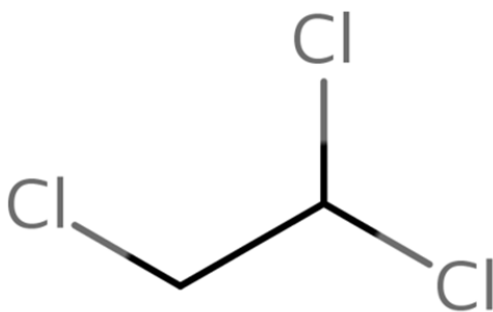




Draft Chemistry, Fate, Release, and Exposure Assessment for 1,1,2-Trichloroethane

Technical Support Document for the Draft Risk Evaluation

CASRN 79-00-5



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954 ABBREVIATIONS AND ACRONYMS

955	7Q10	Lowest 7-day average flow that occurs (on average) once every 10 years
956	30Q5	Lowest 30-day average flow that occurs (on average) once every 5 years
957	AAD	Acute absorbed dose
958	AADR	Acute absorbed dose rate
959	ACGIH	American Conference of Governmental Industrial Hygienists
960	AD	Acute dose
961	ADD	Chronic average daily dose
962	AERMOD	American Meteorological Society (AMS)/EPA Regulatory Model
963	AF	Adjustment factor
964	AMTIC	Ambient Monitoring Technology Information Center
965	APF	Assigned protection factor
966	BAF	Bioaccumulation factor
967	BCF	Bioconcentration factor
968	BLS	Bureau of Labor Service (U.S.)
969	CAD	Chronic absorbed dose
970	CASRN	Chemical Abstracts Service Registry Number
971	CBI	Confidential business information
972	CDR	Chemical Data Reporting
973	ChV	Chronic value
974	COC	Concentration of concern
975	COU	Condition of use
976	DMR	Discharge Monitoring Report
977	DOT	Department of Transportation (U.S.)
978	ECHA	European Chemicals Agency
979	EPA	Environmental Protection Agency (U.S.)
980	ESD	Emission scenario document
981	GC/MS	Gas chromatography with mass spectroscopy
982	GS	Generic scenario
983	HEC	Human equivalent concentration
984	HED	Human equivalent dose
985	HEM	Human Exposure Model

986	HERO	Health and Environmental Research Online (Database)
987	HLC	Henry's Law constant
988	IAD	Intermediate absorbed dose
989	IIOAC	Integrated Indoor-Outdoor Air Calculator (Model)
990	Koc	Organic carbon:water partition coefficient
991	Kow	Octanol: water partition coefficient
992	LCAD	Lifetime chronic absorbed dose
993	LADC	Lifetime average daily concentration
994	LADD	Lifetime average daily dose
995	LCD	Life cycle diagram
996	LOD	Limit of detection
997	MCL	Maximum contaminant limit
998	MOE	Margin of exposure
999	NAICS	North American Industry Classification System
1000	ND	Non-detect
1001	NEI	National Emissions Inventory
1002	NESHAP	National Emission Standards for Hazardous Air Pollutants
1003	NHDPlus	National Hydrography Dataset Plus
1004	NIOSH	National Institute for Occupational Safety and Health
1005	NPDES	National Pollutant Discharge Elimination System
1006	NRC	National Response Center
1007	NTP	National Toxicology Program
1008	OCSP	Office of Chemical Safety and Pollution Prevention (EPA)
1009	OECD	Organisation for Economic Co-operation and Development
1010	OEHHA	Office of Environmental Health Hazard Assessment (California)
1011	OEL	Occupational exposure limit
1012	OES	Occupational exposure scenario
1013	ONU	Occupational non-user
1014	OPPT	Office of Pollution Prevention and Toxics (EPA)
1015	OSHA	Occupational Safety and Health Administration (U.S.)
1016	PBZ	Personal breathing zone
1017	PEL	Permissible exposure limit
1018	PESS	Potentially exposed or susceptible subpopulations
1019	PF	Protection factor
1020	POD	Point of departure
1021	POTW	Publicly owned treatment works
1022	PSC	Point Source Calculator
1023	RCRA	Resource Conservation and Recovery Act
1024	RQ	Risk quotient
1025	SACC	Science Advisory Committee on Chemicals
1026	SDS	Safety data sheet
1027	SDWA	Safe Drinking Water Act
1028	SEG	Similar exposure group
1029	SIC	Standard Industrial Classification
1030	SpERC	Specific Environmental Release Categories
1031	TRI	Toxics Release Inventory
1032	TSCA	Toxic Substances Control Act
1033	TSD	Technical support document
1034	TWA	Time-weighted average

1035	VOC	Volatile organic compound
1036	WHO	World Health Organization
1037	WQP	Water Quality Portal
1038	WWT	Wastewater treatment
1039	UF	Uncertainty factor
1040	U.S.	United States

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SUMMARY

This technical support document (TSD) is part of the *Draft Risk Evaluation for 1,1,2-Trichloroethane* ([U.S. EPA, 2026r](#)) conducted under section 6 of the Toxic Substances Control Act (TSCA). This draft TSD provides detailed information on approaches and methodologies used to assess human and ecological species exposures to 1,1,2-trichloroethane as well as individual assessments and results for the following:

1. Introduction (Section 1)
2. Physical and Chemical Properties of 1,1,2-Trichloroethane (Section 2)
3. Fate and Transport of 1,1,2-Trichloroethane (Section 3)
4. Environmental Releases of 1,1,2-Trichloroethane (Section 4)
5. Ambient Air Pathway Exposure Assessment (Section 5)
6. Surface Water and Sediment Pathway Exposure Assessment (Section 6)
7. Groundwater Pathway Assessment (Section 6)
8. Land Pathway Assessment (Section 8)
9. Bioaccumulation and Trophic Transfer (Section 9)
10. Occupational Exposure to 1,1,2-Trichloroethane (Section 10)
11. Consumer Exposure to 1,1,2-Trichloroethane (Section 11)

This draft TSD evaluates and characterizes exposure for acute and chronic non-cancer effects as well as cancer risk, where applicable, using tiered approaches for exposure (and associated risk) assessment. Although this TSD includes calculated risk estimates and comparison to relative benchmarks as part of the tiered approach, these values are only used by EPA to determine whether further investigation or additional, more refined analyses are necessary or warranted. The calculated risk estimates in this draft assessment are not intended to be used for risk conclusions in the TSD. Calculated risk estimates are based on margins of exposure (MOE) for acute and chronic non-cancer effects and cancer risk for cancer effects. Details on the MOE and cancer risk methodologies and calculations are presented in the *Draft Risk Evaluation for 1,1,2-Trichloroethane* ([U.S. EPA, 2026r](#)). The benchmarks used in this TSD are not “bright-lines” but refer to relevant benchmarks derived and presented in the *Draft Human Health and Environmental Hazard Assessment for 1,1,2-Trichloroethane* ([U.S. EPA, 2026l](#)).

Physical and Chemical Property Assessment (Section 2)

1,1,2-Trichloroethane is a volatile organic compound (vapor pressure = 23 mmHg at 25 °C) and is a clear, colorless liquid at standard temperature and pressure. It has a water solubility of 4,580 mg/L at 25 °C, is readily soluble in organic solvents, and has a Henry’s Law constant of 8.24×10^{-4} atm·m³/mol at 25 °C.

Fate and Transport Assessment (Section 3)

EPA’s assessment of the fate and transport of 1,1,2-trichloroethane suggests that it will tend to be in the vapor phase in ambient air. 1,1,2-Trichloroethane will be moderately volatile from water and partition to ambient air; however, a portion will remain dissolved in water due to its solubility. 1,1,2-Trichloroethane has low to moderate affinity for organic matter (organic carbon:water partition coefficient, log K_{oc} = 2.06) and therefore is not expected to partition strongly to organic phases in aqueous environments (e.g., suspended solids or sediments). In soil, it is expected to have moderate to high mobility with moderate to rapid migration to groundwater. Additionally, 1,1,2-trichloroethane has the potential to volatilize from surface soils based on its low Henry’s Law constant and is not expected to be present in land-applied biosolids. Fugacity modeling further suggests that air is likely to be the major environmental compartment; however, monitoring data and release data suggest that 1,1,2-trichloroethane will be present in groundwater and surface water—particularly deep, slow-moving waters.

Transformation processes of 1,1,2-trichloroethane in the environment include photodegradation, hydrolysis, and biodegradation; it is not expected to undergo direct photolysis but will react with free hydroxyl radicals in the ambient air. As a result, long-range transport of 1,1,2-trichloroethane via the ambient air pathway is possible. It will undergo biodegradation and hydrolysis in aquatic environments, but rates are expected to be slow and volatilization from water will occur more rapidly. 1,1,2-Trichloroethane is formed as the biodegradation product of other chlorinated ethanes, such as 1,1,1,2-tetrachloroethane, and will degrade in the environment to form products such as vinyl chloride, 1,2-dichloroethane, and ethene. Destruction and removal efficiency of 1,1,2-trichloroethane through incineration is expected to meet or exceed 99.99%. Removal efficiencies in wastewater treatment have been reported to vary from 29 to 96% depending on the removal method applied. Because 1,1,2-Trichloroethane has low bioaccumulation and bioconcentration potential, it is not expected to bioaccumulate in aquatic species or undergo trophic transfer.

Release Assessment (Section 4)

EPA's preliminary assessment of environmental releases from industrial processes relied upon industry-reported releases to a variety of publicly available databases including: the 2019 to 2023 Toxics Release Inventory (TRI; air, water, and land); 2017 and 2020 National Emissions Inventory (NEI; air); and the 2019 to 2023 Discharge Monitoring Report (DMR; water). The 1,1,2-trichloroethane release assessment identifies occupational exposure scenarios (OESs) to categorize releases based on similar process operations and creates a cross-walk of OES to conditions of use (COUs) under TSCA. Five OESs evaluated did not have reported releases so EPA estimated releases for those OESs using previously peer-reviewed modeling practices.

Ambient Air Pathway Exposure Assessment (Section 5)

EPA's ambient air pathway exposure assessment describes the tiered approach used to evaluate general population and wildlife population exposures to industrial releases of 1,1,2-trichloroethane via the ambient air pathway inhalation route. This includes discussions on assumptions, uncertainties, strengths, and limitations associated with the approaches and methodologies used for each tier of analysis. All the approaches and methodologies described in the tiered approach have previously undergone peer review and public comment, integrate recommendations from those reviews/public comments, and are applied specifically to 1,1,2-trichloroethane in Section 5.

Results from the highly conservative, upper-bounding Tier 1 analysis led EPA to conclude no additional refined analyses were necessary or warranted for acute non-cancer effects from exposure to 1,1,2-trichloroethane to the general population or acute or chronic non-cancer effects to the wildlife population. This is based on the preliminary findings that modeled concentrations did not result in calculated risk estimates less than the relative benchmark for acute non-cancer effects to the general population or risk quotients (RQs) exceeding 1 for acute or chronic non-cancer effects to the wildlife population. Therefore, the Tier 1 analysis is the final tier of analysis for both acute non-cancer effects to the general population and acute and chronic non-cancer effects to the wildlife population. It is carried forward into the *Draft Risk Evaluation for 1,1,2-Trichloroethane* ([U.S. EPA, 2026r](#)) for purposes of deriving risk estimates and risk characterization as well as informing risk determination and regulatory decision-making.

Results from the highly conservative, upper-bounding Tier 1 and Tier 2 analyses led EPA to conclude that additional, refined analyses to Tier 3 were necessary and warranted for chronic non-cancer and cancer effects to the general population for multiple facilities and multiple COUs. This is based on the findings that modeled concentrations from the Tier 1 and Tier 2 analyses resulted in calculated risk estimates (1) less than the relative benchmark for chronic non-cancer effects, and (2) greater than the

relative benchmark for cancer effects for multiple facilities and multiple COUs. The initial Tier 3 analyses continued to show modeled concentrations resulting in calculated risk estimates less than the relative benchmark for chronic non-cancer effects and greater than the relative benchmark for cancer effects for multiple COUs. Additional refinements within the Tier 3 analysis focused on removing certain conservative assumptions to increase confidence in the exposure scenarios evaluated demonstrated that no modeled concentrations resulted in calculated risk estimates less than the relative benchmark for chronic non-cancer effects or greater than the relative benchmark for cancer effects. Therefore, the Tier 3 analysis is the final tier of analysis for chronic non-cancer and cancer effects and carried forward into the *Draft Risk Evaluation for 1,1,2-Trichloroethane* ([U.S. EPA, 2026r](#)) for purposes of deriving risk estimates and risk characterization as well as informing risk determination and regulatory decision-making. Additional analysis and lines of evidence considered for chronic non-cancer and cancer effects provided additional support for EPA's conclusion that the Tier 3 analysis is the final tier of analysis necessary or warranted for this 1,1,2-trichloroethane ambient air exposure assessment.

Surface Water and Sediment Pathway Exposure Assessment (Section 6)

EPA's assessment of environmental media concentrations for the surface water, sediment, and drinking water pathways focuses on describing a tiered approach to evaluating chemical concentrations in these media using both facility-specific releases and generic scenario releases. This includes discussions on assumptions, strengths, and limitations associated with the approaches and methodologies used for each environmental media and tier of analysis. These calculated media concentrations are used for the characterization of potential general population exposures (incidental oral, incidental dermal, and drinking water) and environmental exposure (surface water and sediment).

EPA's assessment of general population exposure via surface water and drinking water was evaluated for incidental oral ingestion of surface water, incidental dermal exposure to surface water and ingestion of drinking water due to both facility-specific releases and generic scenario releases. Depending on route of exposure, multiple tiers of analysis are employed to refine potential exposures based on identified exposures indicating preliminary risk relative to their respective benchmark. These additional tiers aimed to increase confidence in estimated exposures. Following tiers of refinement, no exposures indicating preliminary risk were identified for facility-specific releases or generic scenario releases across all evaluated pathways and routes.

Groundwater Pathway Exposure Assessment (Section 6)

Monitoring data show that 1,1,2-trichloroethane is a commonly detected groundwater pollutant across the United States. The data also suggest that the highest levels of groundwater are due to previous contamination and are not primarily associated with continuing uses of 1,1,2-trichloroethane. Based on the overall weight of evidence, EPA is not considering groundwater exposure to the general population as part of this evaluation.

Land Pathway Exposure Assessment (Section 8)

EPA identified limited data on concentrations of 1,1,2-trichloroethane in soils. The Agency was unable to identify any soil studies in the United States from 2015 to 2025. The only soil 1,1,2-trichloroethane concentrations above the detection limit came from national and state monitoring databases and were associated with areas with contamination from underground petroleum storage tanks. Overall, the monitoring data suggest that 1,1,2-trichloroethane is not likely to be present in soils from landfills, biosolids, or air deposition. Additionally, the octanol:water partition coefficient (K_{ow}) and K_{oc} suggest that 1,1,2-trichloroethane will have moderate to high mobility in soils and will migrate to groundwater. The Henry's Law constant suggests that 1,1,2-trichloroethane can volatilize from surface soil. Additionally, the fugacity modeling suggests that air deposition is not likely to be a significant pathway

for exposure. 1,1,2-Trichloroethane is not expected to sorb to biosolids based on its K_{oc} and K_{ow}, with volatilization expected to be the major removal mechanism in wastewater treatment plants (WWTPs). Furthermore, based on its current uses and the TRI release data, 1,1,2-trichloroethane is not expected to be disposed of in non-hazardous landfills; however, it can be present in landfills due to biodegradation of other chlorinated ethanes, such as 1,1,1,2-tetrachloroethane. Based on the overall weight of evidence, EPA will not be conducting a quantitative exposure assessment for land pathways for either humans or the environment.

Bioaccumulation and Trophic Transfer (Section 9)

EPA modeled concentrations of 1,1,2-trichloroethane in surface water and sediment based on both reported facility-specific releases reported to the TRI and DMR databases as well as estimated generic scenario releases based on relevant OESs. EPA considered inhalation exposures to terrestrial species via the ambient air pathway. Concentrations of 1,1,2-trichloroethane in soil are likely to be low based on physical and chemical, fate, and transport properties described in Sections 2 and 3. There was also limited monitoring data showing measurable concentrations of 1,1,2-trichloroethane in soils associated with ongoing uses of the chemical. Therefore, EPA did not estimate soil exposure concentrations for ecological or human species.

Low bioaccumulation potential (Section 3.5.4), lack of empirical evidence for accumulation in fish (Section 3.5.4), and absence of dietary hazard information for wildlife ([U.S. EPA, 2026l](#)) indicate that 1,1,2-trichloroethane exposure and risk to piscivorous receptors via fish ingestion are not anticipated. Accordingly, a quantitative screening-level fish ingestion assessment was not conducted for ecological or human receptors.

Occupational Exposure Assessment (Section 10)

EPA assessed occupational inhalation and dermal exposure for OESs that were identified for the COUs of 1,1,2-trichloroethane. Where there was sufficient metadata in the source of the exposure data, the Agency was able to assess exposure for exposure groups that had been identified and monitored for the OES. For other OESs, exposures were assessed for the generic exposure groups of workers and occupational non-users (ONUs).

The hierarchy of inhalation exposure methods was followed to determine the method to estimate inhalation exposure for each OES. The highest available method in the hierarchy for each OES was used. Inhalation exposure data were collected and submitted to EPA as a requirement of a test order for the OES of Manufacturing as a Byproduct. This is the highest quality data available to the Agency as the data is collected specifically for risk evaluations, follows an EPA-approved sampling plan, and requires submission of metadata that has been specified by the Agency. The test order data were directly applicable to the OES of Manufacturing as a Byproduct at Chemical Manufacturing Facilities. The same data was also utilized as analogous data (same chemical, similar OES) to assess exposure for the following OESs: Processing as a Reactant; Formulation of Adhesives; Use of Laboratory Chemicals; and Disposal to Incineration.

Chemical specific area data was utilized to assess inhalation exposures for one OES (Disposal to Landfill). For two OESs (Disposal to POTW; Disposal to Non-POTW WWT), a combination of analogous data (from the test order) and high-quality data from a surrogate chemical (similar chemical, same OES) was utilized. For three of the OESs, surrogate chemical data available from previous EPA risk evaluations and from systematic review of the scientific literature were used to estimate inhalation exposure (Use of Adhesives and Sealants; Open-Top Vapor Degreasing; Cold Cleaning). The OES of Repackaging for Laboratory Chemical Use was assessed using a probabilistic modeling approach

considering that the repackaging could be associated with packaging into small size containers for laboratory chemical use.

Dermal exposure was assessed using the Dermal Exposure to Volatile Liquids (DEVL) Model, which EPA uses to assess potential dermal exposure to volatile chemicals. Chemical-specific data for the parameters of fraction absorbed obtained from a test order and data on weight percents of 1,1,2-trichloroethane as handled during the OESs was used. The dermal modeling also incorporated the variability in the value of fraction absorbed depending on the weight percent of 1,1,2-trichloroethane.

Chemical- and OES-specific data on the number of working years and frequency of exposure, where available such as from test orders were incorporated into estimates of doses for evaluation of chronic non-cancer and cancer risks. The use of personal protective equipment (PPE) can be an important exposure mitigating control and data on the use of PPE such as from test orders was documented for consideration in the risk characterization, in conjunction with information on PPE that EPA identified from other sources.

Consumer Exposure Assessment (Section 11)

EPA identified consumer products containing 1,1,2-trichloroethane available from all reasonably available sources including systematic review, market research, and available databases. Identifying these products helped provide parameters to build the exposure scenario for each possible pathway of exposure. EPA identified two products reasonably available to U.S. consumers. These products are both categorized under the Adhesive and sealants consumer COU. Both two products share a similar use pattern and share identical weight fractions for their 1,1,2-trichloroethane contents. EPA used one base scenario to represent the two products with high, medium, and low exposure models consisting of high, medium, and low values for parameters such as duration of use, weight fraction, and mass of product use. These parameters were selected because they would be the most sensitive parameters given the modeling tool.

EPA used the Consumer Exposure Model (CEM) to model inhalation risk given the high, medium, and low exposure scenarios while dermal absorption modeling was conducted via the fraction absorbed model spreadsheet outside of CEM; this is because CEM is known to overestimate the exposure for dermal absorption. EPA used all available data to determine the appropriate high, medium, and low values for each product. Manufacturer guides along with product safety data sheets (SDSs) were used to identify appropriate values for input parameters when CEM default values were not appropriate. Lifestages applicable to the possible use of the products containing 1,1,2-trichloroethane were limited to Youth 1 (11–15 years), Youth 2 (16–20 years), and Adults (21+ years). Given the pattern of use of the products, it would be unlikely that anyone outside these age groups would be a user. Therefore, exposures were only modeled for these lifestages. EPA's analysis found inhalation exposures did not result in risk estimates below the respective benchmarks for acute or chronic non-cancer effects for consumers utilizing the identified products. The Agency did not find dermal exposures below the respective benchmarks for acute or chronic-non-cancer effects under the highly conservative, high-end consumer exposure scenarios evaluated.

1 INTRODUCTION

This technical support document (TSD) presents the chemistry, fate, release, and exposure assessments (also referred to as the “draft exposure TSD”) in support of the TSCA *Draft Risk Evaluation for 1,1,2-Trichloroethane* (also referred to as the “draft risk evaluation”) ([U.S. EPA, 2026r](#)). The draft risk evaluation was conducted under the Frank R. Lautenberg Chemical Safety for the 21st Century Act, which amended TSCA on June 22, 2016. The new law includes statutory requirements and deadlines for actions related to conducting risk evaluations of existing chemicals.

Under TSCA section 6(b), EPA must designate chemical substances as high-priority substances for risk evaluation or low-priority substances for which risk evaluations are not warranted at the time. Upon designating a chemical as a high priority, the Agency must initiate a risk evaluation on the substance. TSCA section 6(b)(4) directs EPA to conduct risk evaluations for existing chemicals to “determine whether a chemical substance presents an unreasonable risk of injury to health or the environment, without consideration of costs or other non-risk factors, including an unreasonable risk to a potentially exposed or susceptible subpopulation identified as relevant to the risk evaluation by the Administrator under the conditions of use.”

TSCA section 6(b)(4)(D) and implementing regulations require that EPA publish the scope of the risk evaluation to be conducted—including the hazards, exposures, conditions of use and PESS that the Administrator expects to consider—within 6 months after the initiation of a risk evaluation. In addition, a draft scope is to be published pursuant to 40 CFR 702.41. In December 2019, EPA published a list of 20 chemical substances that have been designated high priority substances for risk evaluations (Docket ID: [EPA-HQ-OPPT-2019-0131](#)) (84 FR 71924, December 30, 2019), as required by TSCA section 6(b)(2)(B), which initiated the risk evaluation process for those chemical substances. 1,1,2-trichloroethane is one of the chemicals designated as a high priority substance for risk evaluation.

For this draft exposure TSD, EPA considers and describes use of reasonably available information to estimate environmental concentrations of 1,1,2-trichloroethane in different environmental media and evaluate exposures to ecological and human species resulting from those environmental concentrations. This draft exposure TSD includes the following assessments, organized into sections. Each assessment progressively informs other assessments, and, when taken together, inform the draft risk evaluation, draft risk determination, and regulatory decision-making.

This TSD evaluates and characterizes exposure for acute and chronic non-cancer effects as well as cancer risk, where applicable, using tiered approaches for exposure assessment. Results for all analyses, media, and exposed groups evaluated are presented in the body of this TSD, respective appendices, and associated supplemental files. While all media and exposed groups are considered, not all are evaluated quantitatively. Where a specific media or exposed group is not assessed quantitatively, a discussion and justification for a qualitative assessment is provided based on the Weight of Scientific Evidence, reasonably available information, physical/chemical/fate/transport properties, and other factors.

Although this TSD includes calculated risk estimates and comparison to relative benchmarks as part of the tiered approach, these values are only used by EPA to determine whether further investigation or additional, more refined analyses are necessary or warranted. The calculated risk estimates in this TSD are not intended to be used for risk conclusions in the TSD. Generally, findings where lower-tier, highly conservative exposure scenarios resulted in calculated risk estimates greater than respective benchmarks for acute or chronic non-cancer effects, or less than the respective benchmark for cancer effects, led EPA to determine additional, refined analysis may not be necessary or warranted as those findings are protective of all other less conservative scenarios and therefore no further analysis was conducted.

Findings where lower-tier, highly conservative exposure scenarios resulted in calculated risk estimates less than respective benchmarks for acute or chronic non-cancer effects, or greater than the respective benchmark for cancer effects, led EPA to determine additional, more refined analysis may be necessary or warranted to ensure the exposure scenarios are representative of actual exposures and operating conditions, therefore further investigation or refined analysis was conducted. Calculated risk estimates used to inform the decision to refine or not refine are based on Margins of Exposure (MOE) for acute and chronic non-cancer effects and cancer risk for cancer effects. Details on the MOE and cancer risk methodologies and calculations are presented in the *Draft Risk Evaluation for 1,1,2-Trichloroethane* ([U.S. EPA, 2026r](#)). The benchmarks are not bright lines but refer to relevant benchmarks derived and presented in the *Draft Hazard Assessment for 1,1,2-trichloroethane* ([U.S. EPA, 2026r](#)).

A risk estimate is defined as a calculated, or estimated, probability of harm that exceeds established thresholds, warranting further investigation, mitigation, or regulatory action. It is a critical component of risk characterization, integrating hazard identification, exposure assessment, and dose-response data to determine the likelihood and severity of adverse effects.

The exposures (and associated calculated risk estimates) are focused on informing the level of exposures for a given media and exposed group, the likelihood of adverse effects under conservative exposure scenarios, and whether refined, higher tiers of analyses are necessary or warranted to ensure high-end exposures are not missed while maintaining representative exposures to human and ecological species. While all results are presented in this TSD, only results from the highest tier of analysis completed for a given media or exposed group are carried into the risk evaluation and relied upon to derive risk estimates which inform risk characterization in the *Draft Risk Evaluation for 1,1,2-Trichloroethane* ([U.S. EPA, 2026r](#)).

2 PHYSICAL AND CHEMICAL PROPERTY ASSESSMENT

2.1 Approach and Methodology for Physical and Chemical Property Assessment

EPA gathered and evaluated physical and chemical property data ([U.S. EPA, 2026h](#)) and information according to the process described in the *Draft Systematic Review Protocol Supporting TSCA Risk Evaluations, Version 1.0: A Generic TSCA Systematic Review Protocol with Chemical-Specific Methodologies* (also called the “2021 Draft Systematic Review Protocol”) ([U.S. EPA, 2021b](#)). During the evaluation of 1,1,2-trichloroethane, EPA considered both measured and estimated physical and chemical property data (Table 2-1). Due to the relative availability of data, only measured data with an overall data quality determination of “high” were considered for use in determining the representative physical and chemical properties of 1,1,2-trichloroethane for most properties for this draft risk evaluation. For flash point, only one high-quality data point was available, so the one medium-quality data point was also considered for this parameter.

When a specific data point is selected as the value to be used for a given physical and chemical parameter, priority is given to data from expert-curated, peer-reviewed databases that have been identified as “trusted sources” ([U.S. EPA, 2021b](#)). If no data are available from trusted databases, second preference is given to measured data from studies that implement experimental measurements according to established test guidelines or which are conducted according to scientific principles with sufficient documentation. Finally, estimated, or calculated data are only presented in the instance that no measured data is available. The systematic review process identified multiple data with the same quality rating for many physical-chemical properties discussed in this document. Some of these data were duplicates that were initially extracted more than once (e.g., when multiple databases cite the same study), but were later removed during data curation before any further analysis. Much of the remaining data were collected under standard environmental conditions (i.e., 20–25 °C and 760 mmHg).

2.2 Final Selected Physical and Chemical Property Values for 1,1,2-Trichloroethane

Table 2-1. Summary of Physical and Chemical Property Values for 1,1,2-Trichloroethane

Property	Selected Value(s)	Reference(s)	Data Quality Rating
Molecular formula	C ₂ H ₃ Cl ₃	NA	NA
Molecular weight	133.41 g/mol	NA	NA
Physical form	Clear, colorless liquid at room temperature with a sweet, chloroform-like odor	O'Neil (2013) Dreher et al. (2014) NIOSH (2007)	High
Melting point	−36.5 °C	OEHHA (2011) Rumble (2018a)	High
Boiling point	114 °C	NIOSH (2007) U.S. EPA (2019b)	High
Density	1.4416 g/cm ³ at 20 °C	NCBI (2020a) NLM (2018) O'Neil (2013)	High

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Property	Selected Value(s)	Reference(s)	Data Quality Rating
Vapor pressure	23 mmHg at 25 °C	RIVM (2007) NLM (2018) U.S. EPA (2019b)	High
Vapor density	4.21 (relative to air = 1)	NLM (2018) NCBI (2020a)	High
Water solubility	4,580 mg/L at 25 °C	Rumble (2018b) NLM (2018)	High
Octanol:water partition coefficient (log K _{ow})	2.05 at 25 °C	Elsevier (2019) Mueller and Klein (1992) OECD (2000)	High
Henry's Law constant	8.24E-4 atm·m ³ /mol at 25 °C	NLM (2018) U.S. EPA (2019b)	High
Flash point	32 °C	Rumble (2018c)	High
Autoflammability	460 °C	Rumble (2018c) Dreher et al. (2014)	High
Viscosity	1.69 cP 20 °C	NLM (2018)	High
Refractive index	1.4711 at 20 °C	O'Neil (2013) NLM (2018) Dreher et al. (2014)	High
Dielectric constant	7.28 at 20 °C	Elsevier (2019)	High

2.2.1 Endpoint Assessments

2.2.1.1 Physical Form

1,1,2-Trichloroethane is a clear, colorless liquid with a sweet, chloroform-like odor under ambient conditions ([Dreher et al., 2014](#); [O'Neil, 2013](#); [NIOSH, 2007](#)).

2.2.1.2 Melting Point

Melting point, an inherent chemical property that informs the chemical's physical state (liquid or solid) under environmental conditions, is the temperature at which a chemical substance coexists as its solid and liquid forms in equilibrium under atmospheric pressure (1 atmosphere) ([Rumble, 2021](#)). Physical state information helps assessors understand the chemical's environmental fate and transport. It also helps to inform the chemical's potential exposure routes and bioavailability. EPA extracted 10 values from 11 high-quality sources. Values from one source were extracted as a range of -37.4 to -35.5 °C. Nine values were extracted as discrete values ranging from -37 to -34 °C, with a mean of -36.23 °C and a median of -36.5 °C. Two values (-35 °C and -36.5 °C) were reported by multiple sources and were only considered once when calculating summary statistics. EPA selected a value of -36.5 °C as it is near the median of the high-quality values and comes from a trusted source ([Rumble, 2018a](#); [OEHHA, 2011](#)).

2.2.1.3 Boiling Point

Boiling point is an inherent property that informs the chemical's physical state (*i.e.*, liquid or gas). The boiling point is the temperature at which a chemical substance exists in equilibrium as a vapor and liquid under atmosphere pressure ([Rumble, 2021](#)). EPA extracted 13 values from high-quality sources. One

value was extracted as mean of 12 sources, with value of 113.7 °C ([NIST, 2022](#)). Three sources reported ranges of 113 to 114.1 °C ([Elsevier, 2019](#); [NLM, 2018](#); [O'Neil, 2013](#)). For the six values extracted as discrete values, the range of reported values was 113 to 114 °C, with a mean of 113.4 °C and median of 113.8 °C. Three values (113 °C, 113.8 °C, and 114 °C) were reported by multiple sources and were only considered once when calculating summary statistics. EPA selected a value of 114 °C as it is close to the median of the discrete values ([U.S. EPA, 2019b](#); [NIOSH, 2007](#)).

2.2.1.4 Density

Density is the chemical substance mass per unit volume (*e.g.*, g/mL) and is an inherent property that informs assessor about the chemical's mobility in the environment. EPA extracted 12 values from high-quality sources collected at temperatures ranging from 20 to 30 °C. Two values (1.4416 g/cm³ and 1.4397 g/cm³) were reported by multiple sources, and each was only considered once when calculating summary statistics. For values reported at the environmentally relevant temperature of 20 °C, values ranged from 1.4397 to 1.4432 g/cm³, with a mean 1.4411 of and a median of 1.4410. EPA selected a value of 1.4416 g/cm³ at 20 °C as it is near the mean and median and it is reported by multiple trusted sources ([NCBI, 2020a](#); [NLM, 2018](#); [O'Neil, 2013](#)).

2.2.1.5 Vapor Pressure

Vapor pressure indicates the pressure exerted by a liquid or solid chemical in equilibrium with its vapor at a given temperature (approximately 20-25°C for environmental conditions) (40 CFR 796.1950). Vapor pressure informs the assessors the extent to which a chemical substance has the potential to volatilize and be released into the atmosphere. Vapor pressure can help be used in estimation of concentrations in air and in predicting releases of a chemical to air. A chemical's potential to be present in air is expected to increase as vapor pressure increases. EPA extracted 31 values from 13 high-quality sources collected at temperatures from -36.05 to 113.75 °C. For values reported at the environmentally relevant temperature of 25 °C, values range from 21.8 to 30.3 mmHg, with a mean of 23.8 mmHg and median of 23.2 mmHg. One value (23 mmHg) was reported across three sources ([U.S. EPA, 2019b](#); [NLM, 2018](#); [RIVM, 2007](#)) and was only considered once when calculating summary statistics. EPA selected a value of 23 mmHg at 25 °C as it is close to both the mean and median as is reported by multiple trusted sources ([U.S. EPA, 2019b](#); [NLM, 2018](#); [RIVM, 2007](#)).

2.2.1.6 Relative Vapor Density

Vapor density is the mass of a vapor per unit volume ([U.S. EPA](#); accessed May 4, 2026), and relative vapor density is the ratio between the vapor density of a chemical substance and the vapor density of air (1.0). Relative vapor densities greater than one indicate a higher potential to sink in ambient air, while relative vapor densities less than one indicate a higher potential to rise in ambient air. The vapor density helps to predict the fate and transport of chemical substances when released to air. EPA selected a relative vapor density of 4.21 as it was the only value extracted from two high-quality sources ([NCBI, 2020a](#); [NLM, 2018](#)).

2.2.1.7 Water Solubility

Water solubility indicates the maximum amount of a chemical that will be dissolved in pure water. Water solubility informs many portions in the assessment, not only in fate and transport in the environment, but also when modeling industrial processes and estimating human and ecological hazards and exposure. Chemical substances with high water solubility are expected to readily disperse through the environment. EPA extracted 24 values from high-quality sources reported at temperatures ranging from 0 to 50 °C. Seventeen values were extracted from high-quality sources at the environmentally-relevant temperatures of 20 to 25 °C. Three values (4,000 mg/L, 4,420 mg/L, and 4,500 mg/L) were reported by multiple sources, and each was only considered once when calculating summary statistics.

