Publ Soc Risk Anal.* 2023 Aug;43(8):1533–8. doi:10.1111/risa.14039 PubMed PMID: 36201616.
39. ATSDR. Toxicological profile for Vanadium. Atlanta, GA: U.S. Department of Health and Human Services, Public Health Service; 2012.
40. EPA. Provisional Peer Reviewed Toxicity Values for Vanadium pentoxide (CASRN 1314-62-1) [Internet]. Cincinnati, OH: U.S. Environmental Protection Agency; 2008 [cited 2026 Apr 7]. Available from: <https://cfpub.epa.gov/ncea/pprtv/documents/VanadiumPentoxide.pdf>

You can get this document in other languages, large print, braille or a format you prefer free of charge. Contact the Environmental Public Health Section at EHAP.info@odhsoha.oregon.gov or call 971-673-0482. We accept all relay calls.

Public Health Divison
Environmental Public Health Section
800 NE Oregon St Suite 640
Portland, OR 97232
971-673-0482

<https://www.oregon.gov/oha/PH/HealthyEnvironments/Pages/index.aspx>