Solubilities at environmentally relevant temperatures ranged from 3,500 to 4,800 mg/L, with a mean of 4,320 mg/L and a median of 4,417 mg/L. The minimum value of 3,500 mg/L at 25 °C was identified in an OECD Screening Information Data Sets report and was conducted using OECD method 105; however, the original study information could not be identified ([OECD, 2000](#)). Other evaluations and authoritative databases report higher solubilities in the range of 4,000 to 4,800 mg/L. EPA selected a value of 4,580 mg/L at 25 °C because it is near the median and is reported in multiple trusted databases ([NLM, 2018](#); [Rumble, 2018b](#)).

2.2.1.8 Octanol:Water Partition Coefficient (log K_{ow})

The octanol-water partition coefficient (K_{ow}) is the ratio of a substance's concentration in n-octanol to that in water at equilibrium, and indicates hydrophobicity and potential for sorption and bioaccumulation ([U.S. EPA, 2026](#); accessed May 4, 2026). EPA extracted 11 values from high-quality sources. Three low K_{ow} values (1.89, 2.05, and 2.38) were reported by multiple sources and were considered only once when calculating summary statistics. Reported values ranged from 1.89 to 2.63, with a median of 2.06. EPA selected a value of 2.05 at 25 °C as it is close to the median ([Elsevier, 2019](#); [OECD, 2000](#); [Mueller and Klein, 1992](#)).

2.2.1.9 Henry's Law Constant

The Henry's Law constant is the ratio of the concentration of a chemical substance in air (or vapor) to the concentration of the chemical substance in water at equilibrium ([U.S. EPA, 2026](#); accessed May 4, 2026). The Henry's Law constant (atm·m³/mol) provides an indication of a chemical substance's volatility from water and gives an indication of environmental partitioning, potential removal during wastewater treatment, and routes of environmental exposure. EPA extracted ten values from high-quality sources at temperatures ranging from 20 to 30 °C, with one study not specifying the temperature. The range of reported values across all temperatures was 6.52×10⁻⁴ to 1.14×10⁻³ atm·m³/mol. For this evaluation, EPA is considering values collected at the environmentally relevant temperature of 25 °C. Two of the six values reported at 25 °C (9.08×10⁻⁴ atm·m³/mol and 8.24×10⁻⁴ atm·m³/mol) were reported by multiple sources and were only considered once when calculating summary statistics. The range of values at 25 °C was 6.52×10⁻⁴ to 9.1×10⁻⁴ atm·m³/mol, with a mean of 8.23×10⁻⁴ atm·m³/mol and a median of 8.66×10⁻⁴ atm·m³/mol. EPA selected a value of 8.24×10⁻⁴ atm·m³/mol at 25 °C because it is near the mean and median and was reported by multiple trusted sources ([U.S. EPA, 2019b](#); [NLM, 2018](#)).

2.2.1.10 Flash Point

Flash point is the lowest temperature at which a substance produces sufficient vapor to form an ignitable mixture with air ([U.S. EPA, 2026](#); accessed May 4, 2026). Flash point helps assessors understand the fire hazards of a chemical substance. EPA extracted one high-quality study for this property. EPA also considered one medium-quality study for this parameter. The high-quality study reported a value of 32 °C, while the medium quality study reported a value of 114 °C. Flash point is not an intrinsic property and depends on the method used (*i.e.*, closed cup or open cup). Neither source, which are both databases and not primary sources, states which method was used. EPA selected a value of 32 °C as it is the only value reported from a high-quality source ([Rumble, 2018c](#)). The source for the selected value did not indicate if the value was collected using the open or closed cup method.

2.2.1.11 Autoflammability

Autoflammability is the lowest temperature at which a chemical substance will spontaneously ignite without a spark or flame ([Rumble, 2021](#)). Autoflammability helps assessors understand the fire hazards of a chemical substance. EPA selected a value of 460 °C as it was the only value extracted and was reported by two high-quality sources ([Rumble, 2018c](#); [Dreher et al., 2014](#)).

2.2.1.12 Viscosity

Viscosity is the expected flow resistance of a chemical substance due to the molecular friction within a fluid ([U.S. EPA](#); accessed May 4, 2026). Viscosity helps assessors understand the transport of a chemical substance release directly to the environment. EPA extracted four values from high-quality sources. One source was extracted as a range of eight values from 1.076 to 1.49846 at temperatures 20 to 25 °C ([Elsevier, 2019](#)). One value (1.20 cP) was collected at 20 °C ([Dreher et al., 2014](#)) and two values (1.105 cP and 1.69 cP) were collected 25 °C ([NLM, 2018](#); [Sathyanarayana et al., 2007](#)). EPA selected a value of 1.69 cP at 25 °C because it was extracted from a trusted source ([NLM, 2018](#)).

2.2.1.13 Refractive Index

Refractive index is the ratio of the speed of light in vacuum to its speed in the substance. It supports identification and purity checks and can track composition changes in solutions. EPA extracted five values from high-quality sources. One source reported a range of values of 1.447 to 1.4773 (unitless) ([Elsevier, 2019](#)). The other four reported values ranging from 1.471 to 1.4714, with a mean of 1.4712 and a median of 1.4711. A single value (1.4711) was reported by several sources and was counted only once when calculating summary statistics. EPA selected a value of 1.4711 as it is the median value from sources not reported as range and is the value reported by multiple trusted sources ([NLM, 2018](#); [Dreher et al., 2014](#); [O'Neil, 2013](#)).

2.2.1.14 Dielectric Constant

Dielectric constant (relative permittivity) is a dimensionless measure of a substance's ability to store electrical energy in an electric field relative to a vacuum. It reflects polarity and influences miscibility in water, partitioning, and how the substance behaves in processes and instruments. EPA extracted five values from high-quality sources. One of these values was reported as a range of 8.45 to 8.65 (unitless) at temperatures of -35.7 to -20.2 °C. Three of the values were collected at 20 °C and ranged from 7.12 to 7.29, with a mean of 7.23 and median of 7.28. EPA selected a value of 7.28 at 20 °C because it is the median of the values at the environmentally relevant temperature of 20 °C ([Elsevier, 2019](#)).

2.3 Strengths, Limitations, Assumptions, and Key Sources of Uncertainty for the Physical and Chemical Property Assessment

The physical and chemical property data discussed in the document were the product of a systematic review of reasonably available information. The data analysis, therefore, considered only a subset of all physical and chemical data—not an exhaustive acquisition of all potential data. Due to cross-referencing between many of the databases identified and assessed through the systematic review process, there is potential for data from one primary source to be collected multiple times resulting in duplication within the dataset. This duplication should be considered as a potential source of uncertainty in the data analyses because repeated values could have an impact on the calculated mean and median; however, data-collection procedures and expert judgement were used to minimize this possibility whenever possible. Data extracted as a range of values were excluded from the calculations unless expert judgement could identify precise data points within the range.

Additional sources of uncertainty in these reported physical and chemical values may be inherent to the measurement of the data point itself. For example, sources of uncertainty may be related to the instrumental method and precision with which a data point is measured and reported in the data source. Finally, all data were assumed to be collected under standard environmental conditions (*i.e.*, 20 to 25 °C and 760 mmHg), unless otherwise specified.

3 FATE AND TRANSPORT ASSESSMENT

Fate parameters including biotic and abiotic degradation rates, removal during wastewater treatment, volatilization from lakes and rivers, and organic carbon:water partition coefficient (log K_{OC}) are used to characterize transport and partitioning pathways, identify the environmental persistence potential, identify major environmental pathways, and assess the bioaccumulation potential of 1,1,2-trichloroethane. In assessing the environmental fate and transport of 1,1,2-trichloroethane, EPA considered the full range of results from data that were rated high- and medium-quality. Information on the full extracted data set is available in the *Draft Data Quality Evaluation and Data Extraction Information for Environmental Fate and Transport for 1,1,2-Trichloroethane* ([U.S. EPA, 2026g](#)). Other fate estimates were based on modeling results from EPI Suite™ ([U.S. EPA, 2012](#)), a predictive tool for physical and chemical properties and environmental fate estimation.

3.1 Approach And Methodology for Fate and Transport Assessment

EPA conducted a partitioning assessment to identify the environmental compartments (*i.e.*, surface water, sediment, biosolids, soil, groundwater, air) of major and minor relevance to the fate and transport of 1,1,2-trichloroethane. EPA also conducted fugacity modeling to identify the fate pathways and media most likely to cause exposure as a result of environmental releases. Media-specific fate analyses, which incorporate the partitioning assessment and monitoring data, were performed as described in Section 3.4.

3.1.1 Modeling Inputs

The physical and chemical properties necessary for running EPI Suite™ to estimate fate and fugacity properties of 1,1,2-trichloroethane and performing long range transport modeling are presented in Table 2-1 and in Section 3.1.1.1 were used as inputs.

3.1.1.1 EPI Suite™ Fugacity Modeling

The partitioning approach described by Mackay et al. ([1996](#)) using the Level III Fugacity Model in EPI Suite™ was employed to inform how environmental releases of 1,1,2-trichloroethane partition between environmental compartments (air, water, sediment, and soil). EPI Suite™ was reviewed by the EPA Science Advisory Board ([SAB, 2007](#)), and the individual models that comprise EPI Suite™ have been peer reviewed through publication in technical journals. Citations for the supporting manuscripts are available in the EPI Suite™ help files. The model predicts the partitioning of a substance between air, water, soil, and sediment, and can aid in identifying major and minor compartments for environmental exposure to the compound in question. The Level III Fugacity Model is described as a steady-state, non-equilibrium model that includes the processes of degradation, advection (flow out of evaluative environment) and intermedia transfer. The Level III fugacity model requires the input of physical and chemical properties for 1,1,2-trichloroethane, releases to each compartment of the evaluative environment, and half-lives in each compartment. Physical and chemical properties used in EPI Suite™ are reported in Table 2-1.

The K_{OC} and K_{OW} values control the partitioning in the water compartment, which comprises water, suspended sediment, and aquatic biota. A log K_{OC} of 2.06 was selected for the fugacity modeling (Section 3.2). Due to the wide range of variability seen with biodegradation data in water, soil, and sediment, a half-life of 365 days was selected for those compartments to simulate slow biodegradation rates (Section 3.3.1). Hydrolysis, with a half-life on the order of decades to centuries, was not considered as part of the fugacity analysis as it is likely to be much slower than biodegradation (Section 3.3.2). A half-life of 54.6 days was selected for air, based on the indirect photolysis reaction rate with $\cdot OH$ (Section 3.3.3). All other environmental parameters (*e.g.*, advection times) were left at default values (Appendix H).

For fugacity modeling, EPA used TRI releases from the reporting years of 2023 because it is the most recent year of reporting data considered in this assessment. In 2023, TRI land releases were 25,040 kg. The highest individual release in 2023 was categorized in TRI as “Off-site—other landfills.” This release was a transfer to a waste handling facility that also reports to TRI. In 2023, the waste handling facility reported that greater than 99% of the total 1,1,2-trichloroethane it received was incinerated, with 0.4 pounds being categorized in TRI as “Total other on-site disposal or other releases.” For the fugacity modeling, EPA assumed the entirety of the 25,040 kg release was incinerated and that the air releases from the incineration were captured in the waste handling facility’s TRI reporting. Therefore, the releases used for fugacity modeling were 21 kg to water, 9,772 kg to air, and 7 kg to land (note that TRI reported releases are post control and account for destruction and removal efficiencies). The model was also run for three additional release scenarios with 100% releases to either water, land, or water, and one scenario with equal releases to all media.

3.1.1.2 Long Range Transport Modeling

The potential for long-range transport was assessed using the OECD Pov and LRTP Screening Tool ([Wegmann et al., 2009](#)). The tool includes features that are recommended by the OECD expert group on multimedia modeling. It incorporates a fugacity-based steady state multimedia mass balance model of a global evaluative environment representing soil, water, and the troposphere. In addition to calculating overall environmental persistence (Pov), the model provides two other indicators of long-range transport: characteristic travel distance (CTD) and transfer efficiency (TE). CTD is the distance from the point of release of the chemical to the point at which the concentration of the chemical has dropped to 1/e, or about 37% of its initial value. CTDs are calculated for emissions to air and water and only transport in the medium that received the release is considered. Because soil is not considered mobile, no CTD is calculated for emissions to soil. The tool considers multiple emissions modes to air, water, and soil and reports maximum values for Pov, CTD (except for soil), and TE. Transfer efficiency is the ratio of the mass flux of a substance into an environmental compartment and the emissions mass flux. TE is calculated for emissions to air, water, and soil, and is an indicator of how much of an emission reaches a distant target.

The 1,1,2-trichloroethane chemical properties required as input for the model were taken from Table 2-1. The half-lives in air, water, and soil were estimated to be 1,310 hours (54.6 days), 8,760 hours (365 days), and 8,760 hours (365 days), respectively. The half-life in air is based on the indirect photolysis reaction rate. Due to the wide range of variability seen with biodegradation data in water and soil, a half-life of 365 days (8,760 hours) was selected for those compartments to simulate low biodegradation rates.

3.1.2 Evidence Integration

EPA gathered and evaluated physical and chemical property data and environmental fate information according to the process described in the 2021 *Draft Systematic Review Protocol Supporting TSCA Risk Evaluation* ([U.S. EPA, 2021b](#)). During the evaluation of 1,1,2-trichloroethane, EPA considered both measured and estimated data and information as applicable. Information and fully extracted datasets are available in the *Draft Data Quality Evaluation and Data Extraction Information for Environmental Fate and Transport for 1,1,2-Trichloroethane* ([U.S. EPA, 2026g](#)). The values selected are based on an overall judgement of the strength of the scientific evidence and conclusions regarding the properties and fate of 1,1,2-trichloroethane.

1657 **Table 3-1. Environmental Fate Properties for 1,1,2-Trichloroethane^a**

Property or Endpoint	Value ^a	Reference(s)	Data Quality Rating
Direct photodegradation (Section 3.3.3)	Not expected to be susceptible because light absorption at wavelengths >290 nm was negligible	Rathbun (1998)	Medium
Indirect photodegradation (Section 3.3.3)	$t_{1/2} = 54.6$ days (based on $\cdot\text{OH}$ rate constant of $1.96\text{E-}13 \text{ cm}^3/\text{mole-sec}$ with $[\cdot\text{OH}] = 1.5\text{E}06 \cdot\text{OH}/\text{cm}^3$) ^b	U.S. EPA (2012)	High
Hydrolysis half-life (Section 3.3.2)	$t_{1/2} = 85$ days at pH 9 and 25 °C	OECD (2000)	High
	$t_{1/2} = 37\text{--}25,400$ years at pH 7 and 25 °C	Rathbun (1998)	Medium
	$t_{1/2} = 904$ years at pH 7 and 10 °C		
	$t_{1/2} = 3,020$ years at pH 5.6 and 25 °C		
	$t_{1/2} = 21,300$ years at pH 5.6 and 10 °C		
Aerobic biodegradation (aquatic) (Section 3.3.1)	5% over 28 days (OECD 301C)	OECD (2000)	High
Aerobic biodegradation (soil) (Section 3.3.1)	$t_{1/2} = 6$ months–1 year	NCBI (2020b)	Medium
Anaerobic biodegradation (aquatic) (Section 3.3.1)	64% over 250 days	Hunkeler et al. (2002)	High
	100% over 8 days at 35 °C	Enzinger (1988)	Medium
Anaerobic biodegradation (sediment) (Section 3.3.1)	100% over 21 days	Chen et al. (1996)	High
	$t_{1/2} = 6$ days, 26 days, 335 days, 16 years (in aquifer with 1, 0.1, 0.01, 0.001% organic carbon content)	NCBI (2020b)	Medium
Anaerobic biodegradation (soil) (Section 3.3.1)	$t_{1/2} = 722\text{--}1,444$ days	NCBI (2020b)	Medium
Bioconcentration factor (BCF) (L/kg)	0.7–2.6 in carp (<i>Cyprinus carpio</i>) when exposed to 0.3 mg/L for 6 weeks at 25°C;	OECD (2000)	High

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Property or Endpoint	Value ^a	Reference(s)	Data Quality Rating
wet weight) (Section 3.5.4)	2.9–4.0 in carp (<i>Cyprinus carpio</i>) when exposed to 0.03 mg/L for 6 weeks at 25 °C		
	Upper trophic level = 6.59 ^b ; Middle trophic level = 5.31 ^b ; Lower trophic level = 4.91 ^b	U.S. EPA (2012)	High
Bioaccumulation factor (BAF) (L/kg lipid weight, unless noted) (Section 3.5.4)	Upper trophic level = 6.59 ^b ; Middle trophic level = 5.31 ^b ; Lower trophic level = 4.91 ^b	U.S. EPA (2012)	High
Removal in wastewater treatment (Section 3.5.2)	70.8±7.1% (with pre-exposed acclimated biomass) in pilot-scale activated sludge system from Cincinnati, OH	Bhattacharya et al. (1996)	High
	>29%, >94%, 96% in U.S. POTWs	U.S. EPA (1982)	High
	27.43% ^b	U.S. EPA (2012)	High
POTW = publicly owned treatment works ^a The selection and description of the endpoints presented in this table is presented in Sections 3.2 through 3.5. These endpoints were used to inform the fate transport conclusions (Section 3.6) ^b Measured unless otherwise noted ^c Information was estimated using EPI Suite™ (U.S. EPA, 2012)			

3.2 Partitioning

EPA conducted a partitioning analysis to identify the environmental compartments (*i.e.*, surface water, sediment, biosolids, soil, groundwater, air) of major and minor relevance to the fate and transport of 1,1,2-trichloroethane. The partitioning analysis also helps to identify the fate pathways and media most likely to cause exposure as a result of environmental releases. Media-specific fate analyses are described in Section 3.4.

Environmental transport and partitioning consist of processes such as volatilization, advection, dispersion, diffusion, association with dissolved organic matter, and sorption to solids. These processes, in turn, are controlled by physical and chemical interactions between 1,1,2-trichloroethane and the surrounding media (*e.g.*, air, water, soil, sediments, etc.). 1,1,2-Trichloroethane released to the environment is subject to these processes, though some processes are more likely than others based on its physical, chemical, and fate characteristics. To understand and predict the fate of 1,1,2-trichloroethane in the environment, EPA identified partition coefficients that can provide insight into how 1,1,2-trichloroethane will favor one media over another.

EPA identified a log K_{ow} value of 2.05 through the systematic review process (see Section 2.2.1.8 for a detailed description of the selection process). EPA also identified a Henry's Law constant of 8.24×10⁻⁴ atm·m³/mol through its systematic review process (see Section 2.2.1.9 for a detailed description of the selection process), which was then converted to a unitless air-water partition coefficient (K_{AW}), as shown in Table 3-2.

EPA identified five studies reporting measured organic carbon:water partition coefficient (K_{OC}) values.

Gan (1989) measured soil partition coefficients using two soils with organic carbon percentages of 0.5 and 0.9%. For the two soils, the study reported mean values of 85 and 174 mL/g, based on the average of three replicates for each soil. The study used a carrier (Penreco Oil 2257, which is a mixture of organic chemicals meant to represent petroleum wastes) and therefore the results may not be representative of the partitioning behavior of 1,1,2-trichloroethane as a discrete chemical. Wilson (1981) measured a log K_{oc} for the pure chemical of approximately 1.9 g organic carbon/gram dry soil using a sandy soil with an organic carbon percentage of 0.087%. Rathburn (1998) reported K_{oc} values of 60 (forest soil, 0.2% organic carbon), 63.7 (agricultural soil, 2.2% organic carbon), and 108 (forest soil, 3.7% organic carbon) for three different soils (these values were originally measured by Seip (1986)). Measured log K_{oc} values of 2.94 (0.206% organic carbon), 2.31 (0.5% organic carbon) 1.35 (16.9% organic carbon), and 2.63 (0.136% organic carbon) were measured for four soils collected near Lake Charles, Louisiana (UT Austin, 1987). K_d values of 0.13, 0.48, and 1.03 were measured for a silty clay (0.11% organic carbon), Pleistocene clay (0.25% organic carbon), and Pleistocene sand (1.13% organic carbon), respectively, by Valsaraj (1999). The K_d values were then converted to log K_{oc} values of 1.63, 2.07, and 2.28 using Equation 3-1. The authors of this study acknowledge that sorption to soil is affected by mineral surface interactions in addition to organic carbon; however, for the purposes of this evaluation, when studies only reported an overall soil:water partition coefficient, K_{oc} values were calculated using the following equation, which assumes that sorption to organic carbon is the driving factor.

Equation 3-1.

$$K_d = f_{oc} \times K_{oc}$$

Where:

K_d = soil:water partition coefficient

K_{oc} = organic carbon normalized partition coefficient

f_{oc} = fraction of organic carbon

An additional study estimated a log K_{oc} of 1.75 using a fragment constant model (RIVM, 2007). Another source reported log K_{oc} values of 1.87 and 1.99; however, it is not clear what methods were used to determine these values and therefore they are not being considered quantitatively (Poole and Poole, 1999). The geometric mean of the measured log K_{oc} values is 2.06 and is the value that will be used for the partitioning analysis in this assessment.

EPA identified one measured octanol:air partition coefficient (log K_{OA}) of 3.4 for pure 1,1,2-trichloroethane (U.S. EPA, 2012). EPA identified one study that reported a log oil-air partition coefficient of 2.93 to 3.03; however, the organic partitioning medium was Perenco Oil 2257, which is a mixture of organic compounds that was meant to represent petroleum waste, and not octanol (Gan and Dupont, 1989).

Overall, the vapor pressure (23 mmHg) and Henry's Law constant (8.24×10^{-4} atm·m³/mol) suggest that air will be the major environmental compartment for 1,1,2-trichloroethane. Further, the K_{OA} suggests that 1,1,2-trichloroethane will exist primarily as a vapor in the ambient air. The log K_{AW} of -1.47 indicates that 1,1,2-trichloroethane will be moderately volatile from water and partition to air, but that a portion will remain dissolved in water (solubility = 4,580 mg/L at 25 °C). The log K_{ow} (2.05) and log K_{oc} (2.06) values indicate that 1,1,2-trichloroethane is unlikely to partition strongly to organic phases when in the aqueous phase. This means that in water, 1,1,2-trichloroethane is not expected to adsorb to suspended solids or sediments and is expected to have high mobility in soil. Additionally, 1,1,2-trichloroethane is likely to volatilize from surface soils based on its Henry's Law constant and vapor pressure.

Table 3-2. Partitioning Values for 1,1,2-Trichloroethane

Partition Coefficient	Value	Log Value	Source(s)
Octanol:water (K_{ow})	112	2.05	Elsevier (2019) ; OECD (2000) ; Mueller and Klein (1992)
Organic carbon:water (K_{oc})	114	2.06	Geometric mean of values reported in Valsaraj et al. (1999) ; Rathbun (1998) ; Gan and Dupont (1989) ; UT Austin (1987) ; Wilson et al. (1981)
Octanol:air (K_{OA})	2,511	3.4	U.S. EPA (2012)
Air:water (K_{AW})	0.034 ^a	-1.47 ^a	U.S. EPA (2019b) ; NLM (2018)
^a Calculated using Henry's Law constant reported in Table 2-1.			

3.2.1 Fugacity Modeling

Fugacity modeling was conducted to identify the media most likely to be impacted by environmental releases and which media, and corresponding exposure pathways, should be evaluated. Environmental degradation half-lives were selected for each media based on their predominant transformation pathway.

The results of the fugacity analysis suggest that 1,1,2-trichloroethane tends to stay in the media of release (Figure 3-1). The fugacity analysis assumes constant releases to each media and that the system is at steady state. When 1,1,2-trichloroethane is continuously released solely to air, 96% will remain in air, with small amounts partitioning to water (3%) and soil (1%) when at steady state. When continuously released solely to water, approximately 84% of 1,1,2-trichloroethane will remain in water, 15% will partition to air, and less than 1% to each sediment and soil when at steady state. Similarly, when continuously released solely to soil, 1,1,2-trichloroethane will primarily remain in soil (84%), with 13% partitioning to air, 3% partitioning to water, and less than 1% partitioning to sediment when at steady state. For the equal release scenario, which assumes equal releases of 33% each to air, water, and land, 1,1,2-trichloroethane will predominantly remain in the media of release, with a slight increase in the partitioning to soil, assuming steady-state and constant releases.

The 2023 TRI releases, which had approximately 99% of releases going to air, were used as a release scenario for fugacity modeling. The results of the modeling showed that at steady state, air (95%) would be the primary compartment, with small amounts partitioning to water (4%), soil (2%), and sediment (<1%) (Figure 3-1).

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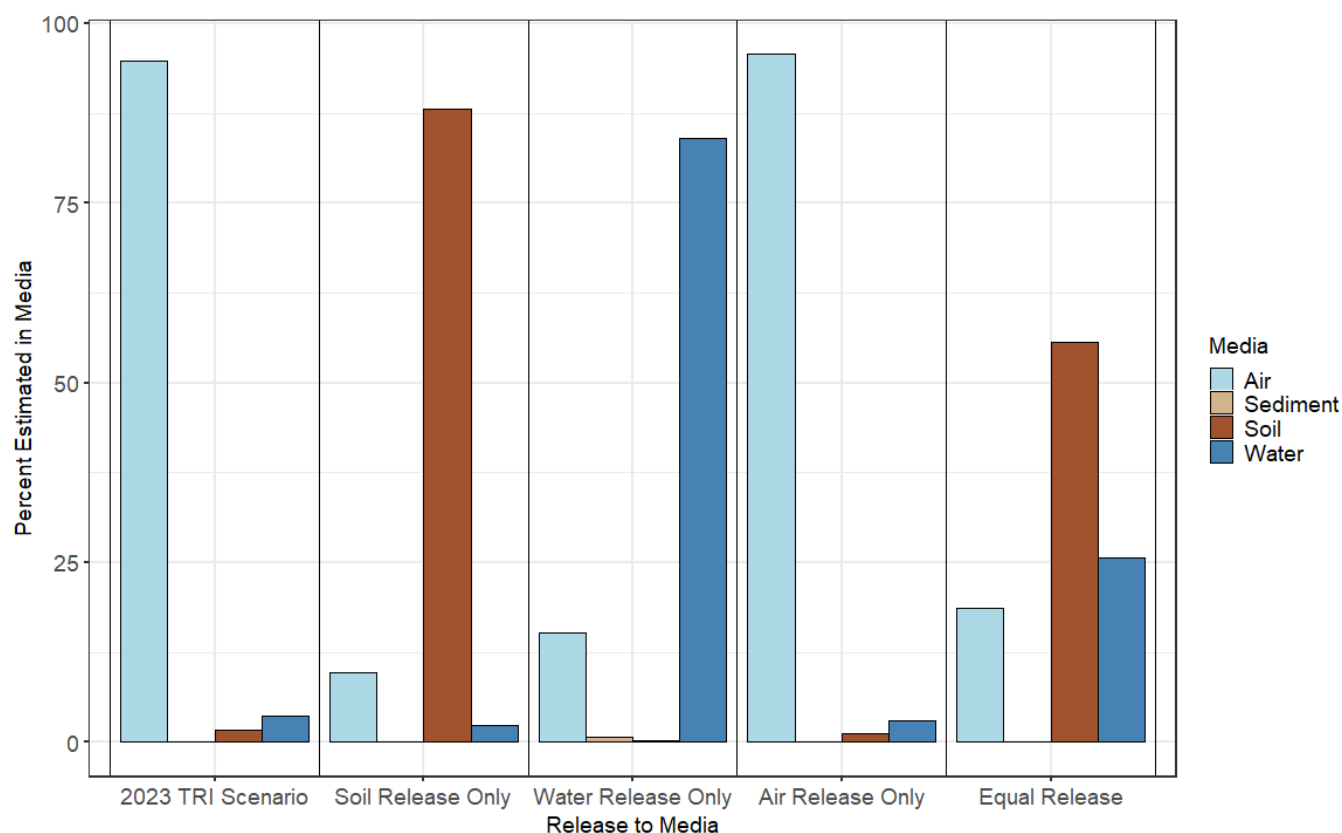


Figure 3-1. EPI Suite™ Level III Fugacity Modeling Graphical Result for 1,1,2-Trichloroethane

3.3 Transformation Processes

1,1,2-Trichloroethane can undergo various transformation processes in environmental media that affect its persistence and retention in the environment. Transformation processes include photodegradation, hydrolysis, and biodegradation.

3.3.1 Biodegradation

In aerobic aquatic environments, 1,1,2-trichloroethane showed negligible biodegradation. An OECD 301C study reported that 1,1,2-trichloroethane is not readily biodegradable with 5% degradation over a 28-day incubation period (OECD, 2000). Under anaerobic environments, 1,1,2-trichloroethane may show higher biodegradability. One study reported slow biotransformation of 1,1,2-trichloroethane after a lag period of 40 days with 64% biodegraded after 250 days to vinyl chloride and ethene (Hunkeler et al., 2002). Another study reported 100% conversion to vinyl chloride and 1,2-dichloroethane in 8 days but at an elevated temperature of 35 °C (Enzminger, 1988).

In sediment, anaerobic biodegradation of 1,1,2-trichloroethane was reported as 100% in 21 days (Chen et al., 1996). The inoculum used was anaerobic sludge from laboratory-scale municipal sludge digester that had been preconditioned with chlorinated solvents. 1,1,2-Trichloroethane was reported to simultaneously biodegrade into vinyl chloride (80% via dichloroelimination) and 1,2-dichloroethane (20% via dechlorination) (Chen et al., 1996). Ethene was also reported to subsequently form by either reductive dechlorination of vinyl chloride or by dichloroelimination of 1,2-dichloroethane, but the predominant precursor was not identified with only 3% being converted to ethene (Chen et al., 1996). Additionally, 1,1,2-trichloroethane was identified as a product of biotic transformation of 1,1,2,2-tetrachloroethane under methanogenic conditions (Chen et al., 1996). The biodegradation half-life of

1,1,2-trichloroethane in an unpolluted anaerobic aquifer was reported as 6 days, 26 days, 335 days, and 16 years based on the organic carbon content of the aquifer material of 1, 0.1, 0.01, and 0.001%, respectively (NCBI, 2020b). No study was identified for aerobic biodegradation in sediment.

In soil, when 1,1,2-trichloroethane was applied to a column filled with sandy soil, no loss was attributed to biodegradation. Both aerobic and anaerobic biodegradation in soil were reported to be slow with half-lives between 6 months and 1 year under aerobic conditions and between 722 and 1,444 days under anaerobic conditions (NCBI, 2020b).

3.3.2 Hydrolysis

1,1,2-Trichloroethane is hydrolyzed under alkaline conditions. 1,1,2-Trichloroethane has a hydrolysis half-life of 85 days at pH 9 and 25 °C (OECD, 2000), but at pH 7 and 25 °C, the hydrolysis half-life of 1,1,2-trichloroethane was reported to range between 37 and 25,400 years (Rathbun, 1998). The half-life of 25,400 years only accounts for neutral hydrolysis rate and does not account for base catalyzed hydrolysis, which is likely to dominate (Jeffers et al., 1989); when excluding the half-life of 25,400 years, hydrolysis half-lives reported by Rathburn (1998) ranged from 37 to 904 years. Moreover, the hydrolysis half-lives were reported as 904 years at pH 7 and 10 °C, 3,020 years at pH 5.6 and 25 °C, and 21,300 years at pH 5.6 and 10 °C (Rathbun, 1998), indicating that hydrolysis of 1,1,2-trichloroethane does not happen under acidic conditions and at lower temperature. Another study reported a hydrolysis half-life of 139 years at pH 7 and 25 °C, again indicating that hydrolysis will be slow (Jeffers et al., 1989).

3.3.3 Direct and Indirect Photodegradation

Direct photodegradation is not expected because 1,1,2-trichloroethane does not have an absorption band in UV and spectral range of sunlight (Rathbun, 1998). In the air, 1,1,2-trichloroethane is expected to exist in the vapor phase where it may react with photochemically produced hydroxyl radicals (indirect photodegradation) at rates corresponding to a half-life of 54.6 days based on the $\cdot\text{OH}$ rate constant of $1.96 \times 10^{-13} \text{ cm}^3/\text{molecule}\cdot\text{sec}$ and 12-hour day with $1.5 \times 10^6 \cdot\text{OH}/\text{cm}^3$ (U.S. EPA, 2012). No studies were identified with data on photolysis of 1,1,2-trichloroethane in soil or water.

3.4 Media Assessments

3.4.1 Air and Atmosphere

Ambient air is likely to be the major environmental compartment for 1,1,2-trichloroethane based on the partitioning analysis, which was based largely on the fugacity modeling results with releases scaled to TRI releases. 1,1,2-Trichloroethane is not expected to undergo significant direct photolysis because it does not absorb radiation in the environmentally available region of the electromagnetic spectrum that has the potential to cause molecular degradation (Rathbun, 1998). 1,1,2-Trichloroethane in the vapor phase will be degraded by reaction with photochemically produced hydroxyl radicals in the atmosphere with a half-life of 54.6 days based on an $\cdot\text{OH}$ rate constant of $1.96 \times 10^{-13} \text{ cm}^3/\text{mole}\cdot\text{sec}$ with an $\cdot\text{OH}$ concentration of $1.5 \times 10^6 \cdot\text{OH}/\text{cm}^3$ (U.S. EPA, 2012). Based on a log K_{OA} of 3.4 (U.S. EPA, 2019b; NLM, 2018), 1,1,2-trichloroethane is not expected to associate strongly with airborne particles. The results of the Level III Fugacity Model in EPI Suite™ using environmental releases of 1,1,2-trichloroethane reported to TRI for the year 2023 indicate that at steady state, greater than 94% of the mass of 1,1,2-trichloroethane released to the environment will partition to the air compartment.

The potential for long-range transport was assessed using the OECD Pov and LRTP Screening Tool due to an expected atmospheric half-life of 54.6 days (U.S. EPA, 2012), significant vapor pressure (23 mmHg) (Section 2.2.1.5), and reported releases to air. The tool estimated an overall environmental

1826 persistence of 189 days, a characteristic travel distance (CTD) of 25,628 km, and a transport efficiency
1827 (TE) of 21%. These results suggest that 1,1,2-trichloroethane has the potential to undergo long-range
1828 transport and a moderate percentage will reach a distant target.

1830 A review of the data in the Ambient Monitoring Technology Information Center (AMTIC) Archive
1831 shows 1,1,2-trichloroethane has consistently been measured in ambient air across the U.S. during the
1832 years of 2019 to 2022. These years were chosen to be consistent with the release assessment used in the
1833 evaluation; however, 2023 data were not available at the time of this evaluation, so the analysis of
1834 AMTIC data was limited to 2019 to 2022 ([U.S. EPA, 2022b](#)). Reported concentrations range from
1835 below detection to 23.4 $\mu\text{g}/\text{m}^3$, with detection limits ranging from 0.014 to 1.63 $\mu\text{g}/\text{m}^3$. Concentrations
1836 above the detection limit were measured in 27 states and Washington D.C. A more detailed description
1837 of the AMTIC Archive data and data collected during systematic review is provided in Section 5.

1838 **3.4.1.1 Key Sources of Uncertainty in the Assessment of Air and Atmosphere**

1839 Based on the fugacity modeling, monitoring data, transport modeling, and physical and chemical
1840 properties, EPA has robust confidence that air will be a major environmental compartment for 1,1,2-
1841 trichloroethane and that it will exist as a vapor in the atmosphere. The atmospheric half-life was based
1842 on one measured value, so there is slight uncertainty in the accuracy of this value. Additionally, while
1843 the transport modeling suggests that 1,1,2-trichloroethane could undergo long range transport to remote
1844 regions, EPA did not identify any literature documenting long range atmospheric transport.

1845 **3.4.2 Aquatic Environments**

1846 1,1,2-Trichloroethane is most likely to enter surface waters and sediments through direct and indirect
1847 discharges from industrial and municipal wastewater treatment plants. 1,1,2-Trichloroethane has a
1848 hydrolysis half-life greater than 37 years at pH 7 and 25 °C (Section 3.3.2); therefore, hydrolysis is not
1849 expected to be an important fate process. Based on the measured range of log K_{oc} values from 1.35 to
1850 2.95, partitioning from the water column to suspended sediments is not expected to be an important
1851 process for 1,1,2-trichloroethane (Section 3.2). A Henry's Law constant of $8.24 \times 10^{-4} \text{ atm} \cdot \text{m}^3/\text{mol}$ at 25
1852 °C indicates that 1,1,2-trichloroethane may volatilize from surface waters. Biodegradation in water is
1853 expected to be slow based on an OECD 301 study showing 5% biodegradation over 28 days (Section
1854 3.3.1). Overall, the evidence suggests that biodegradation and hydrolysis can occur, but rates are
1855 expected to be slow and volatilization from water will be the predominant removal mechanism ([NCBI,
1856 2020b](#)).

1857 **3.4.2.1 Surface Water**

1858 1,1,2-Trichloroethane released to surface water will be subject to loss primarily via volatilization to air.
1859 Biodegradation, hydrolysis, and sorption to suspended and benthic sediments will be minor removal
1860 processes (Section 3.3). A half-life for volatilization from a model river was estimated using the WVOL
1861 Model in EPI Suite™ ([U.S. EPA, 2012](#)), which uses a two-film concept for estimating the flux of
1862 volatiles across the air-water interface ([Liss and Slater, 1974](#)). For a model river 1 m deep with a current
1863 velocity of 1 meter per second (m/s) and a wind velocity of 5 m/s, a volatilization half-life of
1864 approximately 2.0 hours was calculated. Volatilization can vary significantly based on the characteristics
1865 of the water body. For instance, in a deep, slow-moving river (depth of 10 m, wind speed of 0.5 m/s,
1866 current speed of 0.1 m/s) 1,1,2-trichloroethane has an estimated volatilization half-life of 2,722 hours
1867 ([U.S. EPA, 2012](#)). Therefore, although volatilization is expected to be an important loss mechanism in
1868 many surface waters ([NCBI, 2020b](#)), some 1,1,2-trichloroethane will remain in water due to its water
1869 solubility (4,580 mg/L), especially at locations with frequent releases of 1,1,2-trichloroethane to surface
1870 water, such as at wastewater treatment plant (WWTP) outfalls. A review of Water Quality Portal (WQP)
1871 showed concentrations in surface water ranging from below detection to 50 $\mu\text{g}/\text{L}$, with detection limits

ranging from 5×10^{-4} to 0.5 $\mu\text{g/L}$; however, these data are not necessarily spatially or temporally associated with actual releases and therefore are not wholly representative of potential concentrations in environment. A more detailed description of the Water Quality Portal (WQP) data and data collected during systematic review is provided in Section 6.

3.4.2.2 Sediments

1,1,2-Trichloroethane released to water is not expected to significantly partition to organic matter in suspended and benthic sediments based on measured log K_{oc} values ranging from 1.35 to 2.95 (Section 3.2) (NCBI, 2020b). K_{oc} represents the ratio of the concentration of 1,1,2-trichloroethane sorbed to the organic carbon in sediment or soil to the concentration of 1,1,2-trichloroethane in the overlying water at equilibrium. For comparison, highly hydrophobic chemicals that are known to partition to and accumulate in sediments, such as polychlorinated biphenyls (PCBs) have measured K_{oc} values in the range of 10,000 to 100,000 or greater. 1,1,2-Trichloroethane was observed to have half-lives of 6 days to 16 years in an unpolluted aquifer under anaerobic conditions (Section 3.3.1). The large difference in half-lives was ascribed to differences in the organic content of the sediment (NCBI, 2020b). Additionally, 1,1,2-trichloroethane was reported to be completely degraded under anaerobic conditions using a preconditioned inoculum of sludge from a laboratory-scale municipal sludge digester (Section 3.3.1). These results show that 1,1,2-trichloroethane has the potential to undergo reductive dechlorination; however, the overall weight of evidence using inoculums that are most relevant to sediments suggest that biodegradation in sediment will be slow. Further, given its solubility (4,580 mg/L at 25 °C), there is potential for 1,1,2-trichloroethane to be present in sediment pore water and potentially be bioavailable to benthic organisms.

3.4.2.3 Key Sources of Uncertainty in the Assessment of Aquatic Environments

EPA has robust confidence that the hydrolysis rate of 1,1,2-trichloroethane will be very slow at pH 7, which is representative of surface waters, with the estimated half-lives ranging from 37 to 25,000 years (Section 3.3.2). Air deposition to soil was not quantitatively assessed in this evaluation. Air deposition is discussed qualitatively in Section 8.1.3.1. Biodegradation and volatilization are likely to be the two major mechanisms of loss for 1,1,2-trichloroethane from aquatic environments. Volatilization from surface water is likely to be rapid, on the order of hours in shallow, fast-moving water, but this estimate is not based on empirical evidence, so there is uncertainty in the exact rate of volatilization. Volatilization is also dependent on local conditions, such as wind speed, water depth, and current speed and volatilization half-lives can be on the order of months in deep, slow-moving waters. Additionally, EPA identified limited data on the biodegradation of 1,1,2-trichloroethane in water (Section 3.3.1). The available evidence suggests that aquatic biodegradation half-lives will be in the range of months to years. There is limited data showing the presence of 1,1,2-trichloroethane in surface waters or sediment; however, its solubility suggests that it could be present in sediment pore water and surface waters near WWTP outfalls.

3.4.3 Terrestrial Environments

1,1,2-Trichloroethane can potentially be present in terrestrial environments due to processes such as migration of surface water to groundwater, leaching from unlined or improperly maintained landfills, and land application of biosolids. Limited data directly applicable to the fate of 1,1,2-trichloroethane were found in the literature search conducted as part of the systematic review. The available data were used in combination with the high-quality soil sorption data, the physical and chemical properties, and modeling done using EPI Suite™ to help inform the fate assessment of 1,1,2-trichloroethane in terrestrial environments.

Overall, the measured log K_{oc} values ranging from 1.35 to 2.95 suggest that 1,1,2-trichloroethane will

have a low to moderate affinity for organic matter and will undergo moderate to rapid migration to groundwater in terrestrial environments. Additionally, based on its vapor pressure (23 mmHg at 25 °C) and Henry's Law constant (8.24×10^{-4} atm·m³/mol at 25 °C), 1,1,2-trichloroethane will also be subject to volatilization from surface soils. Due to its solubility (4,580 mg/L at 25 °C), 1,1,2-trichloroethane has the potential to be bioavailable in soil pore water.

3.4.3.1 Biosolids

Sewage sludge is the solid, semi-solid, or liquid residue generated by wastewater treatment processes. The term "biosolids" refers to treated sludge that meets the EPA pollutant and pathogen requirements for land application and surface disposal (40 CFR part 503) ([U.S. EPA, 1993](#)).

Given the Henry's Law constant (8.24×10^{-4} atm·m³/mol at 25 °C), vapor pressure (23 mmHg at 25 °C), and data presented in Section 3.5.2, volatilization is expected to be the major removal mechanism for 1,1,2-trichloroethane from WWTPs, with some additional loss due to biodegradation. 1,1,2-Trichloroethane is not expected to partition to sludge during the treatment process and is therefore unlikely to be present in land-applied biosolids. EPA did not identify any monitoring data that showed the presence of 1,1,2-trichloroethane in treated biosolids. Further, 1,1,2-trichloroethane was not monitored for in the National Sewage Sludge Surveys or Biennial Reviews. Overall, the evidence suggests that land application of biosolids is not likely to be a major exposure route.

3.4.3.2 Soil

Based on its measured K_{oc} values, 1,1,2-trichloroethane is expected to have low to moderate affinity for organic matter in soil; therefore, 1,1,2-trichloroethane will likely be subject to migration through surface soil and unlined landfills to groundwater. 1,1,2-Trichloroethane is expected to be present and potentially bioavailable in soil porewater due to its water solubility of 4,580 mg/L. Given the Henry's Law constant and the vapor pressure, 1,1,2-trichloroethane has the potential to volatilize from soil surfaces ([NCBI, 2020b](#)). EPA did not identify any entries in the WQP for soils with concentrations above the detection limit (detection limits ranged from 0.17 to 500,000 µg/kg) for the years 2019 to 2023 (these years were chosen to be consistent with the releases used in this assessment). 1,1,2-Trichloroethane is expected to undergo slow biodegradation in soil (Section 3.3.1). One study reported aerobic half-lives between 6 months and 1 year and anaerobic half-lives between 722 and 1,444 days ([NCBI, 2020b](#)). Overall, soils are not expected to be a significant source of exposure for 1,1,2-trichloroethane due to the likelihood of 1,1,2-trichloroethane to migrate to groundwater and its potential to volatilize from surface soils.

3.4.3.3 Landfills

Landfill leachate is generated by excess rainwater percolating through the waste layers of a landfill. Pollutants such as 1,1,2-trichloroethane can be transferred from the landfilled waste material to the percolating leachate through combined physical, chemical, and microbial processes ([Christensen et al., 2001](#)). Compounds in leachate entering an aquifer will be subject to dilution as the leachate mixes with groundwater. 1,1,2-Trichloroethane is listed under Subtitle C of the Resource Conservation and Recovery Act (RCRA). For the reporting years of 2019 to 2023, TRI land releases ranged from 6 to 25,040 kg/year. The two highest annual releases (5,279 and 25,033 kg) were categorized in TRI as "Off-site—other landfills." These two releases, which occurred in 2022 and 2023, were transfers to a waste handling facility that also reports to TRI. In 2022 and 2023, the waste handling facility reported that greater than 99% of the total 1,1,2-trichloroethane it received was incinerated, with 2 pounds being categorized in TRI as "Total other off-site disposal or other releases" in 2022 and 0.4 pounds being categorized in TRI as "Total other on-site disposal or other releases" in 2023.

While 1,1,2-trichloroethane is not expected to be present in significant quantities in non-hazardous,

Subtitle D landfills, it could be present due to disposal of consumer products or the biodegradation of other chlorinated solvents, such as 1,1,2,2-tetrachloroethane. Due to its K_{oc} , 1,1,2-trichloroethane is expected to be relatively mobile in landfill leachate and would migrate to groundwater. EPA identified limited data on concentrations of 1,1,2-trichloroethane in landfills or landfill leachate. One study did report groundwater concentrations of 7.7 to 31 $\mu\text{g/L}$ at sites located near municipal solid waste landfills in Minnesota, indicating that 1,1,2-trichloroethane could migrate to groundwater near landfills (NCBI, 2020b; Sabel and Clark, 1984). While biodegradation and hydrolysis are slow at ambient temperatures (on the order of months to decades), higher temperatures and reducing conditions that occur in lower portions of landfills might increase the rates of these processes (Section 3.3).

3.4.3.4 Groundwater

1,1,2-Trichloroethane released to land (*e.g.*, via landfills without adequate leachate controls) can migrate through soil and reach groundwater. A geometric mean log K_{oc} value of 2.06 indicates that 1,1,2-trichloroethane will have low affinity for organic matter in soils and will likely migrate to groundwater. 1,1,2-Trichloroethane has a hydrolysis half-life of approximately 37 to 25,000 years (Section 3.3.2), indicating that loss through hydrolysis is not expected in groundwater. Losses of 1,1,2-trichloroethane in groundwater will be due mainly to biodegradation. One study reported biodegradation half-lives of 6 days to 16 years in anaerobic aquifer sediments (NCBI, 2020b).

1,1,2-Trichloroethane in groundwater has been reported in monitoring studies and the WQP. Concentrations reported in the WQP range from below detection to 110 $\mu\text{g/L}$, with detection limits ranging from 0.0349 to 0.5 $\mu\text{g/L}$. The overall detection frequency was 2.8% (34 out of 1,202 samples). A more detailed description of the WQP data and data collected during systematic review is provided in Section 7.1.1. As described in Section 3.4.3.3, one study did report groundwater concentrations of 7.7 to 31 $\mu\text{g/L}$ at sites located near municipal solid waste landfills in Minnesota (NCBI, 2020b; Sabel and Clark, 1984). Another study reported concentrations of 9×10^{-4} to 0.2 mg/L in groundwater near an industrial facility in Florida (Monsanto, 1987). Two studies detected concentrations in groundwater in New Jersey, with one study detecting concentrations up to 31.1 $\mu\text{g/L}$, based on 1,069 samples and a detection frequency of 6.7% (NCBI, 2020b; Greenberg et al., 1982; Page, 1981). The results of the monitoring studies suggest that 1,1,2-trichloroethane is present in groundwater across the U.S.; however, most of the sampling is below detection and detectable concentrations may be the result of legacy disposal or transformation of more highly-chlorinated substances rather than direct release of 1,1,2-trichloroethane from COUs (Section 7.1.1).

3.4.3.5 Key Sources of Uncertainty in the Assessment of Terrestrial Environments

1,1,2-Trichloroethane can volatilize from surface soils; however, there is uncertainty as to the rate as there is little empirical data. Biodegradation is expected to be the major degradation pathway in the subsurface, with half-lives on the order of months to years in both aerobic and anaerobic conditions. There is considerable uncertainty in these rates though, as they were estimated based on a limited number of studies and the studies present a wide range of rates. Additionally, soil characteristics (*e.g.*, organic carbon and pH) can vary laterally and vertically, which can affect transport and biodegradation rates. While releases to land are expected to be low, there are occasionally high releases to landfills reported to TRI, and there is uncertainty as to the ultimate type of disposal/treatment method for these large releases.

3.5 Persistence Potential of 1,1,2-Trichloroethane

Based on the data described in Section 3.3.3, 1,1,2-trichloroethane is expected to be persistent in air based on its indirect photolysis half-life of 54.6 days. 1,1,2-Trichloroethane is also expected to be persistent in groundwater due to its slow anaerobic biodegradation, with half-lives on the order of years

to decades depending on the environmental conditions, and slow hydrolysis, unless the groundwater is alkaline.

3.5.1 Destruction and Removal Efficiency

Incineration of waste 1,1,2-trichloroethane from industrial activities is expected to occur at hazardous waste incinerators at a Destruction and Removal Efficiency (DRE) of 99.99%. Regulations at 40 CFR part 63, Subpart EEE – National Emission Standards for Hazardous Air Pollutants from Hazardous Waste Combustors, require all hazardous waste combustors (incinerators, cement kilns, lightweight aggregate kilns, solid fuel boilers, liquid fuel boilers, and hydrochloric acid production furnaces) to achieve a DRE of 99.99% for each principal organic hazardous constituent (POHC) including 1,1,2-trichloroethane.

3.5.2 Removal in Wastewater Treatment

A study of a pilot-scale activated sludge system with a 4-day solids retention time (SRT) and 7.5-hour hydraulic retention time (HRT) spiked with 11 toxic organics each at a concentration of 0.25 mg/L reported a total removal efficiency for 1,1,2-trichloroethane as 70.8 ± 7.1 % with 37.0 ± 14.4 % attributed to stripping and 31.7 ± 8.2 % attributed to biodegradation ([Bhattacharya et al., 1996](#)). The estimated biodegradation of 1,1,2-trichloroethane in this study may be considered high due to the usage of pre-exposed acclimated biomass.

A report on publicly owned treatment works (POTWs) summarized removal efficiencies of pollutants at 40 plants across 25 different states in the U.S. ([U.S. EPA, 1982](#)). The removal efficiencies were measured as the reduction in concentration of a pollutant from the influent to the secondary effluent, and three plants reported removal efficiencies for 1,1,2-trichloroethane as greater than 29%, greater than 94%, and 96%, averaging to approximately 73% between the three reported values. However, the effect of the detection limit of the analytical method hinders drawing accurate conclusions about the removal rates. Moreover, the specific removal mechanisms (*e.g.*, biodegradation, adsorption, clarification, air stripping, etc.) were not identified.

The STPWIN model within EPI Suite™ estimated a total removal of approximately 28%, of which 2% was attributed to sludge adsorption and 26% to air transfer ([U.S. EPA, 2012](#)). These values were determined assuming 10,000-hour half-lives for primary clarifier, aeration vessel, and settling tank, and thus negligible biodegradation. This assumption is justified by the slow aerobic and anaerobic biodegradation rates observed in biodegradation studies (Section 3.3.1). Moreover, the biodegradation potential from preadapted microbial consortium is neglected which suggests that actual removal and biodegradation of 1,1,2-trichloroethane may be different in wastewater treatment plants.

The uncertainty in wastewater treatment removal efficiencies for 1,1,2-trichloroethane is considerable, as measured data range from 29 to 96%. The average removal efficiency for POTWs (73%) closely aligns with the measured data of a pilot-scale system (70.8 ± 7.1 %) ([Bhattacharya et al., 1996](#)), and thus, is an acceptable figure. Nonetheless, the removal efficiency could be as low as the estimated 28% for conservative evaluations.

3.5.3 Removal in Drinking Water Treatment Plants

Removal of 1,1,2-trichloroethane in drinking water treatment is expected to be primarily due to volatilization. While volatilization is expected to be low in conventional flocculation, coagulation, and sedimentation treatment processes, advanced treatment processes (*e.g.*, granular activated carbon and packed tower aeration) are expected to be efficient at removing 1,1,2-trichloroethane ([U.S. EPA, 2009](#)).

3.5.4 Bioaccumulation Potential of 1,1,2-Trichloroethane

1,1,2-Trichloroethane is not expected to bioaccumulate in aquatic organisms with reported data indicating low bioconcentration factors (BCF). An OECD 305C study reported BCF values in carp (*Cyprinus carpio*) as 0.7 to 2.6 and 2.9 to 4.0 when exposed to concentrations of 0.3 and 0.03 mg/L, respectively, at 25 °C for 6 weeks ([OECD, 2000](#)).

The BCF and BAF values for different trophic levels within an aquatic ecosystem were estimated using the Arnot-Gobas methods in EPI Suite™. The estimated BCF and BAF values for the upper, middle, and lower trophic levels were 6.59, 5.31, and 4.91 L/kg, respectively ([U.S. EPA, 2012](#)).

3.5.5 Key Sources of Uncertainty in the Assessment of Overall Persistence Potential

There is uncertainty in the persistence of 1,1,2-trichloroethane in surface waters. Volatilization is expected to be the major removal mechanism in shallow surface waters, with an estimated half-life on the order of hours; however, volatilization will be much slower in deep, slow-moving waters. The overall weight of evidence suggests that biodegradation and hydrolysis are both expected to be slow in surface waters. There is also uncertainty in the persistence in soils and sediments, due to uncertainty associated with the biodegradation rates; however, 1,1,2-trichloroethane is likely to volatilize from surface soils and be mobile in the subsurface since it is not likely to sorb strongly to either soils or sediments.

EPA did not identify Destruction and Removal Efficiency (DRE) values for 1,1,2-trichloroethane, so EPA is assuming a DRE based on emissions standards specified for hazardous air pollutants in the Clean Air Act. There is considerable variation in the reported wastewater removal efficiencies, with measured efficiencies in full-scale WWTPs ranging from 29 to 96%. Volatilization is expected to be the major removal mechanism, but removal efficiencies will depend on the specific treatment processes used (e.g., diffused aeration, mechanical aeration, or attached growth treatment). Biodegradation is expected to be slow in WWTPs, but some WWTPs can have microbial communities that are adapted to and can degrade 1,1,2-trichloroethane. There are limited data on removal of 1,1,2-trichloroethane from drinking water treatment plants; however, advanced treatment processes (e.g., granular activated carbon and packed tower aeration) are expected to remove 1,1,2-trichloroethane efficiently.

Although EPA only identified one study reporting a measured BCF, the study followed OECD guidelines; therefore, EPA has strong confidence in the BCF value. There is also uncertainty in the BAF as there were no empirical studies measuring this value, meaning that EPA relied on the modeled result from EPI Suite™. Additionally, no information was identified regarding 1,1,2-trichloroethane in terrestrial organisms or higher-level trophic levels for aquatic organisms.

3.6 Fate and Transport Conclusions

EPA evaluated the reasonably available environmental fate and transport information for 1,1,2-trichloroethane. The following are major conclusions from EPA's evaluation:

- Environmental distribution
 - 1,1,2-Trichloroethane is a volatile liquid that is soluble in water. 1,1,2-Trichloroethane is generally expected to be released to air and primarily remain in air; however, when released to soil or sediment, significant portions of 1,1,2-trichloroethane will remain in the media of release.
 - The presence of 1,1,2-trichloroethane in some environmental media could be due to the biodegradation of higher chlorinated ethanes, such as 1,1,2,2-tetrachloroethane. 1,1,2-Trichloroethane can also be biodegraded to produce lesser chlorinated ethanes and

- ethenes, such as 1,1-dichloroethane and vinyl chloride.
- Fate and transport in air
 - 1,1,2-Trichloroethane released to air is expected to remain in air and exist as a vapor.
 - 1,1,2-Trichloroethane will react with hydroxyl radicals, with an estimated half-life of approximately 55 days.
 - Based on the release patterns according to TRI and the relatively long half-life, air is expected to be an important medium for exposure.
 - Fate and transport in soil
 - 1,1,2-Trichloroethane released to soil can be subject to volatilization to air, biodegradation, runoff to surface water, and infiltration to groundwater.
 - Due to its low affinity for soil organic matter ($\log K_{oc} = 2.06$), 1,1,2-trichloroethane is expected to migrate rapidly to groundwater.
 - Fate and transport in surface water and sediment
 - In surface water, 1,1,2-trichloroethane will be subject to volatilization to air, slow biodegradation, advection, dispersion, and dilution.
 - Due to its solubility (4,580 mg/L), continuous releases of 1,1,2-trichloroethane to deep, slow moving surface waters will result in a portion remaining in water and some potentially being bioavailable in sediment pore water.
 - Fate and transport in groundwater
 - When released to land, 1,1,2-trichloroethane will have low affinity for organic matter and will rapidly migrate to groundwater.
 - Persistence and bioaccumulation
 - 1,1,2-Trichloroethane is expected to have low bioaccumulation potential based on its measured bioconcentration factor and estimated bioaccumulation factor both being less than 1,000.
 - 1,1,2-Trichloroethane is likely to be persistent in air, water, and soil, given half-lives in each media.

3.7 Weight of Scientific Evidence Conclusions for Fate and Transport

Evaluation of the weight of scientific evidence conclusions for the fate and transport of 1,1,2-trichloroethane is shown below and is based on categorization of either slight, moderate, or robust, as described in the *Draft Systematic Review Protocol Supporting TSCA Risk Evaluations for Chemical Substances* ([U.S. EPA, 2021b](#)).

Given the consistent results from the high-quality studies discussed, there is robust evidence that 1,1,2-trichloroethane

- Will not undergo direct photolysis (Section 3.3.3)
- Will undergo indirect photolysis by reacting slowly with hydroxyl radicals in the atmosphere, with an estimated half-life of 55 days (Section 3.3.3)
- Will exist as a vapor in air and is not expected to partition to organic matter in the air (Section 3.4.1)
- Will hydrolyze very slowly in water at environmentally relevant pHs and temperatures (Section 3.3.2)
- Will be subject to low to moderate sorption to soil/sediments and therefore will undergo moderate to rapid migration to groundwater (Section 3.2)
- Will have low bioaccumulation potential in aquatic organisms (Section 3.5.4)
- Will be removed during wastewater treatment processes, mainly due to volatilization, with significant biodegradation occurring in some WWTPs (Section 3.5.2)

- Is not readily biodegradable aerobic surface waters (Section 3.3.1)
- Will be biodegraded slowly in anaerobic soils (Section 3.3.1)
- Can be formed as an environmental transformation product due to the biodegradation of 1,1,2,2-tetrachloroethane under anaerobic conditions (Section 3.3.1)
- Can be biodegraded to form vinyl chloride, 1,2-dichloroethane, and ethene under anaerobic conditions (Section 3.3.1)
- May volatilize from surface water and moist surface soil (Sections 3.4.2 and 3.4.3)
- Has the potential to undergo long-range transport in the air due to slow indirect photodegradation (Section 3.4.1)

As a result of limited studies identified, there is moderate evidence that 1,1,2-trichloroethane

- Will have low removal rates from conventional drinking water systems but can be highly removed by advanced treatment technologies (*e.g.*, packed tower aeration) (Section 3.5.3)
- Can be biodegraded in sediments under anaerobic conditions with a half-life on the order of months, especially when the microbial communities have been pre-exposed to 1,1,2-trichloroethane (Section 3.3.1)
- Will have low bioaccumulation potential in terrestrial organisms (Section 3.5.4)

3.7.1 Strengths, Limitations, Assumptions, and Key Sources of Uncertainty for the Fate and Transport Assessment

The Tier I and II partitioning analyses, which incorporate high-quality physical and chemical properties, provide robust evidence that air is likely to be the major medium of exposure for 1,1,2-trichloroethane. For three of the five years assessed in this evaluation, greater than 99% of reported TRI releases were to air. There is some uncertainty in release patterns (Section 3.1.1.1), which introduces some uncertainty in the overall partitioning assessment and suggests that land and water pathways could be important.

When released to air, there is also strong evidence that 1,1,2-trichloroethane will exist as a vapor and will not partition to particulate matter. 1,1,2-trichloroethane is expected to have a relatively long half-life in air (approximately 55 days). Modeling suggests that 1,1,2-trichloroethane can be subject to long-range transport given its atmospheric half-life. While EPA identified monitoring data showing 1,1,2-trichloroethane being consistently detected across the U.S. EPA did not identify monitoring data demonstrating its long-range atmospheric transport.

In aquatic environments, 1,1,2-trichloroethane is expected to volatilize from surface waters. EPA did not identify any studies directly measuring volatilization rates and used EPI Suite™ to estimate a rate for a model lake and stream. Therefore, there is uncertainty in the volatilization rate as it can vary based on the characteristics of the water body. EPA has strong evidence that 1,1,2-trichloroethane is not readily biodegradable in surface water and that hydrolysis is slow in environmentally relevant conditions. EPA identified limited monitoring data with measurable concentrations in surface water but monitoring locations are not necessarily spatially or temporally aligned with releases from TSCA COUs and therefore might not be representative of actual release scenarios. EPA also did not identify sediment monitoring data, but 1,1,2-trichloroethane could be present in sediment pore water given its relatively high solubility. EPA also only identified one study with a measured BCF, meaning there is uncertainty in the actual value; however, EPA has high confidence the BAF and BCF values will be low given the overall evidence available.

In terrestrial environments, 1,1,2-trichloroethane can volatilize from surface soils; however, EPA did not identify any studies measuring volatilization rates from soil, so there is uncertainty in the exact rate, as it will depend on the specific soil characteristics and local conditions (*e.g.*, temperature). Soil and

2195 groundwater biodegradation studies reported a large range of half-lives. Despite the uncertainty in the
2196 exact rate, EPA generally expects biodegradation rates to be slow in both aerobic and anaerobic soils
2197 and groundwater. EPA also has strong evidence demonstrating that 1,1,2-trichloroethane will migrate to
2198 groundwater when released to land due to the groundwater monitoring data identified.

4 RELEASE ASSESSMENT

A key component of EPA's risk evaluation is assessing risks to the environment and general population from releases of 1,1,2-trichloroethane from industrial and commercial facilities. This consists of:

- Estimating releases of 1,1,2-trichloroethane to environmental media (air, water, land) from the COUs at industrial and commercial facilities.
- Estimating the environmental media and general population exposure concentrations of 1,1,2-trichloroethane that result from the releases.
- Comparing the estimated environmental media and general population concentrations with the appropriate hazard values to determine if there is a risk.

This section focuses on the estimation of releases of 1,1,2-trichloroethane to environmental media from industrial and commercial facilities and has three main sections. Section 4.1 describes the approach and methodology that was followed to estimate the releases. In Section 4.2, there are subsections with the release assessments for the individual COUs for 1,1,2-trichloroethane assessed by EPA. The Agency makes risk determinations for each COU. Section 4.3 covers the strengths, limitations, uncertainties, and assumptions for the release assessment and assigns confidence ratings to the release assessment for each COU.

Additionally, the following appendices have been developed that describe release assessment methodologies in more detail:

- Appendix A Environmental Release and Occupational Exposure Model Approaches and Parameters: Includes detailed description of standard models used by EPA in addition to model-specific approaches and parameters.
- Appendix B Procedures for Mapping Facilities from Standard Engineering Sources to Occupational Scenarios: Outlines the procedures EPA follows to map facilities from data sources including CDR, TRI, NEI, and DMR.
- Appendix C Estimating Daily Wastewater Discharges from Discharge Monitoring Reports and Toxics Release Inventory Data: Provides steps and examples for estimating daily wastewater discharges from industrial and commercial facilities manufacturing, processing, or using 1,1,2-trichloroethane.
- Appendix D Guidance for Using the National Emissions Inventory (NEI) and Toxic Release inventory (TRI) for Estimating Releases: Provides steps and examples for estimating air releases from industrial and commercial facilities manufacturing, processing, or using 1,1,2-trichloroethane.

EPA collected and analyzed a significant amount of data in completing this release assessment. Supplemental documents have been included with the risk evaluation to provide transparency on the data EPA used and how it was used in developing the release assessment.

- *Draft Air Releases for 1,1,2-Trichloroethane* ([U.S. EPA, 2026c](#)): Includes the data and calculations used to estimate air releases for 1,1,2-trichloroethane.
- *Draft Land Releases for 1,1,2-Trichloroethane* ([U.S. EPA, 2026m](#)): Includes the data and calculations used to estimate land releases for 1,1,2-trichloroethane.
- *Draft Water Releases for 1,1,2-Trichloroethane* ([U.S. EPA, 2026ag](#)): Includes the data and calculations used to estimate air releases for 1,1,2-trichloroethane.
- *Draft Number of Sites for 1,1,2-Trichloroethane* ([U.S. EPA, 2026n](#)): Includes a list of all facilities from programmatic release data mapped to OES.
- *Draft Repackaging Environmental Release Model 1,1,2-Trichloroethane* ([U.S. EPA, 2026q](#)): Includes the parameters, calculations, and model release results for the Repackaging OES.

- *Draft Formulation of Adhesives and Sealants Environmental Release Model 1,1,2-Trichloroethane* ([U.S. EPA, 2026j](#)): Includes the parameters, calculations, and model release results for the Formulation of adhesives and sealants OES.
- *Draft Open-Top Vapor Degreasing Environmental Release Model 1,1,2-Trichloroethane* ([U.S. EPA, 2026p](#)): Includes the parameters, calculations, and model release results for the Open-top vapor degreasing OES.
- *Draft Use of Adhesives and Sealants Environmental Release Model 1,1,2-Trichloroethane* ([U.S. EPA, 2026ae](#)): Includes the parameters, calculations, and model release results for the Use of adhesives and sealants OES.
- *Draft Use of Laboratory Chemicals Environmental Release Model for 1,1,2-Trichloroethane* ([U.S. EPA, 2026af](#)): Includes the parameters, calculations, and model release results for the Use of laboratory chemicals OES.

Format of this Section of the TSD

In previous risk evaluations, EPA has used different approaches for the TSD on Environmental Releases and Occupational Exposures. For some risk evaluations, separate TSDs have been created for these two topic areas. In other risk evaluations, the environmental release and occupational exposure sections have been combined into one TSD.

For 1,1,2-trichloroethane, EPA has decided to prepare one overall TSD covering the topics of chemistry, fate, release and exposure. This environmental release section is part of this overall TSD but maintains consistency with past risk evaluations by including the three main sections as indicated above.

Lifecycle Summary for 1,1,2-Trichloroethane

CDR provides data from domestic manufacturers (including importers) of 1,1,2-trichloroethane. EPA considered assessing manufacture of 1,1,2-trichloroethane as a primary product; however, based on reported CDR data which would be above those reporting thresholds, mapping of facility reported release data, data from the test order process, and other sources, EPA's current understanding is that manufacture as an unintended byproduct is the primary source of manufacturing. Based on previous site visits, EPA was informed that chemical manufacturers will seek to reclaim value from byproduct streams and process further as a reactant based on information from CDR. A discussion of this was included in the assessment of byproducts that EPA completed for the 1,2-dichloroethane risk evaluation ([U.S. EPA, 2026a](#)) and supports the use of byproduct streams as reactants in the making of other chemicals. Also related to manufacture of 1,1,2-trichloroethane as an unintended byproduct, facility reported release data was mapped to pulp and paper production facilities. 1,1,2-trichloroethane can be formed as a byproduct in pulp and paper production. There were no CDR reports from pulp and paper production, which suggests smaller quantities of release from these facilities.

Information from non-CDR data sources, including facility reported data to TRI, DMR and NEI, SDS, and import landings data from Datamyne ([Descartes, 2018](#)), indicated several downstream industrial and commercial COUs. This consisted of commercial use as a laboratory chemical, industrial and commercial use as an adhesive and sealant, and industrial use as a solvent for cleaning and degreasing. EPA has uncertainty whether there is a direct path from manufacturers of 1,1,2-trichloroethane as a byproduct chemical to these downstream COUs. CDR reporting does not indicate these other downstream COUs. But CDR has threshold reporting values so quantities under these thresholds are not required to be reported. EPA has uncertainty as to whether smaller non-CDR reported quantities may be purchased by chemical distributors for these downstream COUs. EPA assumed production quantities up to the CDR threshold were possible for these downstream COUs.

The import landings data from Datamyne referenced above provides evidence of imports of 1,1,2-trichloroethane by laboratory chemical distributors. 1,1,2-Trichloroethane is a solvent so in itself does not perform adhesion but is a carrier for the adhesive chemicals. Based on the evidence of the presence of 1,1,2-trichloroethane in adhesive and sealant products, a formulation step would be required, and EPA assessed this as an OES. There was a TRI report from one site (Freeport Olin BC) that reported manufacturing as a byproduct along with processing as a reactant and processing as a formulation component. The limited evidence on the solvent for cleaning and degreasing pointed specifically to the OES of open-top vapor degreasing and cold cleaning although EPA is uncertain whether these are current uses.

There was facility reported release data for 1,1,2-trichloroethane from sites associated with disposal including incinerators, landfills, wastewater treatment facilities at industrial facilities, and POTWs. EPA assessed these as individual OES under the overall COU of Disposal. The pathway of 1,1,2-trichloroethane to these disposal sites would be from sites that manufacture, process, and use 1,1,2-trichloroethane and the disposal of their wastes.

4.1 Approach and Methodology

The goals of EPA's release assessment for 1,1,2-trichloroethane were to:

1. Estimate releases for each of the individual COUs for 1,1,2-trichloroethane. Typically, EPA estimates central tendency (50th percentile) and high-end (95th percentile) release rates in kg/site-yr and kg/site-day from facilities for a COU.
2. Achieve the highest confidence that is possible in these release estimates based on the available data and release assessment methodologies. The confidence ratings will vary across the COUs.

Key steps EPA followed in its approach:

- Identified OESs to assess
- Reviewed the Release Assessment Hierarchy
- Reviewed past risk evaluations with similar OES on how releases were assessed
- Searched for facility reported release data for 1,1,2-trichloroethane
- Supplemented facility reported release data with modeling for OES with limited or no data.
- Identified strengths, limitations, uncertainties and assumptions
- Assigned a confidence rating to the release estimates

The first step was to identify the OES associated with the COUs described in Section 4.1.1. The OESs break down a COU into more granular scenarios which is needed since there can be multiple possible scenarios for a COU and the available data and risk associated with each may be different. The difference between a COU and an OES can be illustrated in the following figure (Figure 4-1).

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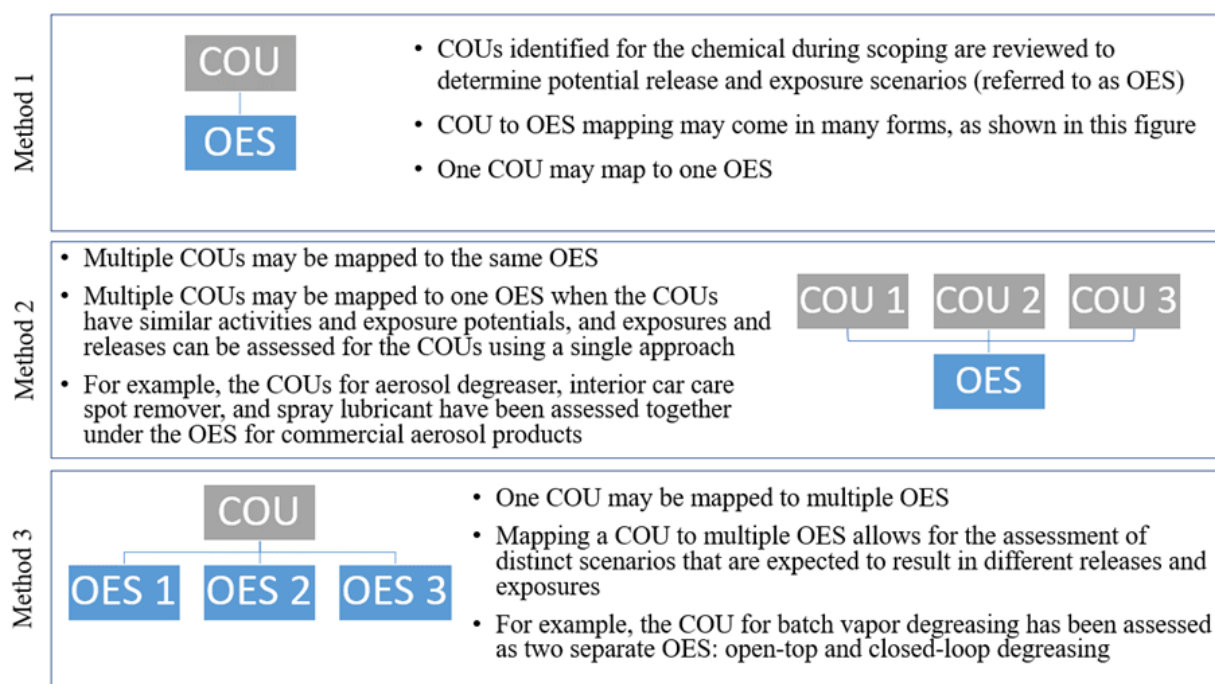


Figure 4-1. Condition of Use to Occupational Exposure Scenario Mapping

EPA then reviewed the release assessment hierarchy which lists available approaches in order of preference. EPA's objective was to use the highest available approach according to the following hierarchy:

1. Monitoring and measured data:
 - a. Releases calculated from site-specific concentration in medium and flow rate data
 - b. Releases calculated from mass balances or emission factor methods using site-specific measured data
2. Modeling approaches:
 - a. Surrogate release data
 - b. Fundamental modeling approaches
 - c. Statistical regression modeling approaches
3. Release limits:
 - a. Company-specific limits
 - b. Regulatory limits (e.g., National Emission Standards for Hazardous Air Pollutants [NESHAPs] or effluent limitations/requirements)

EPA reviewed past risk evaluations with the same OES to see how environmental releases were estimated. Consistency is important and EPA has compiled a summary of how environmental releases were estimated for each OES for all the risk evaluations that EPA has published (draft or final) since the Lautenberg amendments to TSCA were passed.

EPA then searched for facility reported environmental release data for 1,1,2-trichloroethane reported by facilities to data sources such as the TRI. These steps are described in Section 4.1.2.

EPA may decide to supplement the release assessment with modeling if there are limited or no release data for an OES. EPA then considers the use of modeling approaches to estimate releases as described in Section 4.1.3.

EPA summarizes the strengths, limitations, assumptions, and uncertainties associated with the evidence that EPA has gathered for the release assessment and then assigns a confidence rating is assigned for the release assessment for each OES assessed by EPA. This is described in Section 4.1.5. Additional detail on the key steps is provided in more detail in the sections below.

4.1.1 Identify Occupational Exposure Scenarios to Assess

The Final Scoping Document ([U.S. EPA, 2020c](#)) included both a lifecycle diagram (LCD) and a COU Table 4-1. The LCD is presented below in Figure 4-2. A COU is the combination of life cycle stage, category, and subcategory. The LCD is divided into four different lifecycle stages consisting of Manufacture/Import, processing, industrial and commercial uses, and then Disposal. COUs for each of the four lifecycle stages are depicted in the LCD.

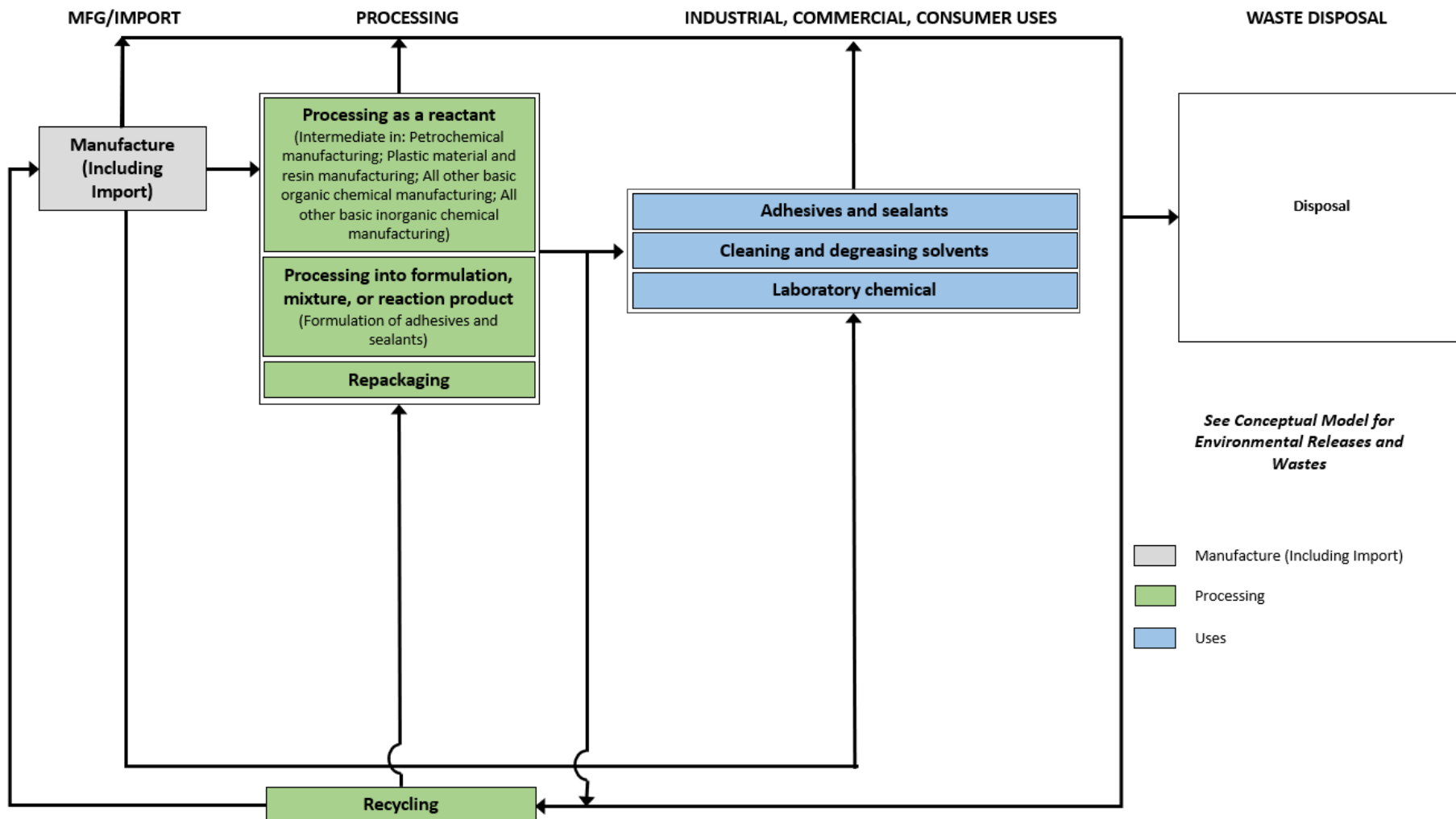


Figure 4-2. 1,1,2-Trichloroethane Life Cycle Diagram

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Table 4-1. Conditions of Use Identified in the Final Scoping Document

Life Cycle Stage ^a	Category ^b	Subcategory ^c	Reference(s)
Manufacturing	Domestic manufacture	Domestic manufacture	U.S. EPA (2019a)
	Import	Import	U.S. EPA (2019a)
Processing	Processing as a reactant	Intermediate in: Plastic manufacturing; Petrochemical manufacturing; All other chemical product manufacturing	U.S. EPA (2019a)
	Recycling	Recycling	U.S. EPA (2019a)
Distribution in commerce	Distribution in commerce	Distribution in commerce	U.S. EPA (2019a)
Industrial use	Adhesives and sealants	Adhesives and sealants	EPA-HQ-OPPT-2018-0421-0006
Commercial use	Adhesives and sealants	Adhesives and sealants	EPA-HQ-OPPT-2018-0421-0003 ; EPA-HQ-OPPT-2018-0421-0013
	Other use	Laboratory chemical	U.S. EPA (2019a)
Consumer use	Adhesives and sealants	Adhesives and sealants	EPA-HQ-OPPT-2018-0421-0003 ; EPA-HQ-OPPT-2018-0421-0013
Disposal	Disposal	Disposal	
^a Life cycle stage use definitions (40 CFR 711.3) – “Industrial use” means use at a site at which 1 or more chemicals or mixtures are manufactured (including imported) or processed. – “Commercial use” means the use of a chemical or a mixture containing a chemical (including as part of an article) in a commercial enterprise providing saleable goods or services. – “Consumer use” means the use of a chemical or a mixture containing a chemical (including as part of an article, such as furniture or clothing) when sold to or made available to consumers for their use. – Although EPA has identified both industrial and commercial uses here, for purposes of distinguishing scenarios in this document, the Agency interprets the authority over “any manner or method of commercial use” under TSCA Section 6(a)(5) to reach both. ^b These categories of conditions of use (COUs) appear in the life cycle diagram, reflect CDR codes, and broadly represent COUs of 1,1,2-trichloroethane in industrial and/or commercial settings and for consumer uses. ^c These subcategories reflect more specific COUs of 1,1,2-trichloroethane.			

EPA’s next step was to identify the OESs to assess for the COUs of 1,1,2-trichloroethane. EPA followed the approaches depicted in Figure 4-1 with considerations of data and environmental release estimation method availability to identify the OES to be assessed for the chemical.

For example, in the case of the Disposal COU, EPA collected facility reported environmental release data for releases from POTWs, Incinerators, Landfills, non-POTW wastewater treatment (WWT), remediation, and assessed these subcategories as OESs for 1,1,2-trichloroethane.

As another example, there are three COU subcategories associated with the processing as a reactive intermediate COU. EPA viewed that the exposure and release potential for these COUs are similar enough that the three COUs could be combined into the one OES of Processing as a Reactant.

COU Additions During the Risk Evaluation

During the course of the 1,1,2-trichloroethane risk evaluation work, an additional COU s was identified

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for 1,1,2-trichloroethane for use as a cleaning and degreasing solvent with applications in open-top vapor degreasing and cold cleaning. These scenarios have different exposure and release potential, and EPA assessed them as separate OES for the COU of cleaning and degreasing solvent.

Table 4-2 below provides a crosswalk of the OESs that are being assessed for 1,1,2-Trichloroethane with the COUs that have been identified.

Table 4-2. Crosswalk of Conditions of Use (COUs) to Assessed Occupational Exposure Scenarios (OESs) for 1,1,2-Trichloroethane

Conditions of Use			Occupational Exposure Scenarios (OESs) for Assessment
Life Cycle Stage ^a	Category ^b	Subcategory ^c	
Manufacturing	Domestic manufacture	Domestic manufacture	Manufacturing as a Byproduct at Chemical Manufacturing Facilities (OES #1)
			Manufacturing as a Byproduct in the Pulp and Paper Industry (OES #2)
	Import	Import	Repackaging for Laboratory Chemical Use (OES #3)
Processing	Processing as a reactant	Intermediate in: Plastic manufacturing	Processing as a Reactant (OES #4)
		Intermediate in: Petrochemical manufacturing	
		Intermediate in: All other chemical product manufacturing	
	Recycling	Recycling	Repackaging for Laboratory Chemical Use (OES #3)
	Repackaging	Repackaging	
	Incorporation into a formulation, mixture, or reaction product	Formulation of adhesives and sealants	Formulation of Adhesives and Sealants (OES #5)
Distribution in commerce	Distribution in commerce	Distribution in commerce	Distribution in Commerce (OES #15) ^d
Industrial use	Adhesives and sealants	Adhesives and sealants	Use of Adhesives and Sealants (OES #6)
	Solvents (for cleaning and degreasing)	Solvents (for cleaning and degreasing)	Open-Top Vapor Degreasing (OES #7)
			Cold Cleaning (OES #8)
Commercial use	Adhesives and sealants	Adhesives and sealants	Use of Adhesives and Sealants (OES #6)
	Other use	Laboratory chemical	Use of Laboratory Chemicals (OES #9)
Consumer use	Adhesives and sealants	Adhesives and sealants	N/A ^e
Disposal	Disposal	Disposal	Disposal to Incineration (OES #10)
			Disposal to Landfill (OES #11)
			Disposal to POTW (OES #12)

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Conditions of Use			Occupational Exposure Scenarios (OESs) for Assessment
Life Cycle Stage ^a	Category ^b	Subcategory ^c	
			Disposal to non-POTW WWT (OES #13)
			Remediation (OES #14)
^a Life cycle stage use definitions (40 CFR 711.3) – “Industrial use” means use at a site at which 1 or more chemicals or mixtures are manufactured (including imported) or processed. – “Commercial use” means the use of a chemical or a mixture containing a chemical (including as part of an article) in a commercial enterprise providing saleable goods or services. – “Consumer use” means the use of a chemical or a mixture containing a chemical (including as part of an article, such as furniture or clothing) when sold to or made available to consumers for their use. – Although EPA has identified both industrial and commercial uses here for purposes of distinguishing scenarios in this document, the Agency interprets the authority over “any manner or method of commercial use” under TSCA section 6(a)(5) to reach both. ^b These categories of conditions of use appear in the life cycle diagram, reflect Chemical Data Reporting (CDR) codes, and broadly represent conditions of use (COUs) of 1,1,2-trichloroethane in industrial and/or commercial settings and for consumer uses. ^c These subcategories reflect more specific COUs of 1,1,2-trichloroethane. ^d Releases and exposures during distribution in commerce are not quantitatively assessed in this risk evaluation. ^e Consumer uses are not assigned to OESs but are assessed elsewhere in this TSD and the draft risk evaluation.			

4.1.2 Estimating Releases for OES – Facility Reported Data

EPA’s first preference in release assessments is to estimate releases using release data reported by facilities to publicly available databases. These sources provided chemical-specific releases from the facility and include key facility identification information that can be used by EPA in the next step of risk evaluation which involves modeling to estimate environmental media concentrations. This is a “Top-Down” approach for estimating releases in which the release data used is for overall releases from the facility which can come from multiple individual sources of release within the facility. EPA relies on three main data sources for facility reported release data which are described in more detail below.

4.1.2.1 Toxic Release Inventory (TRI)

Data Used by EPA

The TRI database includes facility-specific information on disposal and other releases of 1,1,2-trichloroethane to air, water, and land ([U.S. EPA, 2022f](#)). The release data are reported in lb/year. EPA downloaded available water, air, and land release data from TRI. EPA’s practice for risk evaluations is to analyze the five most recent reporting years for TRI data available at the time the risk evaluation analysis work begins to allow for consideration of trends in release rates. For TRI, release data for the reporting years from 2019 through 2023 were used as follows:

- Air emissions in TRI are reported separately for stack air and fugitive air and occur on-site at the facility.
- Water releases in TRI include both reports of annual direct discharges to surface water and annual indirect discharges to off-site POTWs and wastewater treatment (WWT) facilities.
- Land releases in TRI provide the type of release media for a particular facility, as well as how the chemical is managed through recycling, energy recovery, or treatment.

Methods Facilities Use to Estimate Releases

For each release quantity reported, TRI filers select a “basis of estimate” code to indicate the principal method used to determine the release quantity. TRI provides six bases of estimate codes, continuous monitoring, periodic monitoring, mass balance calculations, published emission factors, site-specific

emission factors, and engineering calculations/best engineering judgment. For facilities that use a TRI chemical in multiple operations, the filer may use a combination of methods to calculate the overall release quantity. In such cases, TRI instructs the facility to enter the basis of estimate code for the method that corresponds to the largest portion of the reported release quantity.¹ Additional details on the basis for the reported release estimate (e.g., calculations, underlying assumptions) are not reported in TRI.

Methods EPA Used to Obtain Data for the Risk Evaluation

EPA obtained 2019 to 2023 TRI data for 1,1,2-trichloroethane from EPA's Basic Plus Data Files that collectively contain all the data submitted by facilities on the TRI reporting Form R and Form A for a specific year. EPA followed a similar approach to estimate air, water, and land releases.

Facilities Required to Report to TRI

A facility is required to report to TRI if it has 10 or more full-time employees; is included in an applicable North American Industry Classification System (NAICS) code; and manufactures, processes, or uses specific chemicals in quantities greater than specified thresholds.² For 1,1,2-trichloroethane, the reporting threshold more than 25,000 pounds manufactured or processed, or more than 10,000 pounds used during the reporting year. Facilities provide on-site release information using readily available data (including monitoring data) collected pursuant to other provisions of law, or where such data are not readily available, "reasonable estimates" of the amounts released.

Methods Used by EPA to Map Facility TRI Data to OES

TRI does not include a text field which provides descriptive information on the activities of the chemical at the facility reporting the release to help with mapping the facility to the appropriate OES. However, there are metadata in the TRI database such as facility-specific information such as name, address, NAICS code, and/or TRI use code. For example, the K&G Manufacturing facility in Faribault, Minnesota, reported releases of 1,1,2-trichloroethane to TRI. The facility reported a TRI use code that indicates 1,1,2-trichloroethane is used as a degreaser at the facility. Using the provided use code, EPA mapped the facility to the Open-top vapor degreasing OES.

In some cases, there are multiple TRI uses reported by a given facility. To determine the OES for these facilities, EPA used the CDR, NAICS codes, and internet searches to determine the type of products and operations at the facility.

Release Metrics EPA Calculates from the TRI Release Data

EPA used the reported annual releases directly as reported in TRI. EPA then divided the annual releases over the number of estimated operating days to obtain daily average release estimates. EPA presents the release data as high-end and central tendency estimates in kg/site-yr and kg/site-day. Release estimates are separated by stack and fugitive air emissions, surface water discharges, and land releases.

4.1.2.2 Discharge Monitoring Reports (DMR)

Data Used by EPA

DMR includes facility-specific information on releases of 1,1,2-trichloroethane to water. Under the Clean Water Act (CWA), EPA regulates the discharge of pollutants into receiving waters through the National Pollutant Discharge Elimination System (NPDES). A NPDES permit authorizes facilities to discharge pollutants up to specified limits and requires facilities to monitor their discharges and report

¹ See TRI Program Guidance on EPA's GuideME website under Reporting Forms and Instructions, Section 5. Quantity of the Toxic Chemical Entering Each Environmental Medium On-Site (Form R).

² See <https://trimwebmod.epa.gov/cdx-tri-threshold-screening-tool/action/home/view/tri>

the results to EPA and the state regulatory agency in DMRs. As with TRI, EPA used DMR release data for the reporting years from 2019 through 2023.

Overlap with TRI

Both DMR and TRI include facility-reported estimates of annual direct discharges to surface water in pounds per year from industrial facilities. In some cases, a facility may report to both programs, leading to partial overlap in facilities and surface water release data.

Methods Used by Facilities to Estimate Their Releases

NPDES permits contain monitoring requirements including the mass (or other measurement specified in the permit) of 1,1,2-trichloroethane limited in the permit and the volume of effluent discharged from each outfall. Permits specify the type, intervals, and frequency of monitoring. Facilities are required to collect samples and conduct sample analysis using EPA-approved methods specified in the permit. Facilities use measured concentrations or mass of 1,1,2-trichloroethane, along with effluent discharge volume, to estimate an annual release reported to DMR.

Methods Used by EPA to Obtain Data for the Risk Evaluation

EPA makes the reported data publicly available via EPA's Enforcement and Compliance History Online (ECHO) system and EPA's Water Pollutant Loading Tool (Loading Tool). The data collected are annual release data (lb/yr) for a given reporting year.

EPA downloaded DMR from reporting years 2019 through 2023 ([U.S. EPA, 2022d](#)) using ECHO system and the Loading Tool.

Methods Used by EPA to Map Facility DMR Data to an OES

DMR does not include a text field which provides descriptive information on the activities of the chemical at the facility reporting the release to assist with mapping the facility to the appropriate OES. However, there are metadata in the DMR data such as facility-specific information on the name, address, NAICS code, and/or SIC code. For example, the Ashland Wastewater Treatment Plant in Ashland, Kentucky, reported water discharges of 1,1,2-trichloroethane to DMR. The SIC code provided for this facility is 4952 – Sewerage Systems. EPA mapped the facility to the Disposal to POTW OES based on the reported SIC code. In some cases, EPA assigned the OES by reviewing CDR for 1,1,2-trichloroethane or conducting an internet search of the type of products and operations at the facility.

Release Metrics EPA Calculates from the DMR Data

Where available, EPA used DMR data to estimate annual wastewater discharges, average daily wastewater discharges, and high-end daily wastewater discharges in kg/site-yr and kg/site-day. For DMR, annual discharges are automatically calculated by the Loading Tool based on the sum of the discharges associated with each monitoring period in DMR. Monitoring periods in DMR are set by each facility's NPDES permit and can vary between facilities. Typical monitoring periods in DMR include monthly, bimonthly, quarterly, biannual, and annual reporting.

Treatment of Non-Detects

In instances where a facility reported a period's monitoring results as below the limit of detection (LOD) (also referred to as a non-detect or ND) for a pollutant, the Loading Tool applies a hybrid method to estimate the wastewater discharge for the period. The hybrid method sets the values to half of the LOD if there was at least one detected value in the facility's DMRs in a calendar year. If all values were less than the LOD in a calendar year, the annual load is set to zero. EPA included emissions below the LOD

in the release estimates. To estimate daily discharges, EPA divided the annual discharges over the number of estimated operating days.

4.1.2.3 National Emissions Inventory (NEI)

Data Used by EPA in the Risk Evaluation

NEI was established to track emissions of Criteria Air Pollutants (CAPs)³ and CAP precursors and assist with National Ambient Air Quality Standard (NAAQS) compliance under the CAA. 1,1,2-trichloroethane is on EPA's initial list of HAPs under the CAA.⁴ Air emissions data for the NEI are collected at the state, local, and tribal (SLT or S/L/T) level.⁵ SLT air agencies then submit these data to EPA through the Emissions Inventory System (EIS). In addition to CAP data, many SLT air agencies voluntarily submit data for pollutants on EPA's list of HAPs. EPA uses the data collected from SLT air agencies, in conjunction with supplemental HAP data, to build the NEI. EPA releases an updated NEI every three years.

For this risk evaluation, NEI emissions data for 1,1,2-trichloroethane were collected for point sources. Point sources are stationary sources of air emissions from facilities with operating permits under Title V of the CAA, also called "major sources". Point source facilities include large energy and industrial sites and are reported at the emission unit⁶ and release point-level.⁷ Emissions are reported separately for stack air and fugitive air in lb/yr. NEI also includes facility-specific information on days of operation. EPA used NEI air release data from the 2017 and 2020 reporting years. For the NEI release data, the 2020 reporting year is the most recent data available as of the time of publication of the Draft Risk Evaluation for 1,1,2-Trichloroethane ([U.S. EPA, 2026r](#)) and supporting documents.

³ The CAA requires EPA to set National Ambient Air Quality Standards (NAAQS) for five CAPs: ground-level ozone (O₃), particulate matter (PM), carbon monoxide (CO), lead (Pb), sulfur dioxide (SO₂), and nitrogen dioxide (NO₂).

⁴ See EPA's [initial list of HAPs](#) (accessed December 30, 2025) and subsequent modifications.

⁵ See EPA [Air Emissions Reporting Requirements \(AERR\)](#)

⁶ Defined as any activity at a stationary source that emits or has the potential to emit a regulated air pollutant.

⁷ Defined as the point from which air emissions from one or more processes are released into the atmosphere (*e.g.*, a stack).

Overlap with TRI

NEI and TRI both provide annual stack and fugitive air emission data and include facility-specific information. NEI reports air emissions at the emission unit- and release point-levels, whereas TRI reports air emissions at the facility-level.

Methods Used by Facilities to Estimate Their Releases

For point sources (in general, large facilities), emissions are inventoried at a process-level within a facility and reported to S/L/T air agencies. The point data are collected from S/L/T air agencies and EPA emissions programs including the TRI, the Acid Rain Program, and Maximum Achievable Control Technology (MACT) standards development. Because emissions are inventoried at the process-level, there may be multiple estimates of release within a facility which can be combined into an overall release from the facility.

Methods Used by EPA to Obtain Data for the Risk Evaluation

The first step in using NEI data to estimate air releases is to obtain the NEI data for release estimation and modeling. The NEI data are available on EPA's public website as downloadable zip files, divided into onroad, nonroad, nonpoint, and point source data files. As an alternative, EPA's EIS Gateway allows registered EPA users, registered S/L/T users, and approved contractors to query and download NEI data and associated reporting code descriptions. As a result, this methodology uses the EIS Gateway to query point source data which can be downloaded and imported into an Excel spreadsheet or alternative programs/software to be evaluated, filtered or manipulated to allow reproducibility of the methods/analysis desired. . At this point, EPA's approach uses the EIS lookup tables to populate field descriptions for data fields reported as numerical codes (e.g., NAICS code).

Methods Used by EPA to Map NEI Facilities to OES

NEI provides facility-specific information, such as name, address, site description, and other facility identification information. Additionally, there is information in NEI that can be used to assign a facility to a particular OES. For example, the Baldwin County Solid Waste facility in Summerdale, Alabama, reported air emissions of 1,1,2-trichloroethane to NEI. According to NEI reporting, the facility is included in the waste disposal sector and listed "Landfills" for the Tier 2 Description reporting category. In addition, the NAICS code provided by the facility is 562212 – Solid Waste Landfill. Based on the sector, facility description, and NAICS code, EPA mapped the facility to the Disposal to landfill OES. In some instances, there are multiple release points at a single facility that map to different OES; EPA used the release point with the largest release to map the OES for the entire facility.

Release Metrics EPA Calculates from the NEI Data

EPA used NEI data to estimate annual fugitive and stack air emissions in kg/site-yr. EPA then divided the annual stack and fugitive emissions over the number of estimated operating days to develop daily release estimates in kg/site-day.

4.1.3 Estimating Releases for OES – Modeling Approaches

EPA reviewed results obtained from collection of facility reported release data and mapping the facilities to OES to determine if there were sufficient release data for the OES. For those OESs that did not have sufficient releases data, EPA also conducted environmental release modeling to augment the analysis for the OES.

Where release modeling was used, EPA has documented its rationale for including release modeling and where release modeling was done, EPA also included the available facility reported release data for the OES.

EPA's rationale for modeling to estimate releases for 1,1,2-trichloroethane was when the following occurred:

- Releases are expected for an OES but TRI, DMR, and/or NEI data or release data from systematic review are not available; or
- EPA's judgement is that the facility release data collected may underrepresent the release potential for facilities within the OES; and
- EPA has a release model available to estimate releases for the OES.

Release Modeling Approach

Release modeling is a "bottom-up" approach for estimating releases. EPA utilizes Generic Scenarios (GSs) and Emission Scenario Documents (ESDs) to provide detailed process descriptions when chemical-specific process information was not available, that identify sources of releases from the process. These sources also provide estimation methods for key parameters to estimate magnitude of releases from a facility such as the facility throughput in kg/site-day.

Standard models that have been previously developed by EPA are used to estimate releases for the individual sources of release within the process. The models include loss fraction models as well as models for estimating chemical vapor, land, and water release generation rates. For air releases, EPA uses both box model and near-field modeling approaches to estimate air emission rates from each emission point and from the overall process. If EPA determines that an existing model does not capture the entirety of releases for a given scenario, a new model may be developed.

Key Steps in Release Modeling

EPA used the following approach to obtain high-end and central tendency release estimates:

1. Identify release sources and media of release for facilities within the OES.
2. Identify model input parameters from relevant literature sources, GSs, or ESDs. Model input parameters include the estimated number of sites, container size, mass fractions, and 1,1,2-trichloroethane's physical properties. If a range of input values is available for an input parameter, determine the associated distribution of input values.
3. Identify estimation methods to estimate the release from the release source based on relevant GSs or ESDs and other modeling approaches used by EPA for TSCA Risk Evaluations.
4. Conduct a Monte Carlo simulation to calculate the total 1,1,2-trichloroethane release (by environmental media) across all release sources during each iteration of the simulation.
5. Select the 50th percentile and 95th percentile values to estimate the central tendency and high-end releases, respectively.

For each OES in which EPA modeled releases, EPA performed a Monte Carlo simulation to capture variability in the model input parameters. The simulation used the Latin hypercube sampling method in @Risk Industrial Edition, Version 7.0.0, which generates a sample of possible values. The Agency performed the model at 100,000 iterations to capture a broad range of possible input values. The model generates statistics, and any desired percentile may be selected. EPA selected the 50th percentile and 95th percentile to estimate releases.

4.1.4 Consideration of Release Controls

Facilities apply release controls to reduce the amount of chemicals emitted from their facilities. This can

be driven by regulatory requirements such as permits for air and water discharge. EPA considers release controls in its release assessment as follows:

1. **Facility reported release data** – the releases reported are releases from the facility in the form of surface water discharges, stack air, and fugitive air releases. Release controls to reduce the amount of release would have taken place prior to the estimated amount released from the facility. EPA does not apply any additional treatment efficiency in the assessment of these releases.
2. **Releases estimated from modeling approaches** – releases estimated from models represent the loss from the individual release sources that take place for a process within a facility. At this stage, the process losses are not yet releases from the facility. EPA does apply treatment efficiencies in estimating the environmental releases from these process-losses.
 - Modeled process losses to water – EPA applies a wastewater treatment removal efficiency to the process releases assessed as “releases to water” to estimate the surface water discharge.
 - Modeled process losses to incineration – EPA applies a Destruction Removal Efficiency (DRE) to estimate the resulting releases from incineration as a stack air release.
 - Modeled process losses to fugitive air – fugitive emissions are defined as “those emissions from a stationary source that could not reasonably pass through a stack, chimney, vent, or other functionally equivalent opening.” This implies some fraction of the emissions are not controlled. EPA does not further apply a control efficiency to modeled process losses to fugitive air.
 - Modeled process losses to stack air – 1,1,2-trichloroethane is classified as a hazardous air pollutant under the Clean Air Act and it is likely that some form of controls is applied to stack air emissions. EPA’s current approach is to consider this qualitatively in the assessment, especially when comparing modeled process losses to air with facility reported air emissions.
 - Modeled process losses to landfill – EPA estimates the process losses that could be disposed of in a landfill. Features at the landfill that impact environmental releases from the landfill, for example to groundwater, are considered in this TSD.

4.1.5 Assess Weight of Scientific Evidence and Assign Confidence Ratings for Each OES

After the release assessment for an OES is completed, EPA assesses the weight of scientific evidence for the OES and assigns a confidence rating.

Evaluating the Weight of Scientific Evidence

EPA evaluates the weight of scientific evidence supporting the environmental release estimates based on the strengths, limitations, and uncertainties associated with the environmental release estimates.

Assigning a Confidence Rating

The conclusion is summarized using confidence descriptors: Robust, Moderate, Slight, or Indeterminate. EPA considers factors including the quantity and quality of the data/information, applicability of the release data to the OES (including considerations of temporal relevance, locational relevance), and the representativeness of the estimate for the whole industry.

4.2 Industrial and Commercial Release Assessment

This section provides the individual release assessments for each of the 15 OES for 1,1,2-

trichloroethane. Each OES section consists of three main parts:

- **Process Details:** Includes the evidence that EPA found for the OES, process information for the role of 1,1,2-trichloroethane in the OES and information on the weight percent of 1,1,2-trichloroethane.
- **Facility Estimates:** This includes EPA's estimates for the production volume (PV) in kg/yr of 1,1,2-trichloroethane for the OES, EPA's estimate of the number of sites for 1,1,2-trichloroethane for the OES and EPA's estimate of the number of operating days/yr for facilities of this OES.
- **Environmental Release Estimates:** This section presents a summary table of the environmental releases for the OES organized by both environmental media and data source.

4.2.1 Manufacturing as a Byproduct in Chemical Manufacturing – OES#1

4.2.1.1 OES Details

1,1,2-Trichloroethane is produced as a non-isolated byproduct during the manufacture of 1,2-dichloroethane. 1,1,2-Trichloroethane is also found as a non-isolated byproduct in the manufacture of methyl chloroform (([Stantec ChemRisk, 2024a](#)); [EPA-HQ-OPPT-2018-0421-0015](#)).

At a typical manufacturing site, 1,2-dichloroethane can be manufactured by the vapor- or liquid-phase chlorination of ethylene. The chlorination is carried out at 40 to 50 °C with 5% air or other free-radical inhibitors added to prevent substitution chlorination of the product ([Snedecor et al., 2004](#)). About 1.25 pounds of mixed chlorinated organic liquids, including 1,1,2-trichloroethane, are unintentionally produced per 100 pounds of 1,2-dichloroethane manufactured. The production process is designed to remove the byproducts from the finished product using a separation process based on differences between the boiling point of 1,2-dichloroethane and the boiling points of the impurities. Impurities inadvertently produced during 1,2-dichloroethane manufacture are predominantly converted via other processes into various feedstocks, used in co-located perchloroethylene units, or destroyed by thermal oxidation. At most facilities, both the light and heavy end liquids recovered are typically used as feedstocks in a RCRA-permitted furnace or Hazardous Waste Incinerator, or used to manufacture anhydrous HCl, which is returned as feedstock with its coproduct 1,2-dichloroethane to the front of the oxychlorination 1,2-dichloroethane process ([Vinyl Institute, 2020](#)).

In addition, EPA received process information from the Vinyl Institute in response to a test order issued under section 4(a) of TSCA. As part of the Final Study Plan, the Vinyl Institute testing consortium provided information on 15 total sites from four companies that produce 1,1,2-trichloroethane as a non-isolated byproduct in the manufacture of other chemicals; no members of the testing consortium intentionally manufactured 1,1,2-trichloroethane as a commercial product ([Stantec ChemRisk, 2024a](#)). Following EPA's review and approval of the study plan, the testing consortium selected four sites to sample as selected representative facilities of the 15 sites that were originally identified. The selected sites were noted to "represent the three major process alternatives, include high production volume facilities, and product loading activities" [See Appendix C of ([Stantec ChemRisk, 2024a](#))]. The three major processes were: 1) high chlorine (Cl) type process (direct chlorination), 2) high hydrochloric acid (HCl) type process (oxychlorination), and 3) and high Cl, high HCl type process (collocated direct chlorination and oxychlorination).

Three sites in the 2024 CDR reported that 1,1,2-trichloroethane is manufactured at concentrations from 1 to 30% ([U.S. EPA, 2026b](#)). A fourth byproduct manufacturing site in the 2024 (Olin Blue Cube, Freeport TX), did not report a concentration. In the 2020 CDR, one byproduct manufacturing site, Geon Oxy Vinyl, reported 30% to less than 60%. This same facility reported a concentration of 1 to less than

30% in the 2024 CDR ([U.S. EPA, 2022a](#)). According to the test order summary report, the weight fraction of 1,1,2-trichloroethane produced as a byproduct of these processes varies from <1 percent to 45 percent ([Stantec ChemRisk, 2024a](#)).

4.2.1.2 Facility Estimates

In the 2020 and 2024 CDR, four facilities reported manufacturing an aggregate of 100 million to 1 billion pounds of 1,1,2-trichloroethane annually ([U.S. EPA, 2026b, 2022a](#)). Those same four facilities reported manufacturing of 1,1,2-trichloroethane as CBI in the 2024 CDR. Based on information submitted in response to an EPA test order, these four facilities manufacture 1,1,2-trichloroethane as a non-isolated byproduct ([Stantec ChemRisk, 2024a](#)).

Using information from VI, CDR, DMR, TRI, and NEI, EPA identified 17 facilities that manufacture the chemical as a byproduct at chemical manufacturing sites. A complete list of these facilities is provided in *Draft Number of Sites for 1,1,2-Trichloroethane* ([U.S. EPA, 2026n](#)).

Information on operating days is typically reported by facilities to the NEI. Sites that were mapped to the manufacturing as a byproduct OES in NEI reported operating days ranging from 350 to 365 days/year. For all other sites, EPA applied a default of 350 days/year. Because 1,1,2-trichloroethane is a commodity chemical, EPA assumes that manufacturing plants run 7 days/week, 50 weeks/year or 350 days/year. In addition, all representative facilities from the Vinyl Institute Consortium operated a continuous process on a 24 hour per day, seven day per week schedule for 360 to 365 days per year ([Stantec ChemRisk, 2024a](#)). EPA assumed the number of release days per year will be equal to the number of operating days at the facility.

4.2.1.3 Environmental Release Estimates – Facility Reported Data

Surface water, fugitive air, stack air, and land emissions data were available for this OES from 2019 to 2023 DMR, 2019 to 2023 TRI, and 2017/2020 NEI.

Byproduct facilities were identified using information provided by the Vinyl Institute Test Order Summary Report ([Stantec ChemRisk, 2024a](#)). The report provided the company name and facility locations of consortium members that manufacture 1,1,2-trichloroethane as a byproduct at chemical manufacturing facilities. Facilities were also mapped using TRI use codes indicating byproduct manufacturing.

Each facility provided one or more data points on release emissions. In some cases, a facility reported multiple data points per year. For example, in DMR, facilities report releases at each outfall, and a single facility may have multiple outfalls. EPA estimated the minimum, maximum, 50th, and 95th percentile release metrics for annual emissions (kg/site-yr) using the data points. EPA calculated daily release estimates (kg/site-day) using facility-reported NEI operating information where available, or a default assumption of 350 days/yr.

Facilities may report to multiple programmatic data sources (e.g., a facility may report to both TRI and DMR for surface water discharges). Differences in program reporting thresholds and NPDES permit requirements may result in different numbers of facilities across programs.

Annual and daily release estimates are presented below in Table 4-3. The facility data shown already account for release controls and their associated efficiencies. The difference between DMR and TRI high-end releases is driven by one facility (Westlake US 2 LLC). In 2021, this site reported a max of 2,175 kg to DMR and 38 kg to TRI. This is the same facility that reported high DMR releases of 1,2-

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DCA for several of the years assessed for that chemical, and it was determined that those releases were related to storm events.

Table 4-3. Summary of Environmental Releases During the Manufacture of 1,1,2-Trichloroethane as a Byproduct at Chemical Manufacturing Facilities

Environmental Media	Estimated Yearly Release (kg/site-yr)				Number of Release Days ^a	Daily Release (kg/site-day)		Number of Facilities	Number of Data Points ^b	Source
	Min.	Max.	CT	HE		CT	HE			
Surface water	5.0E-02	38	1.8	29	350	5.2E-03	8.4E-02	5	17	TRI
Surface water	1.1E-02	2,175	2.8	1,339		8.0E-03	3.8	3	10	DMR
Fugitive air	4.5	4,309	97	4,166		0.28	12	13	61	TRI
Fugitive air	1.8E-02	4,161	109	2,323		0.26	5.5	12	23	NEI
Stack air	4.5E-04	2,404	11	717		3.2E-02	2.0	10	49	TRI
Stack air	2.9E-03	629	13	588		3.5E-02	1.6	11	20	NEI
Land ^c	9.1E-03	2.5E04	1.4	9,208		3.9E-03	26	6	17	TRI

CT = central tendency estimates correspond to the 50th percentile of data; DMR = Discharge Monitoring Report; HE = high-end estimates correspond to the 95th percentile of data; NEI = National Emissions Inventory; TRI = Toxics Release Inventory

^a Information on operating days is typically reported by facilities to NEI. Sites that were mapped to the manufacturing as a byproduct OES reported operating days ranging from 350 to 365 days/year. For sites that did not report operating days information, a default of 350 days per year was applied.

^b Data points represent the total number of reports submitted during the years included in the assessment. Because a single facility may report multiple times across the assessed years, the number of data points can exceed the number of facilities. The minimum, maximum, central tendency, and high-end release metrics were calculated based on these data points.

^c Land releases for this OES were reported for the following categories:

230 OFF-SITE – UNDERGROUND INJECTION - CLASS 1 WELLS

236 OFF-SITE – OTHER LANDFILLS

237 OFF-SITE – RCRA SUBTITLE C LANDFILLS

4.2.2 Manufacturing as a Byproduct in the Pulp and Paper Industry – OES #2

4.2.2.1 OES Details

EPA identified sites in the pulp and paper industry reporting releases of 1,1,2-trichloroethane to NEI. A review of COUs identified for 1,1,2-trichloroethane found no association with the pulp and paper industry. Consultation with the Office of Air confirmed that 1,1,2-trichloroethane is not used as an input to the pulp and paper process but may form either unintentionally during bleaching or from incomplete combustion. An NCASI technical bulletin included in an EPA rulemaking docket provides supporting bleach plant emissions data for chlorinated compounds, including 1,1,2-trichloroethane ([EPA-HQ-OAR-2005-0103-0088](#)).

Additional support from the NCASI Handbook (pg. 34) indicates that bleaching processes using chlorine-containing chemicals generate chlorinated organic compounds, including chloroform and other chlorinated species, as byproducts of pulp bleaching ([NCASI, 2008](#)). These compounds are produced when chlorine-based reagents are used in bleaching and are present in bleach plant effluents as part of a broader mixture of chlorinated organic material, often characterized as adsorbable organic halides (AOX) [pg. 34].

The identification of chloroform among bleaching byproducts demonstrates that low molecular weight chlorinated compounds can be formed during these processes ([NCASI, 2008](#)). While 1,1,2-trichloroethane is not specifically identified as a common analyte, it falls under the class of chlorinated organic compounds known to be generated during chlorine-based bleaching.

EPA therefore designated 1,1,2-trichloroethane as an unintentional byproduct of pulp and paper manufacturing and included it as an OES under the manufacture life cycle category.

1,2-trichloroethane may be formed either from the bleaching process, in which case the bleaching agent, chlorine oxide, is the source of chlorine, or during the combustion process as a product of incomplete combustion.

NCASI Handbook (pg. 433-435) indicates that chlorinated organic compounds are formed during pulp bleaching when chlorine-containing chemicals react with organic material remaining in the pulp, including lignin and lignin-derived structures ([NCASI, 2008](#)). Pages 433-435 of the handbook further clarifies that reactive chlorine species generated in bleaching stages (*i.e.*, chlorine and chlorine dioxide-derived oxidants) chemically modify these organic constituents through electrophilic substitution and oxidation reactions, resulting in incorporation of chlorine into organic molecules ([NCASI, 2008](#)).

These reactions occur as lignin is broken down and solubilized during bleaching, producing a mixture of transformation products that includes both larger chlorinated organic material and smaller, discrete compounds formed through fragmentation of lignin-derived structures (pg. 433-435) ([NCASI, 2008](#)). This fragmentation during oxidative bleaching provides a mechanistic basis for the formation of lower molecular weight chlorinated compounds in addition to bulk adsorbable organic halides (AOX).

NCASI also indicates that the use of chlorine dioxide in bleaching modifies these reaction pathways. Compared to elemental chlorine, chlorine dioxide reduces the formation of chlorinated organic byproducts by limiting direct chlorination reactions, while promoting oxidative reactions of lignin that result in formation of non-chlorinated products such as quinones (pg. 434-435) ([NCASI, 2008](#)). This shift reflects a change from substitution-dominated chemistry toward more selective oxidation, although some chlorinated organic compounds may still be formed. NCASI (pg. 34-35) identifies chloroform as one such bleaching byproduct ([NCASI, 2008](#)), demonstrating that simple chlorinated hydrocarbons can be produced under these conditions. The formation of chloroform indicates that cleavage and rearrangement reactions occurring during lignin oxidation can yield small, chlorinated molecules, supporting the possibility that other chlorinated aliphatics may also be generated as minor byproducts.

Several factors influence emissions of chlorinated compounds from bleach plants, including the bleaching sequence, level of bleaching, and bleaching temperature. In addition, most bleach plants use scrubbers to control chlorine emissions, which may also affect 1,1,2-trichloroethane emissions. Scrubber solutions typically contain various organic solvents that may be stripped from the solution and emitted into the scrubber vent gases due to their volatility (EPA-HQ-OAR-2005-0103-0088).

EPA assumes that the weight percent of 1,1,2-trichloroethane produced as a byproduct in pulp and paper processing to be comparable to generation of a byproduct in chemical manufacturing; therefore, EPA expects it to range from <1 to 45 percent ([Stantec ChemRisk, 2024a](#)).

4.2.2.2 Facility Estimates

EPA did not identify production volume information for the manufacturing of 1,1,2-trichloroethane as a byproduct in the pulp and paper industry.

Using information from NEI, EPA identified 71 facilities that manufacture the chemical as a byproduct at in the pulp and paper industry. A complete list of these facilities is provided in *Draft Number of Sites for 1,1,2-Trichloroethane* (U.S. EPA, 2026n).

Information on operating days is typically reported by facilities to the NEI. Sites that were mapped to the manufacturing as a byproduct in the pulp and paper industry OES in NEI reported operating days ranging from 84 to 365 days/year. For all other sites (33 of the 71 total) that did not have the NEI data, EPA applied a default of 350 days/year. Because 1,1,2-trichloroethane is a commodity chemical, EPA assumes that manufacturing plants run 7 days/week, 50 weeks/year or 350 days/year. EPA assumed the number of release days per year will be equal to the number of operating days at the facility.

4.2.2.3 Environmental Release Estimates – Facility Reported Data

Fugitive air and stack air emissions data were available for this OES from NEI. EPA did not identify facilities manufacturing 1,1,2-trichloroethane as a byproduct in the pulp and paper industry in TRI or DMR.

Data in NEI were mapped to this OES using NAICS codes associated with the pulp and paper industry (e.g., 322120 – Paper Mills, 322130 – Paperboard Mills, etc.), and sector/SCC codes indicating pulp and paper processing.

Each facility provided one or more data points on release emissions. EPA estimated the minimum, maximum, 50th, and 95th percentile release metrics for annual emissions (kg/site-yr) using the data points. EPA calculated daily release estimates (kg/site-day) using facility-reported NEI operating information where available, or a default assumption of 350 days/year.

Annual and daily release estimates are presented below in Table 4-4. The facility data shown already account for release controls and their associated efficiencies.

Table 4-4. Summary of Environmental Releases During the Manufacture of 1,1,2-Trichloroethane as a Byproduct in the Pulp and Paper Industry

Environmental Media	Estimated Yearly Release (kg/site-yr)				Number of Release Days ^a	Daily Release (kg/site-day)		Number of Facilities	Number of Data Points ^b	Source
	Min	Max	CT	HE		CT	HE			
Fugitive air	1.3E-04	2,764	46	1,102	350	0.13	3.0	45	79	NEI
Stack air	2.7E-02	1,651	11	241		3.4E-02	0.69	66	106	NEI

CT = central tendency estimates correspond to the 50th percentile of data; HE = high-end estimates correspond to the 95th percentile data; NEI = National Emissions Inventory

^a Information on operating days is typically reported by facilities to NEI. Sites that were assigned to unknown reported operating days ranging from 84–365 days/year.

^b Data points represent the total number of reports submitted during the years included in the assessment. Because a single facility may report multiple times across the assessed years, the number of data points can exceed the number of facilities. The minimum, maximum, central tendency, and high-end release metrics were calculated based on these data points.

4.2.3 Repackaging for Laboratory Chemical Use – OES #3

4.2.3.1 OES Details

A review of import data from 2019 through 2025 identified two import instances of 1,1,2-

trichloroethane to a laboratory chemical distributor ([Descartes Datamyne, 2025](#)).

Chemicals such as 1,1,2-trichloroethane may be imported into the United States in bulk via water, air, land, and intermodal shipments ([Tomer and Kane, 2015](#)). These shipments take the form of oceangoing chemical tankers, railcars, tank trucks, and intermodal tank containers. EPA expects that 1,1,2-trichloroethane is repackaged from import containers into smaller product containers (< 1 gallon) to be used downstream for commercial laboratory use. Repackaging may involve unloading import containers, QC sampling the imported formulation, cleaning the import containers, and loading the formulation into smaller containers to be used downstream ([U.S. EPA, 2022c](#)).

Product safety data sheets indicate that 1,1,2-trichloroethane may be present in laboratory chemical formulations at concentrations ranging from 0.1 to 100% ([Sigma-Aldrich Inc, 2020](#); [Santa Cruz Biotechnology, 2019](#); [SPEX CertiPrep LLC, 2019](#); [Phenova, 2018](#); [ThermoFisher Scientific, 2018](#); [Matheson Tri-Gas, 2017](#)).

4.2.3.2 Facility Estimates

There were no reports of imported or repackaged 1,1,2-trichloroethane in 2020 or 2024 CDR. EPA had evidence of small quantities of imports by laboratory chemical distributors from the Datamyne reference above. Therefore, EPA estimated the total production volume of 1,1,2-trichloroethane imported or repackaged using the CDR reporting threshold limits of either 25,000 pounds (11,340 kg) or five percent of a site's reported PV, whichever value was smaller. EPA considered every site that reported using 1,1,2-trichloroethane to CDR. EPA assumed that sites that claimed their production volume as CBI imported and repackaged 25,000 pounds of 1,1,2-trichloroethane annually. The total production volume for this OES was estimated as 75,000 lb/yr (34,019 kg/yr).

EPA did not identify any repackaging sites in the CDR but was able to map 9 facilities to repackaging from facility reported environmental release data. Based on a review of Datamyne data from 2019 to 2025, EPA identified two import instances of 1,1,2-trichloroethane in 2022 and 2024 to a laboratory. Based on the consignee names, this is an import by Sigma-Aldrich, which is a laboratory chemical distributor ([Descartes Datamyne, 2025](#)).

According to the Chemical Repackaging Generic Scenario, repackaging facilities typically operate from 174 to 260 days per year ([U.S. EPA, 2022c](#)). EPA assumed the number of release days per year will be equal to the number of operating days at the facility.

EPA did not identify chemical-specific data on throughputs or facility operating schedules, therefore, EPA used default values suggested in the Chemical Repackaging Generic Scenario to model releases for this scenario. The repackaging rates range from 1 kg product/site-yr to 315,479 kg product/site-yr. EPA then estimated chemical-specific throughputs by multiplying these product repackaging rates by the expected 1,1,2-trichloroethane concentrations listed in Section 4.2.3.1, resulting in estimated throughputs ranging from 1.9 to 11,340 kg 1,1,2-trichloroethane/site-year.

4.2.3.3 Environmental Release Estimates – Facility Reported Data

Surface water, fugitive air, stack air, and land emissions data were available for this OES from 2019 to 2023 DMR and 2017/2020 NEI. Data were mapped to this OES using NAICS codes (see Section 10.2.3.6 for a list of NAICS codes associated with this OES) and NEI sector and SCC descriptions indicating import.

Each facility provided one or more data points on release emissions. In some cases, a facility reported

multiple data points per year. For example, in DMR, facilities report releases at each outfall, and a single facility may have multiple outfalls. EPA estimated the minimum, maximum, 50th, and 95th percentile release metrics for annual emissions (kg/site-year) using the data points. EPA calculated daily release estimates (kg/site-day) using facility-reported NEI operating information where available, or a default assumption of 250 days/year.

Facilities may report to multiple programmatic data sources (e.g., a facility may report to both TRI and DMR for surface water discharges). Differences in program reporting thresholds and NPDES permit requirements may result in different numbers of facilities across programs.

Estimated annual and daily release estimates are presented below in Table 4-5. The facility data shown already account for release controls and their associated efficiencies.

Table 4-5. Summary of Environmental Releases During the Import of 1,1,2-Trichloroethane

Environmental Media	Estimated Yearly Release (kg/site-yr)				Number of Release Days ^a	Daily Release (kg/site-day)		Number of Facilities	Number of Data Points ^b	Source
	Minimum	Maximum	Central Tendency	High-End		Central Tendency	High-End			
Surface water	8.5E-03	428	0.65	236	250	2.6E-03	0.95	5	10	DMR
Fugitive air	4.0E-03	5.7	0.60	5.0		2.4E-03	1.4E-02	4	6	NEI
Stack air	4.5E-06	0.94	0.20	0.85		5.5E-04	3.3E-03	4	7	NEI
DMR = Discharge Monitoring Report; NEI = National Emissions Inventory Central tendency estimates correspond to the 50th percentile of data, and high-end estimates correspond to the 95th percentile. ^a Information on operating days is typically reported by facilities to NEI. Sites that were mapped to the processing as a reactant OES reported operating days ranging from 250 to 364 days/year. ^b Data points represent the total number of reports submitted during the years included in the assessment. Because a single facility may report multiple times across the assessed years, the number of data points can exceed the number of facilities. The minimum, maximum, central tendency, and high-end release metrics were calculated based on these data points.										

4.2.3.4 Environmental Release Estimates – Modeled

Rationale for Modeling

EPA identified nine facilities mapped to repackaging in facility reported environmental release data. Due to uncertainty in the total number of repackaging sites and whether the facility reported environmental release data is representative of the high-end of for this OES, EPA also estimated releases for repackaging of 1,1,2-trichloroethane using the models, approaches, and media of release described in the July 2022 Chemical Repackaging - Generic Scenario for Estimating Occupational Exposures and Environmental Releases ([U.S. EPA, 2022c](#)).

Modeled release sources included

1. Transfer operation losses to air from unloading 1,1,2-trichloroethane,
2. Product sampling wastes disposed of to incineration or landfill,
3. Open surface losses to air during product sampling,
4. Import container residue released to incineration or landfill,
5. Open surface losses to air during container cleaning,
6. Equipment cleaning releases to incineration or landfill,
7. Open surface losses to air during equipment cleaning, and
8. Transfer operation losses to air from packaging 1,1,2-trichloroethane into containers.

Modeling Approach

EPA used model equations and parameters from the Chemical Repackaging - Generic Scenario for Estimating Occupational Exposures and Environmental Releases ([U.S. EPA, 2022c](#)). EPA performed a Monte Carlo simulation to estimate variability in the model input parameters. The facility annual throughput of 1,1,2-trichloroethane was capped at the TRI processing threshold of 25,000 lb/yr because facilities exceeding this threshold would be expected to report to TRI, and no such reports were identified. The simulation used the Latin hypercube sampling method in @Risk Industrial Edition, Version 8.0.0, which generates a sample of possible values. The Agency performed the model at 100,000 iterations to capture a broad range of possible values. EPA selected the 50th and 95th percentile to estimate releases.

Key modeling parameters

Key modeling parameters used for this OES are presented in Table 4-6 below. These parameters are applicable to all release sources. Refer to Appendix A.3.2 for a full list of input parameters used in the repackaging model.

Table 4-6. Key Modeling Parameters Used to Model Environmental Releases from Repackaging of 1,1,2-Trichloroethane for Laboratory Chemical Use

Modeling Parameter	Variable Type	Value(s)
Production Volume of 1,1,2-Trichloroethane for this OES	CDR-Derived Value	34,019.43 kg/yr
Operating Days	Discrete Distribution	174, 208, and 260 days/yr
Facility Annual Product Throughput	Discrete Distribution	1–315,479 kg/site-yr
1,1,2-Trichloroethane Concentration	Discrete Distribution	0.1–100% by weight
Import Container Volume	Triangular Distribution	100–1,000 gallons; mode of 550 gallons
Laboratory Chemical Product Container Volume	Triangular Distribution	1 mL to 1 L

CDR = Chemical Data Reporting; OES = occupational exposure scenario

Environmental Release Estimates

Releases are estimated for each of the release sources listed above, then combined by media. Table 4-7 summarizes the estimated release results for repackaging. The high-end values are the 95th percentile of the respective simulation output and the central tendencies are the 50th percentile. The number of release days are also a result of the simulation output and are dependent on the facility throughput and number of import containers received. The 1,1,2-trichloroethane facility throughput was capped at the 1,1,2-trichloroethane production volume.

Appendix A.3 includes the model equations and input parameters used in the Monte Carlo simulation for this COU.

Table 4-7. Summary of Modeled Environmental Releases During the Repackaging of 1,1,2-Trichloroethane for Laboratory Chemical Use

Environmental Media	Modeled Yearly Release (kg/site-yr) – Before Treatment		Release Control Efficiency Applied	Modeled Yearly Release (kg/site-yr) – After Treatment		Number of Release Days	Modeled Daily Release (kg/site-day) – After Treatment	
	Central Tendency	High-End		Central Tendency	High-End		Central Tendency	High-End
Fugitive Air	287	778	None	287	778	174 to 260 ^b	1.4	3.5
Uncertain Media (Total):	24	631	None	24	631		0.11	3.0
If Incineration	24	631	99.99% ^a	2.4E–03	6.3E–02		1.1E–05	3.0E–04
If Landfill	24	631	None	24	631		0.11	3.0
Central tendency estimates correspond to the 50th percentile of data, and high-end estimates correspond to the 95th percentile.								
^a Regulations at 40 CFR part 63, Subpart EEE – National Emission Standards for Hazardous Air Pollutants from Hazardous Waste Combustors require all hazardous waste combustors (incinerators, cement kilns, lightweight aggregate kilns, solid fuel boilers, liquid fuel boilers, and hydrochloric acid production furnaces) to achieve a DRE of 99.99 percent for each principal organic hazardous constituent including 1,1,2-trichloroethane. It is important to note that the incineration DRE should only be applied to OES involving industrial sites and not commercial sites.								
^b The number of operating days associated with repackaging sites can be estimated from employment data obtained through the U.S. Bureau of Labor Statistics (BLS) Occupational Employment Statistics. Per the U.S. BLS website, operating duration for each NAICS code is assumed as a ‘year-round, full-time’ hours figure of 2,080 hours. Therefore, dividing this time by an assumed working duration of 8-12 hours/day yields operating days of 174-260 days/year.								

A release control efficiency was applied for the incineration media of release based on the National Emission Standards for Hazardous Pollutants from Hazardous Waste Combustors (40 CFR part 63, subpart EEE) requirement that all hazardous waste combustors achieve a destruction removal efficiency of 99.99 percent for each principal organic hazardous constituent including 1,1,2-trichloroethane. Due to a lack of data, EPA did not account for air emissions controls in the modeled release estimates. Table 4-7 presents results before and after release control efficiency for the incineration media.

Comparability of Modeled Release Estimates with Facility Reported Releases

EPA compared the modeled repackaging release results with the facility reported release data. The modeled repackaging releases to air are higher than the facility reported releases. This may be due to the modeling including higher values for facility throughput and not accounting for any release controls for the fugitive air releases. For the production volume, the model uses 34,019 kg/yr which is based on EPA’s CDR reporting threshold of 25,000 pounds for processing and use information. Because this value is based on reporting thresholds and not actual production volume data, the large discrepancy in facility and modeled air emissions is likely a result of the production volume assumption. In addition, there is uncertainty in whether the data from the facility reported release data adequately captured all releases for this OES, which may contribute to the lower facility release results.

4.2.4 Processing as a Reactant – OES #4

4.2.4.1 OES Details

Processing as a reactant was identified as a condition use in the Scoping Document Conditions of Use Table for 1,1,2-trichloroethane as reported in the 2016 CDR ([U.S. EPA, 2016](#)). Three facilities each in the 2020 and 2024 CDR also reported processing as a reactant as an industrial use ([U.S. EPA, 2026b, 2022a](#)). EPA also identified safety data sheets from Westlake Chemical and Spectrum Chemical with recommended use as intermediate ([Spectrum Chemical, 2019](#); [Westlake Vinyls, 2015](#)).

Processing as a reactant or intermediate is the use of 1,1,2-trichloroethane as a feedstock in the production of another chemical via a chemical reaction in which 1,1,2-trichloroethane is consumed to form the product. 1,1,2-trichloroethane is used as an intermediate in the production of 1,1-dichloroethane and cis- and trans-dichloroethylene ([Earthjustice, 2019](#)). Another process is the manufacture of vinylidene chloride, which is prepared by dehydrochlorination of 1,1,2-trichloroethane with lime or caustic ([Fishbein, 1979](#)). 1,1,2-trichloroethane is also one of the major feedstock chemicals used in the production of carbon tetrachloride, perchloroethylene and hydrochloric acid ([Dow Chemical, 1988](#)). EPA did not find specific container information for 1,1,2-trichloroethane used as a reactant; however, EPA expects 1,1,2-trichloroethane to arrive as a neat liquid in intermediate storage tanks, tank trucks, rail cars, or pipelines received directly from the manufacturing sites.

EPA identified safety data sheets from Westlake Chemical and Spectrum Chemical with recommended use as intermediate, containing 9 to 43 percent and 100 percent 1,1,2-trichloroethane, respectively ([Spectrum Chemical, 2019](#); [Westlake Vinyls, 2015](#)).

4.2.4.2 Facility Estimates

In the 2020 and 2024 CDR, four facilities reported manufacturing an aggregate of 100 million to 1 billion pounds of 1,1,2-trichloroethane annually; three of which reported downstream processing of 1,1,2-trichloroethane as a reactive intermediate ([U.S. EPA, 2026b, 2022a](#)). EPA assumes that a high percentage of the production volume goes towards this use.

In the 2020 and 2024 CDR, three facilities, Geon Oxy Vinyl in Laporte, TX, Olin Blue Cube in Freeport, TX, and Occidental Chemical Corporation in Wichita, KS, reported use of 1,1,2-trichloroethane as an intermediate in the manufacture of all other basic organic chemicals ([U.S. EPA, 2026b, 2022a](#)). Using information from DMR, TRI, and NEI, EPA identified 73 facilities that potentially process 1,1,2-trichloroethane as a reactant. See *Draft Number of Sites for 1,1,2-Trichloroethane* ([U.S. EPA, 2026n](#)) for a list of all facilities mapped to processing as a reactant that reported to programmatic databases.

Information on operating days is typically reported by facilities to NEI. Sites that were mapped to the processing as a reactant OES in NEI reported operating days ranging from 350 to 365 days/yr. For all other sites, based on 1,1,2-trichloroethane being a commodity chemical, EPA assumes processing plants run 7 days/week, 50 weeks/year or 350 days/year. EPA assumed the number of release days per year will be equal to the number of operating days at the facility.

4.2.4.3 Environmental Release Estimates – Facility Reported Data

Surface water, fugitive air, stack air, and land emissions data were available for this OES from 2019 to 2023 DMR, 2019 to 2023 TRI, and 2017/2020 NEI.

Data were mapped to this OES using NAICS codes (see Section 10.2.3.6 for a list of NAICS codes associated with this OES), TRI use codes, and NEI sector and SCC descriptions indicating processing as a reactant.

Each facility provided one or more data points on release emissions. In some cases, a facility reported multiple data points per year. For example, in DMR, facilities report releases at each outfall, and a single facility may have multiple outfalls. EPA estimated the minimum, maximum, 50th, and 95th percentile release metrics for annual emissions (kg/site-yr) using the data points. EPA calculated daily release estimates (kg/site-day) using facility-reported NEI operating information where available, or a default

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assumption of 350 days/yr.

Facilities may report to multiple programmatic data sources (e.g., a facility may report to both TRI and DMR for surface water discharges). Differences in program reporting thresholds and NPDES permit requirements may result in different numbers of facilities across programs.

Annual and daily release estimates are presented below in Table 4-8. The facility data shown already account for release controls and their associated efficiencies.

Table 4-8. Summary of Environmental Releases During the Processing of 1,1,2-Trichloroethane as a Reactant

Environmental Media	Estimated Yearly Release (kg/site-yr)				Number of Release Days ^a	Daily Release (kg/site-day)		Number of Facilities	Number of Data Points ^b	Source
	Minimum	Maximum	Central Tendency	High-End		Central Tendency	High-End			
Surface water	1.4E-03	216	0.33	10	350	9.5E-04	2.9E-02	57	192	DMR
Fugitive air	6.5	320	173	274		0.49	0.78	4	17	TRI
Fugitive air	6.1E-04	129	1.2	116		3.2E-03	0.32	11	16	NEI
Stack air	0.45	57	5.9	52		1.7E-02	0.15	4	13	TRI
Stack air	4.9E-04	50	1.9E-02	42		5.2E-05	0.12	4	8	NEI
Land ^c	2.6	12	5.4	11		1.6E-02	3.1E-02	2	4	TRI

DMR = Discharge Monitoring Report; NEI = National Emissions Inventory; OES = occupational exposure scenario; TRI = Toxics Release Inventory

Central tendency estimates correspond to the 50th percentile of data, and high-end estimates correspond to the 95th percentile.

^a Information on operating days is typically reported by facilities to NEI. Sites that were mapped to the processing as a reactant OES reported operating days ranging from 350 to 365 days/year.

^b Data points represent the total number of reports submitted during the years included in the assessment. Because a single facility may report multiple times across the assessed years, the number of data points can exceed the number of facilities. The minimum, maximum, central tendency, and high-end release metrics were calculated based on these data points.

^c Land releases for this OES were reported for the following categories:
 215 OTHER DISPOSAL
 237 OFF-SITE - RCRA SUBTITLE C LANDFILLS

4.2.5 Formulation of Adhesives and Sealants – OES #5

4.2.5.1 OES Details

Formulation of adhesives and sealants was not identified as a condition of use in the Scoping Document Conditions of Use Table for 1,1,2-trichloroethane; however, because commercial and consumer use of adhesives and sealants were identified, formulation is assessed as an OES. EPA identified safety data sheets and product information for adhesives containing 1,1,2-trichloroethane ([Earthjustice, 2019](#); [Huntsman, 2018](#)).

Incorporation into a formulation, mixture or reaction product refers to the process of mixing or blending of several raw materials to obtain a single product or preparation. EPA did not find specific container information for 1,1,2-trichloroethane used as in formulation; EPA expects 1,1,2-trichloroethane to arrive as a neat liquid in tank trucks, rail cars, totes, or drums received directly from the manufacturing sites. The ESD on Adhesive Formulation outlines the process that involves mixing volatile and non-volatile chemical components in sealed, unsealed or heated processes and packaging for customer use. Sealed

processes are most common for adhesive formulation because many adhesives are designed to set or react when exposed to ambient conditions (OECD, 2009a). No specific information on packaging was found; the ESD on the Use of Adhesives (OECD, 2015) indicates that adhesives are typically shipped in tank cars, totes, or drums.

Information from a Huntsman Advanced Materials Americas LLC safety data sheet indicated that 1,1,2-trichloroethane is used at concentrations of 1 to 5 percent by weight in Araldite 2021 A U.S. adhesive, which is sold as a paste (Huntsman, 2018). Several acrylic adhesives sold by Henkel North America in Bridgewater, New Jersey, including Loctite 329, Loctite 330 Depend Pt A, and Speedbonder H3000 400ML Part A contain up to 1 percent 1,1,2-trichloroethane (Earthjustice, 2019). Gorilla Glue Company in Cincinnati, Ohio sells a Gorilla Weld Resin containing < 0.1 percent 1,1,2-trichloroethane (Earthjustice, 2019). Spectrum Chemical Manufacturing Corp. in Gardena, California also sells 1,1,2-trichloroethane containing adhesives as the resin component of two-part acrylic and epoxy adhesives (Earthjustice, 2019).

4.2.5.2 Facility Estimates

There were no reports of formulation of adhesives containing 1,1,2-trichloroethane in 2020 or 2024 CDR. In addition, EPA did not identify information on the percentage of 1,1,2-trichloroethane production volume used for the formulation of adhesives and sealants. Therefore, EPA estimated the PV for this use using the CDR reporting threshold limits of either 25,000 pounds (11,340 kg) manufactured/imported or five percent of a site's reported PV, whichever value was smaller. EPA considered every site that manufactured/imported 1,1,2-trichloroethane reported to CDR. EPA assumed that sites that claimed their production volume as CBI sent 25,000 pounds of 1,1,2-trichloroethane annually for use in adhesives and sealants. The total production volume for this OES was 75,000 lb/yr (34,019 kg/yr).

EPA did not identify any sites in CDR, DMR, TRI, or NEI that process 1,1,2-trichloroethane into adhesive or sealant formulations. As a result, EPA modeled releases for this scenario and calculated the number of sites as a model output. The number of sites was estimated based on the production volume, the formulation use rate provided by the Adhesive Formulation ESD, and the concentration of 1,1,2-trichloroethane in adhesives. The estimated number of sites for this scenario range from one to nine sites.

Facility operating days were calculated as a model output using the production rate and batch size, ranging from 30 to 365 days/year. Production rate and batch size were estimated using parameters provided by the Adhesive Formulation ESD (OECD, 2009a). The batch size ranges from 300 to 5,000 gallons per batch, contributing to the wide range of estimated operating days.

EPA did not identify chemical-specific data on throughputs, therefore, EPA used default values suggested in the Formulation of Adhesives Emission Scenario Document to model releases for this scenario. The facility adhesive production rate ranges from 380,000 kg adhesive/site-yr to 4,000,000 kg adhesive/site-yr (OECD, 2009a). At a range of 1 to 5 percent of 1,1,2-trichloroethane in the adhesive, the throughput for 1,1,2-trichloroethane ranges from 3,800 kg 1,1,2-trichloroethane/site-yr to 11,340 kg 1,1,2-trichloroethane/site-yr. EPA assumed the number of release days per year will be equal to the number of operating days at the facility.

4.2.5.3 Environmental Release Estimates – Modeled

Rationale for Modeling

EPA did not identify any sites that could be mapped to formulation of adhesives and sealants in facility

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reported environmental release data. Due to the lack of this data available for this OES, EPA estimated releases for formulation of adhesives and sealants using the models, approaches, and media of release described in the April 2009 Emission Scenario Document on Adhesive Formulation ([OECD, 2009a](#)).

Modeled Release Sources

Modeled release sources included:

1. Transfer operation losses to air from unloading the adhesive component,
2. Adhesive component container residue released to water, incineration, or landfill,
3. Open surface losses to air during container cleaning,
4. Vented losses to air during dispersion and blending/process operations,
5. Product sampling wastes disposed of to water, incineration, or landfill,
6. Open surface losses to air during product sampling,
7. Equipment cleaning releases to water, incineration, or landfill,
8. Open surface losses to air during equipment cleaning,
9. Transfer operation losses to air from packaging adhesive/sealant into transport containers, and
10. Off-specification and other waste adhesive to water, incineration, or landfill.

Modeling Approach

EPA used model equations and parameters from the Emission Scenario Document on Adhesive Formulation ([OECD, 2009a](#)). EPA performed a Monte Carlo simulation to estimate variability in the model input parameters. The facility annual throughput of 1,1,2-trichloroethane was capped at the TRI processing threshold of 25,000 lb/yr because facilities exceeding this threshold would be expected to report to TRI, and no such reports were identified. The simulation used the Latin hypercube sampling method in @Risk Industrial Edition, Version 8.0.0, which generates a sample of possible values. The Agency performed the model at 100,000 iterations to capture a broad range of possible values. EPA selected the 50th and 95th percentile to estimate releases.

Key Modeling Parameters

The key modeling parameters used for this OES are presented in Table 4-9 below. These parameters are applicable to all release sources. Refer to Appendix A.4.2 for a full list of input parameters used in the formulation of adhesives and sealants model.

Table 4-9. Key Modeling Parameters Used to Model Environmental Releases from Formulation of Adhesives and Sealants

Modeling Parameter	Variable Type	Value(s)
Production volume of 1,1,2-trichloroethane for this OES	CDR-Derived Value	34,019.43 kg/yr
Facility adhesive production rate (total adhesive)	Uniform Distribution	380,000–4,000,000 kg/site-yr
1,1,2-Trichloroethane concentration prior to formulation	Uniform Distribution	1–30% by weight
Product concentration of 1,1,2-trichloroethane after formulation	Uniform Distribution	1–5% by weight
Adhesive and sealant product container volume	Discrete Distribution	0.013 or 0.1 gallons
CDR = Chemical Data Reporting; OES = occupational exposure scenario		

Environmental Releases

Releases are estimated for each of the release sources listed above, then combined by media. Table 4-10 summarizes the estimated release results for formulation of adhesives and sealants. The high-end values are the 95th percentile of the respective simulation output and the central tendencies are the 50th percentile. Appendix A.4.2 includes the model equations and input parameters used in the Monte Carlo simulation for this COU.

Table 4-10. Summary of Modeled Environmental Releases During the Formulation of Adhesives and Sealants

Environmental Media	Modeled Yearly Release (kg/site-yr) – Before Treatment		Release Control Efficiency Applied	Modeled Yearly Release (kg/site-yr) – After Treatment		Number of Release Days	Modeled Daily Release (kg/site-day) – After Treatment	
	Central Tendency	High-End		Central Tendency	High-End		Central Tendency	High-End
Fugitive Air	2.5	3.9	None	2.5	3.9	8 to 365	6.3E-02	0.14
Stack Air	8.2	39	None	8.2	39		6.5E-02	0.16
Uncertain Media (Total):	668	829	None	668	829		4.7	19
If Water	668	829	73% ^a	180	224		1.3	5
If Incineration	668	829	99.99% ^b	6.7E-02	8.3E-02		4.7E-04	1.9E-03
If Landfill	668	829	None	668	829		4.7	19

POTW = publicly owned treatment works

Central tendency estimates correspond to the 50th percentile of data, and high-end estimates correspond to the 95th percentile.

^a Based on the current Fate TSD, the average removal efficiency for POTWs is 73%, which closely aligns with the measured data of a pilot-scale system (70.8 +/- 7.1).

^b Regulations at 40 CFR part 63, Subpart EEE – National Emission Standards for Hazardous Air Pollutants from Hazardous Waste Combustors, require all hazardous waste combustors (incinerators, cement kilns, lightweight aggregate kilns, solid fuel boilers, liquid fuel boilers, and hydrochloric acid production furnaces) to achieve a DRE of 99.99 percent for each principal organic hazardous constituent (POHC) including 1,1,2-trichloroethane. It is important to note that the incineration DRE should only be applied to OES involving industrial sites and not commercial sites.

Release control efficiencies were applied for the water and incineration media of release. A removal efficiency of 73% was applied to water releases based on the average removal efficiency for POTWS, which closely aligns with the measured data of a pilot scale system (70.8 +/- 7.1%). The incineration release efficiency is based on the National Emission Standards for Hazardous Pollutants from Hazardous Waste Combustors (40 CFR part 63, subpart EEE) requirement that all hazardous waste combustors achieve a destruction removal efficiency of 99.99% for each principal organic hazardous constituent including 1,1,2-trichloroethane. Due to a lack of data, EPA did not account for air emissions controls in the modeled release estimates.

Comparability of Modeled Release Estimates with Facility Reported Releases

EPA did not identify any facility-reported environmental release data related to the formulation of adhesives and sealants; therefore, EPA compared the modeled repackaging release results with other OES in the processing lifecycle category with facility release data. The modeled air releases are generally on the same order of magnitude as the processing as a reactant release estimates, which supports the validity of the model approach.

The releases to uncertain media are several orders of magnitude higher than the water and land releases estimated for processing as a reactant. This discrepancy is likely attributed to the 1,1,2-trichloroethane

production volume parameter used in the model. The model uses 34,019 kg/yr which is based on EPA's CDR reporting threshold of 25,000 pounds for processing and use information. Because this value is based on reporting thresholds and not actual production volume data, the large discrepancy in facility and modeled emissions is likely a result of the production volume assumption.

4.2.6 Use of Adhesives and Sealants – OES #6

For this assessment, EPA is combining the COUs of Industrial and Commercial Use of Adhesives and Sealants into one OES.

4.2.6.1 OES Details

Industrial Use: Adhesives and Sealants

Evidence for this OES: Adhesive and sealant use was identified as a condition of use in the Scoping Document Conditions of Use Table for 1,1,2-trichloroethane. According to public comments provided by the Aerospace Industries Association (AIA), 1,1,2-trichloroethane is used in the aerospace sector. Specifically, it is a component of proprietary acrylic and methacrylate adhesive formulations used by civil aviation and Department of Defense customers ([EPA-HQ-OPPT-2018-0421-0006](#)).

Process Information: No specific information was found on the use of industrial adhesives containing 1,1,2-trichloroethane. The ESD on the Use of Adhesives ([OECD, 2015](#)) indicates that adhesives are unloaded from tank cars, totes, or drums, diluted and mixed, then applied via roll, spray, curtain coating, or bead or syringe application. The adhesive is then cured or reacted. As 1,1,2-trichloroethane is volatile, it is expected to evaporate during curing.

Weight % Information: A comment from the American Coatings association indicated that 1,1,2-trichloroethane is present as an impurity in some adhesives in amounts between 0.1 and 10% ([EPA-HQ-OPPT-2018-0421-0003](#)).

Commercial Use: Adhesives and Sealants

Adhesive and sealant use was identified as a condition of use in the Scoping Document Conditions of Use Table for 1,1,2-trichloroethane. A commenter ([EPA-HQ-OPPT-2018-0421-0013](#)) provided descriptions of their use of 1,1,2-trichloroethane as a component of common off the shelf adhesives, further informing EPA's understanding of this condition of use.

EPA did not find specific container information for 1,1,2-trichloroethane used as an adhesive and sealant; however, EPA expects 1,1,2-trichloroethane to arrive as liquid or paste in drums or smaller containers received from the formulator. A commenter indicates that 1,1,2-trichloroethane may be present in the resin component of two-part acrylic and epoxy adhesives ([EPA-HQ-OPPT-2018-0421-0013](#)). Product instructions indicate that the two components should be dispensed onto a disposable surface, mixed until uniform, and then applied to substrates for bonding. Full curing occurs in 24 hours ([Gorilla Glue Company, 2020](#)). During curing, 1,1,2-trichloroethane is reacted ([EPA-HQ-OPPT-2018-0421-0013](#)).

Information from a Huntsman Advanced Materials Americas LLC safety data sheet indicated that 1,1,2-trichloroethane is used at concentrations of 1 to 5% by weight in Araldite 2021 A U.S. adhesive ([Huntsman, 2018](#)). A public comment indicated that 1,1,2-trichloroethane is present as an impurity in some adhesives in amounts between 0.1 and 10 percent ([EPA-HQ-OPPT-2018-0421-0003](#)). 1,1,2-Trichloroethane is present in two-component adhesive products at a concentration of less than 0.1 percent ([EPA-HQ-OPPT-2018-0421-0003](#)) ([Gorilla Glue Company, 2018](#)).

4.2.6.2 Facility Estimates

EPA reviewed available information from the 1,1,2-Trichloroethane Use Report, systematic review, and CDR. There were no reports of sites using adhesive or sealants containing 1,1,2-trichloroethane in 2020 or 2024 CDR. Additionally, the Use Report and systematic review did not include data on the percentage of 1,1,2-trichloroethane associated with this use. Therefore, EPA estimated the total production volume of 1,1,2-trichloroethane for this use using the CDR reporting threshold limits of either 25,000 pounds (11,340 kg) or five percent of a site's reported PV, whichever value was smaller. EPA considered every site that reported using 1,1,2-trichloroethane to CDR. EPA assumed that sites that claimed their production volume as CBI processed 25,000 pounds of 1,1,2-trichloroethane annually. The total production volume for this OES was 75,000 lb/yr (34,019 kg/yr).

Using programmatic data from NEI, EPA identified nine sites that use products containing 1,1,2-trichloroethane as an adhesive or sealant. See *Draft Number of Sites for 1,1,2-Trichloroethane* ([U.S. EPA, 2026n](#)) for a list of all facilities mapped to use as an adhesive or sealant that reported to programmatic databases.

Information on operating days is typically reported by facilities to NEI. Sites that were mapped to the use of adhesives and sealants OES in NEI reported operating days ranging from 250 to 365 days/yr. According to the Use of Adhesives Emission Scenario Document, facilities typically operate 260 days/year ([OECD, 2015](#)). EPA assumed the number of release days per year will be equal to the number of operating days at the facility.

EPA did not identify chemical-specific data on throughputs, therefore, EPA used default values suggested in the Use of Adhesives Emission Scenario Document to model releases for this scenario. The Emission Scenario Document provides throughputs for various adhesive types. The adhesive product identified for this scenario falls under the Motor and Non-Motor Vehicle Parts, and Tire Manufacturing (Except Retreading) general end-use category ([Huntsman, 2018](#)). The facility annual adhesive use rate for this end-use category is 13,500 kg/site-yr ([OECD, 2015](#)). At a range of 1 to 5% of 1,1,2-trichloroethane in the adhesive, the throughput for 1,1,2-trichloroethane ranges from 135 kg 1,1,2-trichloroethane/site-yr to 675 kg 1,1,2-trichloroethane/site-yr.

4.2.6.3 Environmental Release Estimates – Facility Reported Data

Fugitive and stack air release data were available for this OES from 2017 and 2020 NEI. Data were mapped using NEI sectors, SCC descriptions, and emission unit descriptions indicating coating, adhesive, and sealant use.

Each facility provided one or more data points on release emissions. In some cases, a facility reported multiple data points per year. For example, in NEI, facilities report releases at the emission-unit level, and a single facility may have multiple emission units. EPA estimated the minimum, maximum, 50th, and 95th percentile release metrics for annual emissions (kg/site-yr) using the data points. EPA calculated daily release estimates (kg/site-day) using facility-reported NEI operating information where available, or a default assumption of 260 days/yr.

Annual and daily release estimates are presented below in Table 4-11. The facility data shown already account for release controls and their associated efficiencies.

Table 4-11. Summary of Environmental Releases During the Use of Adhesives and Sealants

Environmental Media	Estimated Yearly Release (kg/site-yr)				Number of Release Days ^a	Daily Release (kg/site-day)		Number of Facilities	Number of Data Points ^b	Source
	Minimum	Maximum	Central Tendency	High-End		Central Tendency	High-End			
Fugitive air	0.54	45	2.5	39	260	7.2E-03	0.16	4	5	NEI
Stack air	4.9E-04	3.2	0.46	3.1		1.8E-03	1.2E-02	6	8	NEI

NEI = National Emissions Inventory; OES = occupational exposure scenario
 Central tendency estimates correspond to the 50th percentile of data, and high-end estimates correspond to the 95th percentile.
^a Information on operating days is typically reported by facilities to NEI. Sites that were mapped to the use of adhesives and sealants OES reported operating days ranging from 250 to 365 days/year.
^b Data points represent the total number of reports submitted during the years included in the assessment. Because a single facility may report multiple times across the assessed years, the number of data points can exceed the number of facilities. The minimum, maximum, central tendency, and high-end release metrics were calculated based on these data points.

Due to the limited facility release data, EPA supplemented the release assessment with a modeling approach.

4.2.6.4 Environmental Release Estimates – Modeled

Rationale for Modeling

EPA identified a small number of sites mapped to use of adhesives and sealants in facility reported environmental release data. Due to the limited air release data and absence of data for other release media for this OES, EPA estimated releases for use of adhesives and sealants using the models, approaches, and media of release described in the April 2015 Emission Scenario Document on the Use of Adhesives ([OECD, 2015](#)).

Modeled Release Sources Included

1. Container residue losses to incineration or landfill,
2. Transfer operations losses to air from unloading the adhesive formulation,
3. Equipment cleaning releases to incineration or landfill,
4. Open surface losses to air during equipment cleaning, and
5. Evaporative losses to air during curing/drying.

Modeling Approach

EPA used model equations and parameters from the Emission Scenario Document on the Use of Adhesives ([OECD, 2015](#)). EPA performed a Monte Carlo simulation to estimate variability in the model input parameters. The simulation used the Latin hypercube sampling method in @Risk Industrial Edition, Version 8.0.0, which generates a sample of possible values. The Agency performed the model at 100,000 iterations to capture a broad range of possible values. EPA selected the 50th and 95th percentile to estimate releases.

Key Modeling Parameters

The key modeling parameters used for this OES are presented in Table 4-12 below. These parameters are applicable to all release sources. Refer to Appendix A.5.2 for a full list of input parameters used in the use of adhesives and sealants model.

Table 4-12. Key Modeling Parameters Used to Model Environmental Releases from the Use of Adhesives and Sealants

Modeling Parameter	Variable Type	Value(s)
Production volume for 1,1,2-trichloroethane for this OES	CDR-Derived Value	34,019.43 kg/yr
Operating days	ESD Default Value	260 days/yr
Annual facility adhesive throughput – total adhesive	ESD Default Value	13,500 kg/site-yr
Concentration of 1,1,2-trichloroethane in adhesive/sealant product as applied	Uniform Distribution	1 to 5% by weight
Volume of adhesive/sealant product containers containing 1,1,2-trichloroethane	Discrete Distribution	0.013 or 0.1 gallons
CDR = Chemical Data Reporting; ESD = emission scenario document; OES = occupational exposure scenario		

Environmental Releases

Releases are estimated for each of the release sources listed above, then combined by media. Table 4-13 summarizes the estimated release results for the use of adhesives and sealants. The high-end values are the 95th percentile of the respective simulation output and the central tendencies are the 50th percentile. Appendix A.5 includes the model equations and input parameters used in the Monte Carlo simulation for this COU.

Table 4-13. Summary of Modeled Environmental Releases During the Use of Adhesives and Sealants

Environmental Media	Modeled Yearly Release (kg/site-yr) – Before Treatment		Release Control Efficiency Applied	Modeled Yearly Release (kg/site-yr) – After Treatment		Number of Release Days	Modeled Daily Release (kg/site-day) – After Treatment	
	Central Tendency	High-End		Central Tendency	High-End		Central Tendency	High-End
Fugitive Air	402	643	None	402	643	260 ^c	1.5	2.5
Uncertain Media (Total):	2.7	5.9	None	2.7	5.9		1.0E-02	2.3E-02
If Water	2.7	5.9	73% ^a	0.73	1.6		2.7E-03	6.2E-03
If Incineration	2.7	5.9	99.99% ^b	2.7E-04	5.9E-04		1.0E-06	2.3E-06
If Landfill	2.7	5.9	None	2.7	5.9		1.0E-02	2.3E-02
ESD = emission scenario document; OES = occupational exposure scenario; POTW = publicly owned treatment works Central tendency estimates correspond to the 50 th percentile of data, and high-end estimates correspond to the 95th percentile. ^a Based on the current Fate TSD, the average removal efficiency for POTWs is 73%, which closely aligns with the measured data of a pilot-scale system (70.8+/- 7.1). ^b Regulations at 40 CFR part 63, Subpart EEE – National Emission Standards for Hazardous Air Pollutants from Hazardous Waste Combustors, require all hazardous waste combustors (incinerators, cement kilns, lightweight aggregate kilns, solid fuel boilers, liquid fuel boilers, and hydrochloric acid production furnaces) to achieve a DRE of 99.99 percent for each principal organic hazardous constituent (POHC) including 1,1,2-trichloroethane. It is important to note that the incineration DRE should only be applied to OES involving industrial sites and not commercial sites. ^c The number of release days used was based on the ESD default of 260 days/yr.								

Release control efficiencies were applied for the water and incineration media of release. A removal efficiency of 73% was applied to water releases based on the average removal efficiency for POTWs, which closely aligns with the measured data of a pilot scale system (70.8 +/- 7.1%). The incineration release efficiency is based on the National Emission Standards for Hazardous Pollutants from Hazardous Waste Combustors (40 CFR part 63, subpart EEE) requirement that all hazardous waste combustors to achieve a destruction removal efficiency of 99.99% for each principal organic hazardous constituent including 1,1,2-trichloroethane. Due to a lack of data, EPA did not account for air emissions controls in the modeled release estimates.

Comparability of Modeled Release Estimates with Facility Reported Data

EPA identified nine relevant facilities in NEI. Due to the uncertainty in whether the data from these nine facilities adequately captured all releases for this OES, the Agency modeled releases. The potential non-representativeness of the NEI data may contribute to the modeled air releases being several orders of magnitude greater than the facility release data. In addition, discrepancies may arise from model parameters such as the 1,1,2-trichloroethane production volume. The model uses 34,019 kg/yr which is based on EPA's CDR reporting threshold of 25,000 pounds for processing and use information. Because this value is based on reporting thresholds and not actual production volume data, the large discrepancy in NEI and modeled air emissions is likely a result of the production volume assumption.

The majority of the 1,1,2-trichloroethane released during the use of adhesive is emitted to air. Due to the chemical's high volatility, most of the substance evaporates during use, resulting in minimal releases during cleaning and disposal.

4.2.7 Open-Top Vapor Degreasing – OES #7

4.2.7.1 OES Details

Industrial Use: Open-Top Vapor Degreaser

Evidence for this OES: Use of cleaning and degreasing solvents was not identified as a COU in the Scoping Document Conditions of Use Table for 1,1,2-trichloroethane; but was added as a COU during the development of the Risk Evaluation. According to reported 2017 NEI data, 1,1,2-trichloroethane is used in open-top vapor degreasing and cold cleaning ([U.S. EPA, 2020a](#)).

Process Information: EPA did not find specific container information for 1,1, 2-trichloroethane used in vapor degreasing. The ESD on the Use of Vapor Degreasers assumes that vapor degreasers are typically supplied in 55-gallon drums from manufacturers or processors. In batch open top vapor degreasers (OTVDs), a vapor cleaning zone is created by heating the liquid solvent in the OTVD causing it to volatilize. Solvent vapor rises to the height of the chilled condensing coils on the inside walls of the unit, producing a hot vapor zone below the coils. The condensing coils cool the vapor, causing it to condense and return to the bottom of the degreaser. Workers manually load or unload fabricated parts directly into or out of the vapor cleaning zone. As cleaning occurs, wastes build up in the degreasing solvent; the sludge is cleaned from the degreaser and the solvent replaced. Dirty solvent is typically disposed of by incineration. Wastewater releases may come from moisture in the atmosphere that condenses into the degreasing solvent, water-based oils and lubricants on parts being degreased, or steam used to regenerate carbon adsorbers used to control solvent emissions ([OECD, 2021](#)).

Weight % Information: The ESD on the Use of Vapor Degreasers states that primary vapor degreasing solvents are typically supplied at 80 to 99% (typically >90%) ([OECD, 2021](#)).

4.2.7.2 Facility Estimates

There were no reports of sites using degreasing solvents containing 1,1,2-trichloroethane in 2020 or 2024 CDR. Therefore, EPA estimated the total production volume of 1,1,2-trichloroethane for this use using the CDR reporting threshold limits of either 25,000 pounds (11,340 kg) or five percent of a site's reported PV, whichever value was smaller. EPA considered every site that reported using 1,1,2-trichloroethane to CDR. EPA assumed that sites that claimed their production volume as CBI use 25,000 pounds of 1,1,2-trichloroethane annually. The total production volume for this OES was 75,000 lb/yr (34,019 kg/yr).

Using programmatic data from NEI and TRI, EPA identified seven facilities that use 1,1,2-trichloroethane as a solvent for cleaning and/or vapor degreasing. See *Draft Number of Sites for 1,1,2-Trichloroethane* ([U.S. EPA, 2026n](#)) for a list of all facilities mapped to this scenario that reported to programmatic databases.

Information on operating days is typically reported by facilities to NEI. Sites that were mapped to this OES in NEI reported operating days ranging from 260 to 364 days/yr. EPA assumed the number of release days per year will be equal to the number of operating days at the facility.

Based on the limited programmatic data, EPA modeled releases for this scenario. Facility throughput was estimated by dividing the NEI air emission data by the air emission loss fraction from the Emission Scenario Document on the Use of Vapor Degreasers ([OECD, 2021](#)). The air emission data were modeled as a discrete distribution using emissions reported for each of the seven solvent cleaning and degreasing sites in NEI. The facility annual throughput of 1,1,2-trichloroethane estimated in the model ranges from 78 kg/site-yr to 4,546 kg/site-yr.

4.2.7.3 Environmental Release Estimates – Facility Reported Data

Fugitive and stack air release data were available for this OES from 2019 through 2023 TRI and 2017 and 2020 NEI. Data were mapped using TRI use codes, NEI sectors, SCC descriptions, and emission

unit descriptions indicating solvent cleaning/degreasing.

Each facility provided one or more data points on release emissions. In some cases, a facility reported multiple data points per year. For example, in NEI, facilities report releases at the emission-unit level, and a single facility may have multiple emission units. EPA estimated the minimum, maximum, 50th, and 95th percentile release metrics for annual emissions (kg/site-yr) using the data points. EPA calculated daily release estimates (kg/site-day) using facility-reported NEI operating information where available, or a default assumption of 260 days/yr.

Annual and daily release estimates are presented below in Table 4-14. The facility data shown already account for release controls and their associated efficiencies.

Table 4-14. Summary of Environmental Releases During the Use of Cleaning and Degreasing Solvents

Environmental Media	Estimated Yearly Release (kg/site-yr)				Number of Release Days ^a	Daily Release (kg/site-day)		Number of Facilities	Number of Data Points ^b	Source
	Minimum	Maximum	Central Tendency	High-End		Central Tendency	High-End			
Fugitive air	304		-	-	260	1.2		1	1	TRI
Fugitive air	0.10	816	0.45	654		4.4E-02	2.2	5	7	NEI
Stack air	3,638		-	-		14		1	1	TRI
Stack air	0.22	7,230	3,615	6,869		14	26	2	4	NEI

NEI = National Emissions Inventory; OES = occupational exposure scenario; TRI = Toxics Release Inventory
Central tendency estimates correspond to the 50th percentile of data, and high-end estimates correspond to the 95th percentile.

^a Information on operating days is typically reported by facilities to NEI. Sites that were mapped to the use of cleaning and degreasing solvents OES reported operating days ranging from 260 to 364 days/year.

^b Data points represent the total number of reports submitted during the years included in the assessment. Because a single facility may report multiple times across the assessed years, the number of data points can exceed the number of facilities. The minimum, maximum, central tendency, and high-end release metrics were calculated based on these data points.

4.2.7.4 Environmental Release Estimates – Modeled

Rationale for Modeling

EPA identified a limited number of sites mapped to use of cleaning and degreasing solvents in programmatic data. Due to the limited air release data and absence of data for other release media, EPA estimated releases for open-top vapor degreasing using the models and approaches described in the December 2021 Emission Scenario Document on the Use of Vapor Degreasers ([OECD, 2021](#)).

Modeled Release Sources

Modeled release sources included:

1. Release to incineration or landfill from cleaning of transport containers,
2. Release to air during vapor degreasing operations,
3. Release to water from vapor degreasing wastewater, and
4. Release to incineration from cleaning degreasing machine and disposing waste solvent.

Modeling Approach

EPA estimated releases for use of adhesives and sealants using the model equations and parameters

described in the December 2021 Emission Scenario Document on the Use of Vapor Degreasers ([OECD, 2021](#)). EPA performed a Monte Carlo simulation to estimate variability in the model input parameters. The facility annual throughput of 1,1,2-trichloroethane was capped at the TRI use threshold of 10,000 lb/yr because facilities exceeding this threshold would be expected to report to TRI, and only one report was identified. The simulation used the Latin hypercube sampling method in @Risk Industrial Edition, Version 8.0.0, which generates a sample of possible values. The Agency performed the model at 100,000 iterations to capture a broad range of possible values. EPA selected the 50th and 95th percentile to estimate releases.

Key Modeling Parameters

The key modeling parameters used for this OES are presented in Table 4-15 below. Refer to Appendix A.6.2 for a full list of input parameters used in the model.

Table 4-15. Key Modeling Parameters Used to Model Environmental Releases from the Use of Cleaning and Degreasing Solvents

Modeling Parameter	Variable Type	Value(s)
Production volume for 1,1,2-trichloroethane for this OES	CDR-Derived Value	34,019.43 kg/yr
Operating days	NEI-Based Discrete Distribution	260 to 364 days/yr
Vapor degreaser emissions (release point 2)	NEI-Based Discrete Distribution	0.008 to 7,230 kg/site-yr
Concentration of 1,1,2-trichloroethane as used	ESD Default	100% by weight
Frequency of solvent changeout	ESD Default	26 days/yr
CDR = Chemical Data Reporting; ESD = emission scenario document; NEI = National Emissions Inventory; OES = occupational exposure scenario		

Environmental Releases

Releases are estimated for each of the release sources listed above, then combined by media. Table 4-16 summarizes the estimated release results for the use of cleaning and degreasing solvents. The high-end values are the 95th percentile of the respective simulation output and the central tendencies are the 50th percentile. Appendix A.6 includes the model equations and input parameters used in the Monte Carlo simulation for this COU.

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Table 4-16. Summary of Modeled Environmental Releases During the Use of Cleaning and Degreasing Solvents

Environmental Media	Modeled Yearly Release (kg/site-yr) – Before Treatment		Release Control Efficiency Applied	Modeled Yearly Release (kg/site-yr) – After Treatment		Number of Release Days	Modeled Daily Release (kg/site-day) – After Treatment	
	Central Tendency	High-End		Central Tendency	High-End		Central Tendency	High-End
Fugitive Air or Stack Air	0.46	4,069	None	0.46	4,069	357	1.8E-03	12
Water	64	117	73% ^a	17	32	357	0.19	0.33
Incineration	10	389	99.99% ^b	1.0E-03	3.9E-02	26	3.9E-05	1.5E-03
Uncertain Media (Total):	1.9	188	None	1.9	188	357	5.7E-03	0.55
If Incineration	1.9	188	99.99% ^b	1.9E-04	1.9E-02	357	5.7E-07	5.5E-05
If Landfill	1.9	188	None	1.9	188	357	5.7E-03	0.55

POTW = publicly owned treatment works
 Central tendency estimates correspond to the 50th percentile of data, and high-end estimates correspond to the 95th percentile.
^a Based on the current Fate TSD, the average removal efficiency for POTWs is 73%, which closely aligns with the measured data of a pilot-scale system (70.8 +/- 7.1%).
^b Regulations at 40 CFR part 63, Subpart EEE – National Emission Standards for Hazardous Air Pollutants from Hazardous Waste Combustors, require all hazardous waste combustors (incinerators, cement kilns, lightweight aggregate kilns, solid fuel boilers, liquid fuel boilers, and hydrochloric acid production furnaces) to achieve a DRE of 99.99 percent for each principal

Release control efficiencies were applied for the water and incineration media of release. A removal efficiency of 73% was applied to water releases based on the average removal efficiency for POTWS, which closely aligns with the measured data of a pilot scale system (70.8 +/- 7.1 percent). The incineration release efficiency is based on the National Emission Standards for Hazardous Pollutants from Hazardous Waste Combustors (40 CFR part 63, subpart EEE) requirement that all hazardous waste combustors to achieve a destruction removal efficiency of 99.99% for each principal organic hazardous constituent including 1,1,2-trichloroethane. Due to a lack of data, EPA did not account for air emissions controls in the modeled release estimates.

Comparability of Modeled Release Estimates with Facility Reported Releases

EPA identified seven relevant facilities in TRI and NEI. Due to the uncertainty in whether the data from these facilities adequately captured all releases for this OES, the Agency modeled releases. The potential non-representativeness of the facility data may contribute to the modeled air releases being several orders of magnitude greater than the facility release data. The modeled release estimates are also higher than facility release data from other OES. Discrepancies may also arise from model parameters such as the 1,1,2-trichloroethane production volume. The model uses 34,019 kg/yr which is based on EPA's CDR reporting threshold of 25,000 pounds for processing and use information. Because this value is based on reporting thresholds and not actual production volume data, the large discrepancy in facility and modeled air emissions is likely a result of the production volume assumption.

4.2.8 Cold Cleaning – OES #8

Use of cleaning and degreasing solvents was not identified as a condition of use in the Scoping Document Conditions of Use Table for 1,1,2-trichloroethane. According to reported 2017 and 2020 NEI data, 1,1,2-trichloroethane is used in cold solvent cleaning/stripping ([U.S. EPA, 2023a, 2020a](#)). EPA has collected additional information for this use and has identified several safety data sheets for cold cleaning. An Exim Trading ([2011](#)) safety data sheet listed use as a degreaser for internal and external

cleaning of refrigeration and air conditioning systems, electrical connectors, electric motors, panels, chassis of mechanical equipment, videos, transformers, watches and all types of electrical equipment, in which 1,1,2-trichloroethane is present from 5 to 10 ppm. Another safety data sheet from Partsmaster Inc. (2013) for a brake cleaner indicated trace quantities of 1,1,2-trichloroethane. Finally, a safety data sheet from Spectrum Chemical Manufacturing Corp (2019) listed recommended use as solvent, containing 100 percent 1,1,2-trichloroethane. Several possibilities exist for cleaning and degreasing; however, available data are not sufficient to separate the OES. Given the uncertainty on additional OES that may be applicable, EPA is providing qualitative information on the potential use of 1,1,2-trichloroethane in cold cleaning.

EPA did not find specific container information for 1,2-trichloroethane used as a solvent for cleaning and degreasing; however, EPA expects 1,1,2-trichloroethane to arrive as liquid in drums or smaller containers received from manufacturers or processors. Cold cleaners are non-boiling solvent degreasing units. Cold cleaning operations include spraying, brushing, flushing, and immersion. In a typical batch-loaded, maintenance cold cleaner, dirty parts are cleaned manually by spraying and then soaking in the tank. After cleaning, the parts are either suspended over the tank to drain or are placed on an external rack that routes the drained solvent back into the cleaner. Batch manufacturing cold cleaners could vary widely but have two basic equipment designs: the simple spray sink and the dip tank. The dip tank design typically provides better cleaning through immersion and often involves an immersion tank equipped with agitation (U.S. EPA, 1981). Emissions and subsequent exposures from batch cold cleaning machines typically result from (1) evaporation of the solvent from the solvent-to-air interface, (2) “carry out” of excess solvent on cleaned parts, and (3) evaporative losses of the solvent during filling and draining of the machine (U.S. EPA, 2006a).

Based on the available sources discussed above, 1,1,2-trichloroethane may be present in the cleaner from 5 ppm (0.0005%) through 100%.

4.2.9 Use of Laboratory Chemicals – OES #9

4.2.9.1 OES Details

Laboratory use was identified as a condition of use in the Scoping Document Conditions of Use Table for 1,1,2-trichloroethane. A commenter (EPA-HQ-OPPT-2018-0421-0028) indicated 1,1,2-trichloroethane use in analytical standards, research, equipment calibration, and sample preparation applications, including as a reference sample for analysis of terrestrial and extraterrestrial material samples, which the commenter also indicated was a critical use, further informing EPA’s understanding of this condition of use. Several Safety Data Sheets for 1,1,2-trichloroethane indicated recommended use as a laboratory chemical (Sigma-Aldrich Inc, 2020; Santa Cruz Biotechnology, 2019; SPEX CertiPrep LLC, 2019; Phenova, 2018; ThermoFisher Scientific, 2018; Matheson Tri-Gas, 2017).

EPA did not find specific container information for 1,1,2-trichloroethane used as a reactant; however, EPA expects 1,1,2-trichloroethane to arrive as a neat liquid in drums or smaller containers received from the manufacturer or repackager. The Use of Laboratory Chemicals Generic Scenario indicated process steps of transferring laboratory chemical from shipping containers, container cleaning, equipment cleaning, laboratory analyses, and disposal of waste chemicals (U.S. EPA, 2023d).

Safety Data Sheets indicated that 1,1,2-trichloroethane may be present in laboratory chemicals from 0.1 to 100% (Sigma-Aldrich Inc, 2020; Santa Cruz Biotechnology, 2019; SPEX CertiPrep LLC, 2019; Phenova, 2018; ThermoFisher Scientific, 2018; Matheson Tri-Gas, 2017).

4.2.9.2 Facility Estimates

There were no reports of 1,1,2-trichloroethane for laboratory use in 2020 or 2024 CDR. Therefore, EPA estimated the total production volume of 1,1,2-trichloroethane imported or repackaged using the CDR reporting threshold limits of either 25,000 pounds (11,340 kg) or five percent of a site's reported PV, whichever value was smaller. EPA considered every site that reported using 1,1,2-trichloroethane to CDR. EPA assumed that sites that claimed their production volume as CBI use 25,000 pounds of 1,1,2-trichloroethane for laboratory use annually. The total production volume for this OES was 75,000 lb/yr (34,019 kg/yr).

Using programmatic data from DMR and NEI, EPA identified three facilities that use 1,1,2-trichloroethane for laboratory use. See *Draft Number of Sites for 1,1,2-Trichloroethane* ([U.S. EPA, 2026n](#)) for a list of all facilities mapped to this scenario that reported to programmatic databases. Release modeling (Section 4.2.9.4 below) suggests that the number of sites may range from 23 to 36,873 sites based on 2020 Census Data and information provided by the Laboratory Chemical Generic Scenario ([U.S. EPA, 2023d](#)).

Information on operating days is typically reported by facilities to NEI. The site mapped to the laboratory use OES in NEI reported 350 days/yr of operation. According to the Laboratory Chemical Generic Scenario, facility operating days typically range from 174 to 260 days per year ([U.S. EPA, 2023d](#)). EPA assumed the number of release days per year will be equal to the number of operating days at the facility.

EPA did not identify chemical-specific data on throughputs or facility operating schedules, therefore, EPA used default values and approaches suggested in the Laboratory Chemical Generic Scenario to model releases for this scenario. The facility annual throughput of 1,1,2-trichloroethane ranges from 0.92 kg/site-yr to 1,469 kg/site-yr ([U.S. EPA, 2023d](#)).

4.2.9.3 Environmental Release Estimates – Facility

Surface water discharge data was available from 2019 through 2023 DMR and fugitive air release data were available from 2017 and 2020 NEI to estimate environmental releases during the use of 1,1,2-trichloroethane as a laboratory chemical.

Data were mapped using NEI sectors, SCC descriptions, and NAICS codes indicating laboratory use. See Section 10.2.7.6 for a list of NAICS codes associated with this OES.

Each facility provided one or more data points on release emissions. In some cases, a facility reported multiple data points per year. For example, in NEI, facilities report releases at the emission-unit level, and a single facility may have multiple emission units. EPA estimated the minimum, maximum, 50th, and 95th percentile release metrics for annual emissions (kg/site-yr) using the data points. EPA calculated daily release estimates (kg/site-day) using facility-reported NEI operating information where available, or a default assumption of 260 days/yr.

Annual and daily release estimates are presented below in Table 4-17. The facility data shown already account for release controls and their associated efficiencies.

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Table 4-17. Summary of Environmental Releases for the Commercial Use of 1,1,2-Trichloroethane as a Laboratory Chemical

Environmental Media	Estimated Yearly Release (kg/site-yr)				Number of Release Days ^a	Daily Release (kg/site-day)		Number of Facilities	Number of Data Points ^b	Source
	Min.	Max.	CT	HE		CT	HE			
Surface water	3.7E-02	2.3	0.15	1.9	260	5.9E-04	7.2E-03	2	10	DMR
Fugitive air	2.5E-05	2.5E-05	2.5E-05	2.5E-05		7.2E-08	7.2E-08	1	2	NEI

CT = central tendency; DMR = Discharge Monitoring Report; HE = high-end; NEI = National Emissions Inventory
Central tendency estimates correspond to the 50th percentile of data, and high-end estimates correspond to the 95th percentile.
^a Information on operating days is typically reported by facilities to NEI. The site mapped to the use as a laboratory chemical OES reported 350 days/yr of operation.
^b Data points represent the total number of reports submitted during the years included in the assessment. Because a single facility may report multiple times across the assessed years, the number of data points can exceed the number of facilities. The minimum, maximum, central tendency, and high-end release metrics were calculated based on these data points.

4.2.9.4 Environmental Release Estimates – Modeled

Rationale for Modeling

EPA identified a small number of sites (three) mapped to the use of laboratory chemicals in programmatic data. Release modeling projects that the number of sites may range from 23 to 36,873 sites based on 2020 Census Data and information provided by the Laboratory Chemical Generic Scenario ([U.S. EPA, 2023d](#)). Due to the limited release data available, EPA estimated releases for the use of laboratory chemicals using the models, approaches, and release sources described in the January 2023 Laboratory Chemical Generic Scenario ([U.S. EPA, 2023d](#)).

Modeled Release Sources

Modeled release sources included:

1. Transfer operation losses to air during unloading of volatile chemicals,
2. Container residue losses to incineration or landfill,
3. Open surface losses to air during container cleaning,
4. Equipment cleaning losses to incineration or landfill,
5. Open surface losses to air during equipment cleaning,
6. Releases to air from lab analysis, and
7. Releases to incineration or landfill from disposal of laboratory waste.

Modeling Approach

EPA estimated releases for use of laboratory chemicals using the model equations and parameters described in the Revised Draft Generic Scenario on the Use of Laboratory Chemicals ([U.S. EPA, 2023d](#)). EPA performed a Monte Carlo simulation to estimate variability in the model input parameters. The simulation used the Latin hypercube sampling method in @Risk Industrial Edition, Version 8.0.0, which generates a sample of possible values. The Agency performed the model at 100,000 iterations to capture a broad range of possible values. EPA selected the 50th and 95th percentile to estimate releases.

Key Modeling Parameters

The key modeling parameters used for this OES are presented in Table 4-18 below. Refer to Appendix A.7 for a full list of input parameters used in the model.

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Table 4-18. Key Modeling Parameters Used to Model Environmental Releases from the Use of Laboratory Chemicals

Modeling Parameter	Variable Type	Value(s)
Production Volume	CDR-Derived Value	34,019.43 kg/yr
Operating Days	Discrete Distribution	174 to 260 days/yr
Facility Laboratory Chemical Throughput	NEI-Based Discrete Distribution	0.50 to 4,000 mL/site-day
Product Concentration	Discrete Distribution	0.1 to 100% by weight
Container Volume	Triangular Distribution	0.00026 to 0.66 gallons
CDR = Chemical Data Reporting; NEI = National Emissions Inventory		

Environmental Releases Summary Table

Releases are estimated for each of the release sources listed above, then combined by media. Table 4-19 summarizes the estimated release results for the use of laboratory chemicals. The high-end values are the 95th percentile of the respective simulation output and the central tendencies are the 50th percentile.

Appendix A.7 includes the model equations and input parameters used in the Monte Carlo simulation for this OES.

Table 4-19. Summary of Modeled Environmental Releases During the Use of Laboratory Chemicals

Chromiums

Environmental Media	Modeled Yearly Release (kg/site-yr) – Before Treatment		Release Control Efficiency Applied	Modeled Yearly Release (kg/site-yr) – After Treatment		Number of Release Days	Modeled Daily Release (kg/site-day) – After Treatment	
	Central Tendency	High-End		Central Tendency	High-End		Central Tendency	High-End
Fugitive Air or Stack Air	4.8	13	None	4.8	13	174 to 260	2.1E-02	5.3E-02
Uncertain Media (Total):	317	1,040	None	317	1,040		1.4	4.5
If Incineration	317	1,040	99.99% ^a	3.2E-02	0.10		1.2E-04	4.0E-04
If Landfill	317	1,040	None	317	1,040		1.4	4.5
Central tendency estimates correspond to the 50 th percentile of data, and high-end estimates correspond to the 95 th percentile. ^a Regulations at 40 CFR part 63, Subpart EEE – National Emission Standards for Hazardous Air Pollutants from Hazardous Waste Combustors, require all hazardous waste combustors (incinerators, cement kilns, lightweight aggregate kilns, solid fuel boilers, liquid fuel boilers, and hydrochloric acid production furnaces) to achieve a DRE of 99.99 percent for each principal organic hazardous constituent (POHC) including 1,1,2-trichloroethane. It is important to note that the incineration DRE should only be applied to OES involving industrial sites and not commercial sites.								

A release control efficiency was applied for the incineration media of release based on the National Emission Standards for Hazardous Pollutants from Hazardous Waste Combustors (40 CFR part 63, subpart EEE) requirement that all hazardous waste combustors achieve a destruction removal efficiency of 99.99% for each principal organic hazardous constituent including 1,1,2-trichloroethane. Due to a lack of data, EPA did not account for air emissions controls in the modeled release estimates.

Comparability of Modeled Releases with Facility Reported Data

EPA identified two relevant facilities in DMR and one facility in NEI. Due to the uncertainty in whether the data from these facilities adequately captured all releases for this OES, the Agency modeled releases. The potential non-representativeness of the facility data may contribute to the modeled air and uncertain media of release being several orders of magnitude greater than the facility release data for this OES and

other OES with facility release data. In addition, discrepancies may arise from model parameters such as the 1,1,2-trichloroethane production volume. The model uses 34,019 kg/yr which is based on EPA's CDR reporting threshold of 25,000 pounds for processing and use information. Because this value is based on reporting thresholds and not actual production volume data, the large discrepancy in facility and modeled emissions is likely a result of the production volume assumption.

4.2.10 Disposal to Incineration – OES #10

4.2.10.1 OES Details

According to NEI, DMR, and TRI, numerous sites report releases of 1,1,2-trichloroethane during incineration ([U.S. EPA, 2026a](#), [2023a](#), [2022f](#), [2020a](#)). Based on a comment from EarthJustice, the vast majority of 1,1,2-trichloroethane waste (99.7 percent of all waste transfers out of generating facilities) is burned in incinerators and cement kilns and the leading destination for 1,1,2-trichloroethane waste are incinerators inside chlorinated chemical complexes ([EPA-HQ-OPPT-2018-0421-0013](#)).

No specific information for 1,1,2-trichloroethane during incineration was found. Waste 1,1,2-trichloroethane may be shipped in various size containers or piped directly to incineration sites at various concentrations. Commercial scale hazardous waste incinerators are generally two-chamber units, a rotary kiln followed by an afterburner, that accept both solid and liquid waste. Liquid wastes are pumped through pipes and are fed to the unit through nozzles that atomize the liquid for optimal combustion ([ETC, 2018](#); [Heritage, 2018](#)). Incoming hazardous waste is usually received by truck or rail, and an inspection is required for all waste received. Receiving areas for liquid waste generally consist of a docking area, pumphouse, and some kind of storage facilities ([ETC, 2018](#); [Kitto and Stultz, 1992](#)).

No specific information for 1,1,2-trichloroethane during waste disposal was found. EPA assumes that 1,1,2-trichloroethane may be received at any concentration described in the individual OES (0.0005% through 100%).

4.2.10.2 Facility Estimates

Using programmatic data from DMR, TRI, and NEI, EPA identified 20 sites that treat 1,1,2-trichloroethane or waste containing 1,1,2-trichloroethane via incineration. See *Draft Number of Sites for 1,1,2-Trichloroethane* ([U.S. EPA, 2026n](#)) for a list of all facilities mapped to this scenario that reported to programmatic databases.

Information on operating days is typically reported by facilities to NEI. Sites mapped to the Incineration OES in NEI reported operating days ranging from 250 to 365 days/yr. Otherwise, EPA assumes a schedule of 250 days/yr of operation. EPA assumed the number of release days per year will be equal to the number of operating days at the facility.

4.2.10.3 Environmental Release Estimates – Facility Reported Data

EPA used 2019 through 2023 DMR, 2019 through 2023 TRI, and 2017/2020 NEI data to estimate environmental releases during the disposal of 1,1,2-trichloroethane to incineration.

Data were mapped using TRI use codes, NEI sectors, SCC descriptions, and NAICS codes indicating disposal to incineration. See Section 10.2.8.6 for a list of NAICS codes associated with this OES.

Each facility provided one or more data points on release emissions. In some cases, a facility reported multiple data points per year. For example, in NEI, facilities report releases at the emission-unit level, and a single facility may have multiple emission units. EPA estimated the minimum, maximum, 50th,

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and 95th percentile release metrics for annual emissions (kg/site-yr) using the data points. EPA calculated daily release estimates (kg/site-day) using facility-reported NEI operating information where available, or a default assumption of 250 days/yr.

Annual and daily release estimates are presented below in Table 4-20. The facility data shown already account for release controls and their associated efficiencies.

Table 4-20. Summary of Environmental Releases During Waste Handling, Treatment, and Disposal (Incineration)

Environmental Media	Estimated Yearly Release (kg/site-yr)				Number of Release Days ^a	Daily Release (kg/site-day)		Number of Facilities	Number of Data Points ^b	Source
	Min.	Max.	CT	HE		CT	HE			
Surface Water	1.9E-02	2.3E-02	2.1E-02	2.2E-02	250	8.2E-05	9.0E-05	1	2	DMR
Fugitive air	1.4E-03	64	0.50	45		2.0E-03	0.18	5	21	TRI
Fugitive air	4.0E-04	14	3.2E-03	8.7		1.3E-05	3.3E-02	9	15	NEI
Stack air	4.5E-04	2.8	0.13	2.8		5.3E-04	1.1E-02	5	16	TRI
Stack air	1.8E-04	340	0.27	143		1.1E-03	0.53	14	25	NEI
Land ^c	5.4E-03	6.4	1.8E-02	4.7		7.3E-05	1.9E-02	3	5	TRI

CT = central tendency; DMR = Discharge Monitoring Report; HE = high-end; NEI = National Emissions Inventory; TRI = Toxics Release Inventory

Central tendency estimates correspond to the 50th percentile of data, and high-end estimates correspond to the 95th percentile.

^a Information on operating days is typically reported by facilities to NEI. Sites that were mapped to the incineration OES reported operating days ranging from 250 to 365 days/year.

^b Data points represent the total number of reports submitted during the years included in the assessment. Because a single facility may report multiple times across the assessed years, the number of data points can exceed the number of facilities. The minimum, maximum, central tendency, and high-end release metrics were calculated based on these data points.

^c Land releases for this OES were reported for the following categories:

230 OFF-SITE – UNDERGROUND INJECTION - CLASS 1 WELLS

236 OFF-SITE - OTHER LANDFILLS

237 OFF-SITE - RCRA SUBTITLE C LANDFILLS

241 OFF-SITE - DISPOSAL - TRANSFER TO WASTE BROKER

4.2.11 Disposal to Landfill – OES #11

4.2.11.1 OES Details

According to NEI, DMR, and TRI, numerous sites report releases of 1,1,2-trichloroethane from landfills ([U.S. EPA, 2026ah](#), [2023a](#), [2022f](#), [2020a](#)).

No specific information for 1,1,2-trichloroethane during landfill disposal was found. Waste 1,1,2-trichloroethane may be shipped in various size containers to landfill sites at various concentrations. 1,1,2-trichloroethane is a U-listed hazardous waste under code U227 under RCRA; therefore, discarded, unused pure and commercial grades of 1,1,2-trichloroethane are regulated as a hazardous waste under RCRA (40 CFR 261.33(f)). Hazardous waste landfills are excavated or engineered sites specifically designed for the final disposal of non-liquid hazardous waste. Design standards for these landfills require double liner, double leachate collection and removal systems, leak detection system, run on, runoff and wind dispersal controls, and construction quality assurance program ([U.S. EPA, 2018](#)).

No specific information for 1,1,2-trichloroethane during waste disposal was found. EPA assumes that 1,1,2-trichloroethane may be received at any concentration described in the individual OES (0.0005% through 100%).

4.2.11.2 Facility Estimates

Using programmatic data from DMR, TRI, and NEI, EPA identified 89 landfill sites that handle 1,1,2-trichloroethane or waste containing 1,1,2-trichloroethane. See *Draft Number of Sites for 1,1,2-Trichloroethane* ([U.S. EPA, 2026n](#)) for a list of all facilities mapped to this scenario that reported to programmatic databases.

Information on operating days is typically reported by facilities to NEI. Sites mapped to the Landfill OES in NEI reported operating days ranging from 250 to 364 days/yr. Otherwise, EPA assumes a schedule of 250 days/yr of operation. EPA assumed the number of release days per year will be equal to the number of operating days at the facility.

4.2.11.3 Environmental Release Estimates – Facility Reported Data

EPA used 2019 through 2023 DMR, 2019 through 2023 TRI, and 2017/2020 NEI data to estimate environmental releases during the disposal of 1,1,2-trichloroethane to landfills.

Data were mapped using TRI use codes, NEI sectors, SCC descriptions, and NAICS codes indicating disposal to landfill. See Section 10.2.9.6 for a list of NAICS codes associated with this OES.

Each facility provided one or more data points on release emissions. In some cases, a facility reported multiple data points per year. For example, in NEI, facilities report releases at the emission-unit level, and a single facility may have multiple emission units. EPA estimated the minimum, maximum, 50th, and 95th percentile release metrics for annual emissions (kg/site-yr) using the data points. EPA calculated daily release estimates (kg/site-day) using facility-reported NEI operating information where available, or a default assumption of 250 days/yr.

Annual and daily release estimates are presented below in Table 4-21. The facility data shown already account for release controls and their associated efficiencies.

Table 4-21. Summary of Environmental Releases During Waste Handling, Treatment, and Disposal (Landfill)

Environmental Media	Estimated Yearly Release (kg/site-yr)				Number of Release Days ^a	Daily Release (kg/site-day)		Number of Facilities	Number of Data Points ^b	Source
	Min.	Max.	Central Tendency	High-End		Central Tendency	High-End			
Surface Water	1.5E-03	1.0	3.6E-02	0.97	250	1.4E-04	3.9E-03	6	15	DMR
Fugitive air	4.5E-03	162	9.1E-02	117		3.6E-04	0.47	5	17	TRI
Fugitive air	2.2E-05	73	0.74	24		2.5E-03	9.4E-02	64	105	NEI
Stack air	1.4E-02	4.1	0.23	3.0		9.3E-04	1.2E-02	4	12	TRI
Stack air	1.6E-05	138	0.60	61		2.5E-03	0.25	34	54	NEI
Land ^c	0.91	4.5	2.3	4.3		9.1E-03	1.7E-02	3	3	TRI

DMR = Discharge Monitoring Report; NEI = National Emissions Inventory; OES = Occupational Exposure Scenario; TRI = Toxics Release Inventory

Central tendency estimates correspond to the 50th percentile of data, and high-end estimates correspond to the 95th percentile.

^a Information on operating days is typically reported by facilities to NEI. Sites that were mapped to the landfill OES reported operating days ranging from 250 to 364 days/year.

^b Data points represent the total number of reports submitted during the years included in the assessment. Because a single facility may report multiple times across the assessed years, the number of data points can exceed the number of facilities. The minimum, maximum, central tendency, and high-end release metrics were calculated based on these data points.

^c Land releases for this OES were reported for the following categories:

237 OFF-SITE - RCRA SUBTITLE C LANDFILLS

4.2.12 Disposal to POTW – OES#12

4.2.12.1 OES Details

According to NEI and DMR, numerous sites report releases of 1,1,2-trichloroethane from POTWs ([U.S. EPA, 2026ah](#), [2023a](#), [2020a](#)).

No specific information for 1,1,2-trichloroethane during POTW disposal was found. Disposal to POTW refers to the collection and routing of 1,1,2-trichloroethane-containing wastes to third-party publicly owned treatment works which treat the wastes utilizing water treatment units.

No specific information for 1,1,2-trichloroethane during waste disposal was found. EPA assumes that 1,1,2-trichloroethane may be received at any concentration described in the individual OES (0.0005% through 100%).

4.2.12.2 Facility Estimates

Using programmatic data from DMR and NEI, EPA identified 114 POTW sites that handle 1,1,2-trichloroethane or waste streams containing 1,1,2-trichloroethane. See *Draft Number of Sites for 1,1,2-Trichloroethane* ([U.S. EPA, 2026n](#)) for a list of all facilities mapped to this scenario that reported to programmatic databases.

Information on operating days is typically reported by facilities to NEI. Sites mapped to the POTW OES in NEI reported operating days ranging from 250 to 364 days per year. Otherwise, EPA assumes a schedule of 365 days/yr of operation. EPA assumed the number of release days per year will be equal to the number of operating days at the facility.

4.2.12.3 Environmental Release Estimates – Facility Reported Data

EPA used 2019 through 2023 DMR and 2017/2020 NEI data to estimate environmental releases during the disposal of 1,1,2-trichloroethane to POTWs.

Data were mapped using SIC codes, NAICS codes, NEI sectors, SCC descriptions, and DMR codes indicating disposal to POTW. See Section 10.2.10.6 for a list of NAICS codes associated with this OES.

Each facility provided one or more data points on release emissions. In some cases, a facility reported multiple data points per year. For example, in NEI, facilities report releases at the emission-unit level, and a single facility may have multiple emission units. EPA estimated the minimum, maximum, 50th, and 95th percentile release metrics for annual emissions (kg/site-yr) using the data points. EPA calculated daily release estimates (kg/site-day) using facility-reported NEI operating information where available, or a default assumption of 365 days/yr.

Annual and daily release estimates are presented below in Table 4-22. The facility data shown already account for release controls and their associated efficiencies.

Table 4-22. Summary of Environmental Releases During Waste Handling, Treatment, and Disposal (POTW)

Environmental Media	Estimated Yearly Release (kg/site-yr)				Number of Release Days ^a	Daily Release (kg/site-day)		Number of Facilities	Number of Data Points ^b	Source
	Min.	Max.	CT	HE		CT	HE			
Surface Water	1.2E-03	295	1.9	28	365	5.3E-03	7.6E-02	108	253	DMR
Fugitive air	4.3E-03	20	3.1E-02	18		8.8E-05	7.1E-02	5	7	NEI
Stack air	8.1E-06	8.1E-06	8.1E-06	8.1E-06		2.3E-08	2.3E-08	1	2	NEI

CT = central tendency; DMR = Discharge Monitoring Report; HE = high end; NEI = National Emissions Inventory; OES = occupational exposure scenario; POTW = publicly owned treatment works

Central tendency estimates correspond to the 50th percentile of data, and high-end estimates correspond to the 95th percentile.

^a Information on operating days is typically reported by facilities to NEI. Sites that were mapped to the POTW OES reported operating days ranging from 250 to 364 days/year.

^b Data points represent the total number of reports submitted during the years included in the assessment. Because a single facility may report multiple times across the assessed years, the number of data points can exceed the number of facilities. The minimum, maximum, central tendency, and high-end release metrics were calculated based on these data points.

4.2.13 Disposal to non-POTW WWT – OES #13

4.2.13.1 OES Details

According to NEI and DMR, numerous sites report releases of 1,1,2-trichloroethane from non-POTW WWTs ([U.S. EPA, 2026ah](#), [2023a](#), [2020a](#)).

No specific information for 1,1,2-trichloroethane during disposal at non-POTW WWT was found. Disposal to Non-POTW WWT refers to the collection and routing of 1,1,2-trichloroethane containing wastes to a water treatment system which treats the wastewater utilizing water treatment units.

No specific information for 1,1,2-trichloroethane during waste disposal was found. EPA assumes that 1,1,2-trichloroethane may be received at any concentration described in the individual OES (0.0005% through 100%).

4.2.13.2 Facility Estimates

Using programmatic data from DMR and NEI, EPA identified 260 non-POTW WWT sites that handle 1,1,2-trichloroethane or waste streams containing 1,1,2-trichloroethane. See *Draft Number of Sites for 1,1,2-Trichloroethane* ([U.S. EPA, 2026n](#)) for a list of all facilities mapped to this scenario that reported to programmatic databases.

Information on operating days is typically reported by facilities to NEI. Sites mapped to the non-POTW WWT OES in NEI reported operating days ranging from 250 to 365 days/yr. Otherwise, EPA assumes a schedule of 250 days/yr of operation. EPA assumed the number of release days per year will be equal to the number of operating days at the facility.

4.2.13.3 Environmental Release Estimates – Facility Reported Data

EPA used 2019 through 2023 DMR and 2017/2020 NEI data to estimate environmental releases during the disposal of 1,1,2-trichloroethane to non-POTW WWTs.

Data were mapped using SIC codes, NAICS codes, NEI sectors, SCC descriptions, and DMR codes indicating disposal to non-POTW WWT. See Section 10.2.10.6 for a list of NAICS codes associated with this OES.

Each facility provided one or more data points on release emissions. In some cases, a facility reported multiple data points per year. For example, in NEI, facilities report releases at the emission-unit level, and a single facility may have multiple emission units. EPA estimated the minimum, maximum, 50th, and 95th percentile release metrics for annual emissions (kg/site-yr) using the data points. EPA calculated daily release estimates (kg/site-day) using facility-reported NEI operating information where available, or a default assumption of 250 days/yr.

Annual and daily release estimates are presented below in Table 4-23. The facility data shown already account for release controls and their associated efficiencies.

Table 4-23. Summary of Environmental Releases During Waste Handling, Treatment, and Disposal (Non-POTW WWT)

Environmental Media	Estimated Yearly Release (kg/site-yr)				Number of Release Days ^a	Daily Release (kg/site-day)		Number of Facilities	Number of Data Points ^b	Source
	Min.	Max.	CT	HE		CT	HE			
Surface Water	1.1E-03	13	0.32	7.8	250	1.3E-03	3.1E-02	22	54	DMR
Fugitive air	3.0E-06	17	1.8	13		7.3E-03	3.5E-02	19	28	NEI
Stack air	1.1E-07	849	5.5E-05	8.3E-04		2.2E-07	3.3E-06	224	431	NEI

CT = central tendency; DMR = Discharge Monitoring Report; HE = high-end; NEI = National Emissions Inventory; POTW = publicly owned treatment works; OES = occupational exposure scenario; WWT = wastewater treatment
 Central tendency estimates correspond to the 50th percentile of data, and high-end estimates correspond to the 95th percentile.
^a Information on operating days is typically reported by facilities to NEI. Sites that were mapped to the non-POTW WWT OES reported operating days ranging from 250 to 365 days/year.
^b Data points represent the total number of reports submitted during the years included in the assessment. Because a single facility may report multiple times across the assessed years, the number of data points can exceed the number of facilities. The minimum, maximum, central tendency, and high-end release metrics were calculated based on these data points.

4.2.14 Remediation – OES #14

4.2.14.1 OES Details

EPA identified sites that report releases of 1,1,2-trichloroethane from remediation to DMR ([U.S. EPA, 2026ah](#)).

No specific information for 1,1,2-trichloroethane during remediation was found. Remediation refers to the removal of pollutants from contaminated soil, water, or air.

No specific information for 1,1,2-trichloroethane during waste disposal was found. EPA assumes that 1,1,2-trichloroethane may be received at any concentration described in the individual OES (0.0005% through 100%).

4.2.14.2 Facility Estimates

Using programmatic data from DMR and NEI, EPA identified 48 remediation sites for 1,1,2-trichloroethane. See *Draft Number of Sites for 1,1,2-Trichloroethane* ([U.S. EPA, 2026n](#)) for a list of all facilities mapped to this scenario that reported to programmatic databases.

Information on operating days is typically reported by facilities to NEI. Sites mapped to the Remediation OES in NEI reported operating days ranging from 250 to 364 days/yr. Otherwise, EPA assumes a schedule of 250 days/yr of operation. EPA assumed the number of release days per year will be equal to the number of operating days at the facility.

4.2.14.3 Environmental Release Estimates – Facility Reported Data

EPA used 2019 through 2023 DMR and 2017/2020 NEI data to estimate environmental releases during the remediation of 1,1,2-trichloroethane.

Data were mapped using SIC codes, NAICS codes, NEI sectors, and SCC descriptions indicating remediation.

Each facility provided one or more data points on release emissions. In some cases, a facility reported multiple data points per year. For example, in NEI, facilities report releases at the emission-unit level, and a single facility may have multiple emission units. EPA estimated the minimum, maximum, 50th, and 95th percentile release metrics for annual emissions (kg/site-yr) using the data points. EPA calculated daily release estimates (kg/site-day) using facility-reported NEI operating information where available, or a default assumption of 250 days/yr.

Environmental Release Summary Table: Annual and daily release estimates are presented below in Table 4-24. The facility data shown already account for release controls and their associated efficiencies.

Table 4-24. Summary of Environmental Releases During Waste Handling, Treatment, and Disposal (Remediation)

Environmental Media	Estimated Yearly Release (kg/site-yr)				Number of Release Days ^a	Daily Release (kg/site-day)		Number of Facilities	Number of Data Points ^b	Source
	Min.	Max.	CT	HE		CT	HE			
Surface Water	6.6E-04	1.5	1.5E-02	0.24	250	6.1E-05	9.7E-04	44	130	DMR
Fugitive air	2.1E-04	217	4.5	186		8.8E-05	7.1E-02	4	6	NEI
Stack air	7.2E-02	77	39	73		0.15	0.29	2	4	NEI
CT = central tendency; DMR = Discharge Monitoring Report; HE = high-end; NEI = National Emissions Inventory Central tendency estimates correspond to the 50th percentile of data, and high-end estimates correspond to the 95th percentile. ^a Information on operating days is typically reported by facilities to NEI. Sites that were mapped to the remediation OES reported operating days ranging from 250 to 364 days/year. ^b Data points represent the total number of reports submitted during the years included in the assessment. Because a single facility may report multiple times across the assessed years, the number of data points can exceed the number of facilities. The minimum, maximum, central tendency, and high-end release metrics were calculated based on these data points.										

4.2.15 Distribution in Commerce – OES #15

4.2.15.1 OES Details

Evidence for this OES: EPA expects that 1,1,2-trichloroethane and 1,1,2-trichloroethane-containing products are distributed throughout commerce from manufacturing sites to repackaging sites, processing as a reactant or formulation sites, and then to other downstream end use sites.

Process Information: Based on information from the other OES, 1,1,2-trichloroethane may be transported in pure liquid form and in various liquid formulations with a range of potential 1,1,2-trichloroethane concentrations.

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Distribution of 1,1,2-trichloroethane in commerce includes transit activities that involve the movement of the chemical, (e.g., via motor vehicles, railcars, water vessels), and temporary storage and warehousing of the chemical during distribution.

Table 4-25 outlines EPA's understanding of how each OES receives the chemical and how it will be distributed for further processing or use.

Table 4-25. Receipt and Distribution in Commerce of 1,1,2-Trichloroethane Per OES

OES	How the OES Receives the Chemical	How the OES Distributes the Chemical
Manufacturing as a byproduct at chemical manufacturing facilities	Not applicable	Bulk transport from chemical manufacturing facilities via railcars, bulk marine vessels and barges to chemical manufacturing and processing facilities. Evidence points to byproduct being further processed as a reactant. EPA has uncertainty whether byproduct is sold for the downstream OES of 1,1,2-trichloroethane but assumes this is possible.
Manufacturing as a byproduct in the pulp and paper industry	Not applicable	EPA did not identify evidence of further distribution of 1,1,2-trichloroethane created from this source for further processing and uses.
Import-Repackaging for laboratory chemical use	Import in large containers for repackaging into small container sizes	Transport to commercial laboratory uses.
Processing as a reactant	Bulk transport from chemical manufacturing facilities	Not applicable. 1,1,2-Trichloroethane is reacted away
Formulation of adhesives and sealants	EPA assumes transport from chemical manufacturing facilities or through chemical distributors	Transport to industrial/commercial users of adhesives and sealants.
Use of adhesives and sealants	Transport from processing-formulation facilities	Not applicable. No further distribution in commerce expected after use.
Use of cleaning and degreasing solvents	Uncertain. EPA has limited evidence for this use – assume chemical distributors	Not applicable. No further distribution in commerce expected after use.
Use of laboratory chemicals	Transport from importer-repackaging facilities	Not applicable. No further distribution in commerce expected after use.
Disposal (Incineration, landfill, POTW, non-POTW WWT, or remediation)	Transport of wastes from manufacturing, processing or use facilities	Not applicable

OES	How the OES Receives the Chemical	How the OES Distributes the Chemical
OES = occupational exposure scenario; POTW = publicly owned treatment works; WWT = wastewater treatment		

4.2.15.2 Facility Estimates

EPA considers temporary warehousing sites part of the distribution in commerce OES. Using programmatic data from DMR and NEI, EPA initially identified 13 temporary storage and warehousing sites to Distribution in Commerce, but upon further review revised the mapping of those sites to repackaging as a better fit for activities at these types of facilities that could have sources and activities leading to environmental releases and occupational exposures. See *Draft Number of Sites for 1,1,2-Trichloroethane* ([U.S. EPA, 2026n](#)) for a list of all facilities mapped to this scenario that reported to programmatic databases.

4.2.15.3 Release Assessment

EPA's searched for data on leaks and spills that occur during transportation from the following sources: NRC data and DOT data. EPA downloaded NRC data for the 2019 to 2023 calendar years and reviewed it for reports pertaining to distribution of 1,1,2-trichloroethane. Upon review, ERG found that none of the reported releases for 1,1,2-trichloroethane appeared to occur during distribution of the chemical. It is important to note that the data reported to NRC in the past does not correlate to possible spills in the future. Due to the lack of correlation, EPA is unable to estimate the frequency or volume of any spills that may occur in the future or provide estimates representative of a "typical" spill, as each spill represents a unique scenario. EPA also examined DOT data using the Hazmat Incident Report Search Tool.⁸ No spill events were identified.

4.2.16 Non-OES Release Data

A summary of the mapping results of facility reported environmental release data is presented below in Table 4-26.

Table 4-26. Summary of Facility OES Mapping Results

Site Designation	Number of Sites	Percentage of Sites
Total number of sites with release data	2,670	100%
Number of sites mapped to OES	725	27%
Unknown	13	0.5%
Non-OES (miscellaneous)	1,640	61%
Non-OES (combustion)	290	11%
Non-TSCA	2	0.1%
OES = occupational exposure scenario; TSCA = Toxic Substance Control Act		

As shown in the table, some of the sites reporting releases of 1,1,2-trichloroethane have not been mapped into an OES for 1,1,2-trichloroethane and have been grouped into the categories of: not mapped

⁸[DOT Hazmat Incident Report Search Tool](#).

to an OES, non-OES (miscellaneous), non-OES (combustion), and non-TSCA. EPA's practice is to do screening-level analysis of environmental concentrations from these sites. If exposures of concern are identified from this analysis, EPA can do additional analysis for these sites to identify more specifically why 1,1,2-trichloroethane was reported to be released from the facility.

4.2.16.1 Not Mapped to an OES

This category includes facilities in industries such as hotels, casinos, or airports. The uses of 1,1,2-trichloroethane at these types of sites and why environmental release data was reported is not known. Data were mapped using SIC codes and NAICS codes.

Table 4-27. Summary of Environmental Releases for Sites Assigned to Not Mapped to an OES

Environmental Media	Estimated Yearly Release (kg/site-yr)				Number of Release Days	Daily Release (kg/site-day)		Number of Facilities	Number of Data Points ^a	Source
	Min.	Max.	CT	HE		CT	HE			
Surface water	1.5E-03	0.76	6.3E-02	0.49	250	2.5E-04	2.0E-03	13	36	DMR

CT = central tendency; DMR = Discharge Monitoring Report; HE = high-end; OES = occupational exposure scenario
Central tendency estimates correspond to the 50th percentile of data, and high-end estimates correspond to the 95th percentile.

^a Data points represent the total number of reports submitted during the years included in the assessment. Because a single facility may report multiple times across the assessed years, the number of data points can exceed the number of facilities. The minimum, maximum, central tendency, and high-end release metrics were calculated based on these data points.

4.2.16.2 Non-OES (Miscellaneous)

This category includes facilities involved in natural gas extraction, support activities for oil and gas, nonmetallic mineral mining, and fuel combustion. The uses of 1,1,2-trichloroethane at these types of sites and why environmental release data was reported is not known. Data were mapped using NAICS codes, NEI sectors, and SCC descriptions.

Table 4-28. Summary of Environmental Releases for Sites Assigned to Non-OES (Miscellaneous)

Environmental Media	Estimated Yearly Release (kg/site-yr)				Number of Release Days ^a	Daily Release (kg/site-day)		Number of Facilities	Number of Data Points ^b	Source
	Min.	Max.	CT	HE		CT	HE			
Fugitive air	2.7E-08	14	2.3E-02	1.5	250	1.0E-04	4.6E-03	510	797	NEI
Stack air	9.0E-09	1,588	0.18	14		8.0E-04	5.7E-02	1,198	1,923	NEI

CT = central tendency; HE = high-end; NEI = National Emissions Inventory
Central tendency estimates correspond to the 50th percentile of data, and high-end estimates correspond to the 95th percentile.

^a Information on operating days is typically reported by facilities to NEI. Sites that were assigned to out of scope reported operating days ranging from 1 to 365 days/year.

^b Data points represent the total number of reports submitted during the years included in the assessment. Because a single facility may report multiple times across the assessed years, the number of data points can exceed the number of facilities. The minimum, maximum, central tendency, and high-end release metrics were calculated based on these data points.

4.2.16.3 Non-OES (Combustion)

This category includes facilities that list combustion as the source of 1,1,2-trichloroethane emissions. The emissions may be due to the use of an AP-42 emissions factor which was not based on quantitative measurements, but non-detects. AP-42 is an EPA Air Office source of compilation of air emission

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factors from stationary sources ([U.S. EPA, 2005](#)).

Table 4-29. Summary of Environmental Releases For Sites Assigned to Non-OES (Combustion)

Environmental Media	Estimated Yearly Release (kg/site-yr)				Number of Release Days ^a	Daily Release (kg/site-day)		Number of Facilities	Number of Data Points ^b	Source
	Min.	Max.	CT	HE		CT	HE			
Fugitive air	2.2E-03	110	2.2E-03	89	250	8.7E-06	0.35	5	6	NEI
Stack air	4.0E-08	59	0.28	14		1.1E-03	4.3E-02	287	495	NEI

CT = central tendency; HE = high-end; NEI = National Emissions Inventory
 Central tendency estimates correspond to the 50th percentile of data, and high-end estimates correspond to the 95th percentile.
^a Information on operating days is typically reported by facilities to NEI. Sites that were assigned to out of scope – combustion reported operating days ranging from 1 to 365 days/year.
^b Data points represent the total number of reports submitted during the years included in the assessment. Because a single facility may report multiple times across the assessed years, the number of data points can exceed the number of facilities. The minimum, maximum, central tendency, and high-end release metrics were calculated based on these data points.

4.3 Weight of Scientific Evidence Conclusions for Release Assessment

Section 4.1 described the methodology and approaches that EPA used to estimate environmental releases for industrial and commercial activities for 1,1,2-trichloroethane. Details of the execution of the methods and the results of environmental releases estimates obtained for each OES are covered in Section 4.2. EPA's confidence in the release assessments for the OES can vary based on the assessment approach, evidence available, the quality of the data and inputs for model parameters, and the strengths, limitations, assumptions, and key sources of uncertainties.

EPA assesses these factors to determine a weight of scientific evidence (WOSE) rating for the release assessment for the OES and assigns ratings using the descriptors of robust, moderate, slight, or indeterminant, according to EPA's Draft Systematic Review Protocol ([U.S. EPA, 2021b](#)). The ratings help to characterize the release assessment and are part of the inputs to the risk determination that EPA makes for the OES.

Weight of scientific evidence ratings for the environmental release estimates for each OES, including details on the basis EPA used to determine the rating, are provided in the section and tables below.

Table 4-30 summarizes EPA's overall confidence in the environmental release estimates for each OES.

4.3.1 Overall Confidence in Release Estimates by OES

Table 4-30. Weight of Scientific Evidence Conclusions in Release Estimates

OES	Weight of Scientific Evidence Conclusion in Release Estimate	Confidence Rating
Manufacturing as a Byproduct at Chemical Manufacturing Facilities	Evidence Found: For this OES, EPA had release information from water, land, and air from TRI, water from DMR, and air from NEI. Strengths: Water releases are assessed using reported releases from 2019-2023 DMR and TRI. These databases received a medium to high data quality rating in systematic review. The primary strength of TRI data is that TRI compiles the best readily available release data for all reporting facilities. Based on reporting thresholds, TRI captures the highest throughput sites. Since releases are related to throughput, this increases confidence that the highest emitters are captured in this assessment. Air releases are assessed using reported releases from 2019–2023 TRI, and 2017 and 2020 NEI. A strength of NEI data is that NEI captures additional sources that are not included in TRI due to reporting thresholds. Limitations/Assumptions/Uncertainties: Factors that decrease the overall confidence for the water estimates include the uncertainty in the accuracy of reported releases, and uncertainty in mapping sites in DMR to the Manufacturing OES. Most facilities only report NAICS codes; therefore, it is uncertain whether the site performs manufacturing or another chemical process, such as processing as a reactant. Additionally, there are nine byproduct manufacturing sites that report releases to other media in other reporting databases (TRI and NEI), but do not report releases to water in TRI. It is unclear whether these sites do not release to water, or the site does not meet reporting thresholds for TRI. Factors that decrease the overall confidence for the air estimates include the uncertainty in the accuracy of reported releases, and the limitations in representativeness to all sites because TRI and NEI may not capture all relevant sites. In some cases, operating days were reported by facilities in NEI. Otherwise, EPA made assumptions on the number of operating days to estimate daily releases. Factors that decrease the overall confidence for the land release estimates include the uncertainty in the accuracy of reported releases, and the limitations in representativeness to all sites because TRI may not capture all relevant sites. Based on other reporting	Moderate-Robust

OES	Weight of Scientific Evidence Conclusion in Release Estimate	Confidence Rating
	databases (DMR and NEI), there are nine additional byproduct manufacturing sites that report releases to other media but do not report releases to land. Weight of Scientific Evidence Conclusion: In conclusion, although there is uncertainty of whether the databases capture all sites releasing to each medium, the release data are rated medium to high in systematic review and provide releases directly from a wide number of manufacturing facilities. Based on this information, EPA has concluded that the weight of scientific evidence for this assessment provides a moderate to robust confidence in the estimate of releases in consideration of the strengths and limitations of reasonably available data.	
Manufacturing as a Byproduct in the Pulp and Paper Industry	Evidence Found: For this OES, EPA had air release data from NEI. EPA did not identify air, water, or land release data from TRI or DMR. Strengths: Air releases are assessed using reported releases from 2017 and 2020 NEI. A strength of NEI data is that NEI captures additional sources that are not included in TRI due to reporting thresholds, and the release data are rated high in systematic review. Limitations/Assumptions/Uncertainties: Factors that decrease the overall confidence for the estimates include the uncertainty in the accuracy of reported releases, and the limitations in representativeness to all sites because NEI may not capture all relevant sites. In some cases, operating days were reported by facilities in NEI. Otherwise, EPA made assumptions on the number of operating days to estimate daily releases. Weight of Scientific Evidence Conclusion: In conclusion, although there is uncertainty of whether the databases capture all sites releasing to each medium, the release data are rated high in systematic review and provide releases directly from a wide number of manufacturing facilities (71 sites). Based on this information, EPA has concluded that the weight of scientific evidence for this assessment provides a moderate confidence in the estimate of releases in consideration of the strengths and limitations of reasonably available data.	Moderate
Import-Repackaging for Laboratory Use	Evidence Found: For this OES, EPA did not identify any release information from programmatic data. Therefore, releases to the environment are assessed using the GS on Chemical Repackaging, which has a high data quality rating from the systematic review process (U.S. EPA, 2022c). EPA used EPA/OPPT models combined with Monte Carlo	Slight-Moderate

OES	Weight of Scientific Evidence Conclusion in Release Estimate	Confidence Rating
	modeling to estimate releases to the environment, with media of release assessed using assumptions from the GS and EPA/OPPT models. Strengths: A strength of the Monte Carlo modeling approach is that variation in model input values and a range of potential releases values is more likely than a discrete value to capture actual releases at sites. Limitations/Assumptions/Uncertainties: The Agency believes the primary limitation to be the uncertainty in the representativeness of values toward the true distribution of potential releases. In addition, EPA lacks 1,1,2-trichloroethane repackaging throughput data; therefore, throughput estimates are based on the Chemical Repackaging GS and CDR reporting thresholds. EPA assumed that the media of release for repackaging waste is to hazardous waste landfill or incineration, per the GS. Weight of Scientific Evidence Conclusion: Based on this information, EPA has concluded that the weight of scientific evidence for this assessment provides a slight to moderate confidence in the estimate of releases in consideration of the strengths and limitations of reasonably available data.	
Processing as a Reactant	Evidence Found: For this OES, EPA had release information for water, air, and land from TRI, water from DMR, and air from NEI. Strengths: Water releases are assessed using reported releases from 2019–2023 DMR, which has a medium overall data quality determination from the systematic review process. The primary strength of TRI data is that TRI compiles the best readily available release data for all reporting facilities. Based on reporting thresholds, TRI captures the highest throughput sites. Since releases are related to throughput, this increases confidence that the highest emitters are captured in this assessment. The water release assessment is based on 57 reporting sites. Air releases are assessed using reported releases from 2019–2023 TRI as well as 2017 and 2020 NEI. A strength of NEI data is that NEI captures additional sources that are not included in TRI due to reporting thresholds. Limitations/Assumptions/Uncertainties: There is uncertainty in mapping sites to TRI and DMR as most facilities only report NAICS code; therefore, it is uncertain what type	Moderate-Robust

OES	Weight of Scientific Evidence Conclusion in Release Estimate	Confidence Rating
	of chemical process the site performs (manufacturing, processing as a reactant, etc.). Based on other reporting databases (NEI and TRI), there are 16 additional sites that report releases to other media but do not report releases to water. Factors that decrease the overall confidence for this OES include the uncertainty in the accuracy of reported releases and the limitations in representativeness to all sites because TRI and NEI may not capture all relevant sites. Based on other reporting databases (DMR), there are 56 additional sites that report releases to other media but do not report releases to air. The primary limitation of the land release estimates is that the assessment is based on three reporting sites and EPA did not have additional sources to estimate land releases from this OES. Based on other reporting databases (DMR, NEI, TRI), there are 70 additional sites that report releases to other media but do not report releases to land. Weight of Scientific Evidence Conclusion: In conclusion, although there is uncertainty of whether the databases capture all sites releasing to each medium, the release data are rated medium to high in systematic review and provide releases directly from a wide number of facilities (73 sites) that process 1,1,2-trichloroethane as a reactant. Based on this information, EPA has concluded that the weight of scientific evidence for this assessment provides a moderate to robust estimate of releases in consideration of the strengths and limitations of reasonably available data.	
Formulation of Adhesives and Sealants	Evidence Found: For this OES, EPA did not identify any release information from programmatic data. Therefore, releases to the environment are assessed using the April 2009 Emission Scenario Document on Adhesive Formulation, which has a high data quality rating from the systematic review process (OECD, 2009a). EPA used EPA/OPPT models combined with Monte Carlo modeling to estimate releases to the environment. Strengths: A strength of the Monte Carlo modeling approach is that variation in model input values and a range of potential releases values is more likely than a discrete value to capture actual releases at sites. Limitations/Assumptions/Uncertainties: The primary limitation the uncertainty in the representativeness of values toward the true distribution of potential releases. In addition,	Slight-Moderate

OES	Weight of Scientific Evidence Conclusion in Release Estimate	Confidence Rating
	EPA lacks 1,1,2-trichloroethane formulation throughput data; therefore, throughput estimates are based on the ESD and CDR reporting thresholds. Media of release were assessed using assumptions from the GS and EPA/OPPT models. Weight of Scientific Evidence Conclusion: Based on this information, EPA has concluded that the weight of scientific evidence for this assessment provides a slight to moderate confidence in the estimate of releases in consideration of the strengths and limitations of reasonably available data.	
Use of Adhesives and Sealants	Evidence Found: For this OES, EPA had release information only for air from NEI. EPA identified nine facilities reporting air releases of 1,1,2-trichloroethane that were potentially relevant to the use of adhesives and sealants. EPA determined these data are not sufficient to confidently capture the entirety of environmental releases for this scenario due to the fact they were from the NEI database and only reported on releases to air. Therefore, releases to the environment were also assessed using the ESD on Use of Adhesives (OECD, 2015). Strengths: The ESD has a high data quality rating from the systematic review process. EPA used this ESD combined with Monte Carlo modeling to estimate releases to the environment, with media of release assessed using assumptions from the ESD Model. More information about the details and assumptions of the model can be found in Appendix A.5. A strength of the Monte Carlo modeling approach is that variation in model input values and a range of potential releases values is more likely than a discrete value to capture actual releases at sites. Limitations/Assumptions/Uncertainties: The Agency further believes the primary limitation to be the uncertainty in the representativeness of values toward the true distribution of potential releases. In addition, EPA lacks 1,1,2-trichloroethane chemical throughput data (<i>i.e.</i>, kg of chemical used per site per year); therefore, EPA used default values suggested in the Use of Adhesives Emission Scenario Document to model releases for this scenario. The facility annual adhesive use rate is 13,500 kg/site-yr (OECD, 2015). Comparison of modeled values with the NEI data is difficult due to uncertainty on the throughput (kg/site-yr) of 1,1,2- trichloroethane at the NEI sites in comparison to the throughput value used in the modeling.	Slight-Moderate

OES	Weight of Scientific Evidence Conclusion in Release Estimate	Confidence Rating
	<i>Weight of Scientific Evidence Conclusion:</i> Overall, EPA concludes the weight of scientific evidence for this assessment is slight to moderate.	
Use as a Solvent for Cleaning and Degreasing	<i>Evidence Found:</i> For this OES, EPA had release information for air from TRI and NEI. EPA identified seven facilities reporting air releases of 1,1,2-trichloroethane. Due to the difficulty of determining the exact activities that occur at each site and the method of use (aerosol vs non-aerosol), EPA assumed that the seven sites may potentially use non-aerosol cleaning/degreasing based on the industry and source classification codes for each source. Since so few sites reported to the databases and data points from NEI report only air releases, EPA also chose to model releases for cleaning and degreasing to obtain estimates for releases to other media. <i>Strengths:</i> To bolster the limited release data for this OES, EPA modeled this OES under the assumption that vapor degreasing is the method used for cleaning and degreasing using products containing 1,1,2-trichloroethane. Releases to the environment are assessed using assumptions and methods from the ESD on the Use of Vapour Degreasers which has a high data quality rating from the systematic review process (OECD, 2021). A strength of the Monte Carlo modeling approach is that variation in model input values and a range of potential release values is more likely than a discrete value to capture actual releases at sites. <i>Limitations/Assumptions/Uncertainties:</i> EPA believes the primary limitation to be the uncertainty in the actual method when 1,1,2-trichloroethane is used in cleaning and degreasing (vapor degreasing was chosen as a conservative assumption based on reported NEI data), and uncertainty about the representativeness of values toward the true distribution of potential releases. In addition, EPA lacks 1,1,2-trichloroethane throughput data and number of facilities; therefore, the number of facilities and throughput estimates are based on throughputs provided by the ESD and applying conservative assumptions to public comments provided to EPA (see Appendix A.6). <i>Weight of Scientific Evidence Conclusion:</i> Based on this information, EPA has concluded that the weight of scientific evidence for this assessment provides a slight to moderate estimate of releases in consideration of the strengths and limitations of reasonably available data.	Slight-Moderate
Use as a Laboratory	<i>Evidence Found:</i> For this OES, EPA had release information for water from DMR and	Slight - Moderate

OES	Weight of Scientific Evidence Conclusion in Release Estimate	Confidence Rating
Chemical	for air from NEI. EPA identified three facilities reporting water and air releases of 1,1,2-trichloroethane. However, EPA determined this data is not sufficient to capture the entirety of environmental releases for this scenario. Therefore, releases to the environment are assessed using the Draft GS on the Use of Laboratory Chemicals, which has a high data quality rating from the systematic review process (U.S. EPA, 2023d). EPA used EPA/OPPT models combined with Monte Carlo modeling to estimate releases to the environment. Strengths: EPA believes a strength of the Monte Carlo modeling approach is that variation in model input values and a range of potential releases values is more likely than a discrete value to capture actual releases at sites. Limitations/Assumptions/Uncertainties: The primary limitation is the uncertainty in the representativeness of values toward the true distribution of potential releases. In addition, EPA lacks 1,1,2-trichloroethane laboratory chemical throughput data; therefore, throughput estimates are based on stock solution throughputs from the Draft GS on the Use of Laboratory Chemicals and on CDR reporting thresholds. The Agency also has an estimate for the number of laboratories only through the three facilities reporting to DMR and NEI, which may not capture all sites if some laboratories do not report to the programmatic databases. EPA assumed that the media of release for disposal of laboratory waste is to hazardous waste landfill or incineration, per the GS. EPA has more certainty regarding the use of 1,1,2-trichloroethane for this OES from SDSs and combines that with the facility release data available and supporting evidence from the model. Weight of Scientific Evidence Conclusion: Based on this information, EPA has concluded that the weight of scientific evidence for this assessment provides a slight to moderate estimate of releases in consideration of the strengths and limitations of reasonably available data.	
Disposal to Incineration	Evidence Found: For this OES, EPA had release information for air and land from TRI, for water from DMR, and for air from TRI and NEI. Strengths: Water releases for incineration sites are assessed using reported releases from	Moderate-Robust

OES	Weight of Scientific Evidence Conclusion in Release Estimate	Confidence Rating
	2019–2023 DMR. A strength of using DMR data and the Pollutant Loading Tool is that the tool calculates an annual pollutant load by integrating monitoring period release reports provided to the EPA and extrapolating over the course of the year. Air releases for incineration sites are assessed using reported releases from 2019–2023 TRI as well as the 2017 and 2020 NEI. A strength of NEI data is that NEI captures additional sources that are not included in TRI due to reporting thresholds. Based on reporting thresholds, TRI captures the highest throughput sites. Since releases are related to throughput, this increases confidence that the highest emitters are captured in this assessment. Limitations/Assumptions/Uncertainties: The DMR approach assumes average quantities, concentrations, and hydrologic flows for a given period are representative of other times of the year. In some cases, operating days were reported by facilities in NEI. Otherwise, EPA made assumptions on the number of operating days to estimate daily releases. Factors that decrease the confidence for this OES include the uncertainty in the accuracy of reported releases, and the limitations in representativeness to all sites because TRI and NEI may not capture all relevant sites. Weight of Scientific Evidence Conclusion: Based on this information, EPA has concluded that the weight of scientific evidence for this assessment provides a moderate to robust estimate of releases in consideration of the strengths and limitations of reasonably available data.	
Disposal to Landfill	Evidence Found: For this OES, EPA had release information for air and land from TRI, for water from DMR, and for air from TRI and NEI. Strengths: Water releases for landfill sites are assessed using reported releases from 2019–2023 DMR. A strength of using DMR data and the Pollutant Loading Tool is that the tool calculates an annual pollutant load by integrating monitoring period release reports provided to the EPA and extrapolating over the course of the year. Air releases for landfill sites are assessed using reported releases from 2019–2023 TRI as well as the 2017 and 2020 NEI. A strength of NEI data is that NEI captures additional sources that are not included in TRI due to reporting thresholds. Based on reporting thresholds, TRI captures the highest throughput sites. Since releases are related to throughput, this increases confidence that the highest emitters are captured in this assessment.	Moderate-Robust

OES	Weight of Scientific Evidence Conclusion in Release Estimate	Confidence Rating
	<i>Limitations/Assumptions/Uncertainties:</i> The DMR approach assumes average quantities, concentrations, and hydrologic flows for a given period are representative of other times of the year. In some cases, operating days were reported by facilities in NEI. Otherwise, EPA made assumptions on the number of operating days to estimate daily releases. Factors that decrease the confidence for this OES include the uncertainty in the accuracy of reported releases, and the limitations in representativeness to all sites because TRI and NEI may not capture all relevant sites. <i>Weight of Scientific Evidence Conclusion:</i> In conclusion, although there is uncertainty of whether the databases capture all sites releasing to each medium, the release data are rated medium to high in systematic review and provide releases directly from a wide number of landfill facilities (89 sites). Based on this information, EPA has concluded that the weight of scientific evidence for this assessment provides a moderate to robust estimate of releases in consideration of the strengths and limitations of reasonably available data.	
Disposal to POTW	<i>Evidence Found:</i> For this OES, EPA had release information for air from 2017 and 2020 NEI and for water from 2019-2023 DMR. <i>Strengths:</i> A strength of using DMR data and the Pollutant Loading Tool is that the tool calculates an annual pollutant load by integrating monitoring period release reports provided to the EPA and extrapolating over the course of the year. A strength of NEI data is that NEI captures additional sources that are not included in TRI due to reporting thresholds. <i>Limitations/Assumptions/Uncertainties:</i> The DMR approach assumes average quantities, concentrations, and hydrologic flows for a given period are representative of other times of the year. In some cases, operating days were reported by facilities in NEI. Otherwise, EPA made assumptions on the number of operating days to estimate daily releases. Factors that decrease the confidence for this OES include the uncertainty in the accuracy of reported releases, and the limitations in representativeness to all sites because NEI may not capture all relevant sites. <i>Weight of Scientific Evidence Conclusion:</i> In conclusion, although there is uncertainty of whether the databases capture all sites releasing to each medium, the release data are	Moderate-Robust

OES	Weight of Scientific Evidence Conclusion in Release Estimate	Confidence Rating
	rated medium to high in systematic review and provide releases directly from a wide number of POTW facilities (114 sites). Based on this information, for POTW releases, EPA has concluded that the weight of scientific evidence for this assessment provides a moderate to robust estimate of releases in consideration of the strengths and limitations of reasonably available data.	
Disposal to Non-POTW WWT	Evidence Found: For this OES, EPA had release information for air from 2017 and 2020 NEI and for water from 2019-2023 DMR. Strengths: A strength of using DMR data and the Pollutant Loading Tool is that the tool calculates an annual pollutant load by integrating monitoring period release reports provided to the EPA and extrapolating over the course of the year. A strength of NEI data is that NEI captures additional sources that are not included in TRI due to reporting thresholds. Limitations/Assumptions/Uncertainties: The DMR approach assumes average quantities, concentrations, and hydrologic flows for a given period are representative of other times of the year. In some cases, operating days were reported by facilities in NEI. Otherwise, EPA made assumptions on the number of operating days to estimate daily releases. Factors that decrease the confidence for this OES include the uncertainty in the accuracy of reported releases, and the limitations in representativeness to all sites because NEI may not capture all relevant sites. Weight of Scientific Evidence Conclusion: In conclusion, although there is uncertainty of whether the databases capture all sites releasing to each medium, the release data are rated medium to high in systematic review and provide releases directly from a wide number of non-POTW WWT facilities (260 sites). Based on this information, for non-POTW WWT releases, EPA has concluded that the weight of scientific evidence for this assessment provides a moderate to robust estimate of releases in consideration of the strengths and limitations of reasonably available data.	Moderate-Robust
Remediation	Evidence Found: For this OES, EPA had release information for air from 2017 and 2020 NEI and for water from 2019-2023 DMR. Strengths: A strength of using DMR data and the Pollutant Loading Tool is that the tool calculates an annual pollutant load by integrating monitoring period release reports	Moderate

OES	Weight of Scientific Evidence Conclusion in Release Estimate	Confidence Rating
	provided to the EPA and extrapolating over the course of the year. A strength of NEI data is that NEI captures additional sources that are not included in TRI due to reporting thresholds. Factors that decrease the confidence for this OES include the uncertainty in the accuracy of reported releases, and the limitations in representativeness to all sites because NEI may not capture all relevant sites. Limitations/Assumptions/Uncertainties: The DMR approach assumes average quantities, concentrations, and hydrologic flows for a given period are representative of other times of the year. In some cases, operating days were reported by facilities in NEI. Otherwise, EPA made assumptions on the number of operating days to estimate daily releases. Weight of Scientific Evidence Conclusion: Based on this information, EPA has concluded that the weight of scientific evidence for this assessment provides a moderate estimate of releases in consideration of the strengths and limitations of reasonably available data.	
Distribution in Commerce	Evidence Found: For this OES, EPA had release information for water from DMR and for air from NEI. EPA identified 13 temporary storage and warehousing sites in programmatic data. Strengths: A strength of using DMR data and the Pollutant Loading Tool is that the tool calculates an annual pollutant load by integrating monitoring period release reports provided to the EPA and extrapolating over the course of the year. A strength of NEI data is that NEI captures additional sources that are not included in TRI due to reporting thresholds. Factors that decrease the confidence for this OES include the uncertainty in the accuracy of reported releases, and the limitations in representativeness to all sites because NEI may not capture all relevant sites. Limitations/Assumptions/Uncertainties: The DMR approach assumes average quantities, concentrations, and hydrologic flows for a given period are representative of other times of the year. In some cases, operating days were reported by facilities in NEI. Otherwise, EPA made assumptions on the number of operating days to estimate daily releases.	Moderate

OES	Weight of Scientific Evidence Conclusion in Release Estimate	Confidence Rating
	<i>Weight of Scientific Evidence Conclusion:</i> Based on this information, for distribution in commerce releases, EPA has concluded that the weight of scientific evidence for this assessment provides a moderate estimate of releases in consideration of the strengths and limitations of reasonably available data.	
COU = condition of use; DMR = Discharge Monitoring Report; ESD = emission scenario document; GS = generic scenario; NEI = National Emissions Inventory; OES = occupational exposure scenario; POTW = publicly owned treatment works; TRI = Toxics Release Inventory; WWT = wastewater treatment		

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5 AMBIENT AIR PATHWAY EXPOSURE ASSESSMENT

This ambient air pathway exposure assessment evaluates inhalation exposures of both the general population (including fenceline communities and PESS) and wildlife populations to 1,1,2-trichloroethane resulting from industrial releases of 1,1,2-trichloroethane to the ambient air under conditions of use. General population refers to a subset of the total population in the United States who reside or frequent locations in proximity to releasing facilities where inhalation exposures to 1,1,2-trichloroethane via the ambient air pathway are likely, including fenceline communities and PESS. Wildlife refers to a population of terrestrial animals that may encounter industrial facilities releasing 1,1,2-trichloroethane to the ambient air resulting in inhalation of 1,1,2-trichloroethane by that terrestrial animal.

EPA considered both monitoring and modeling information in this ambient air pathway exposure assessment for 1,1,2-trichloroethane. All approaches and methodologies used for this ambient air exposure assessment previously underwent peer review and public comment and are described in detail in Appendix E. Relevant recommendations and comments received during those reviews on the approaches and methodologies are integrated when applied to 1,1,2-trichloroethane.

Based on the physical and chemical properties of 1,1,2-trichloroethane described in Section 2, fate and transport properties of 1,1,2-trichloroethane described in Section 3 (including persistence in air and volatilization from surface soils), reported releases to ambient air described in Section 4, and available ambient air monitoring data, inhalation is expected to be a primary route of exposure of both the general population and ecological receptors. Since 1,1,2-trichloroethane is not expected to be present in land-applied biosolids neither deposition nor inhalation of 1,1,2-trichloroethane contaminated dust or soil is evaluated in this ambient air exposure assessment.

5.1 Monitoring Information and AirToxScreen

EPA systematically reviewed literature (through 2023) looking for published studies which monitored 1,1,2-trichloroethane in the ambient air, but did not identify any U.S. or Canadian studies specifically measuring 1,1,2-trichloroethane. One study ([Padilla et al., 2024](#)) was identified and compared ambient monitoring data from the AMTIC archive dataset to modeled concentrations (using EPA's AirToxScreen and Risk Screening Environmental Indicators (RSEI) screening models and the 2017 NEI reported releases for all facilities (many that do not fall under a COU) for 79 hazardous air pollutants. 1,1,2-Trichloroethane was included in the 79 HAPs evaluated. Findings from this study showed EPA's screening level models underestimated exposure concentrations to 1,1,2-trichloroethane and recommended EPA apply an adjustment factor to any modeled concentration to represent the ambient concentration to which individuals are exposed in the general population. The recommended adjustment factor for 1,1,2-trichloroethane in ([Padilla et al., 2024](#)) was 2.9 indicating the mean average modeled concentrations of 1,1,2-trichloroethane from EPA's screening models were 2.9 times less than monitored concentrations at the AMTIC monitoring sites. Although this is the adjustment factor proposed by the study, it is based on all reported releases for all facilities reporting to the 2017 NEI, most of which are not attributed to a COU. Additionally, since the monitored concentrations from the AMTIC archive represent all contributing sources (including secondary formation, mobile sources, combustion sources, etc.) of 1,1,2-trichloroethane, the total measured concentrations from the AMTIC archive cannot be attributed to a COU or a specific facility. Based on these two factors, EPA does not apply the adjustment factor from the Padilla study to the modeled concentrations relied upon or described in this risk evaluation for 1,1,2-trichloroethane which are COU specific. Furthermore, EPA conducted its own analysis using a higher tier, non-screening model (HEM) to evaluate COU specific releases from facilities reporting to TRI and modeled concentrations directly at AMTIC monitoring sites

that measured 1,1,2-trichloroethane. A detailed description of EPA's analysis and the findings from the analysis are presented in Section 5.2.5. Generally, EPA's analysis showed modeled COU specific concentrations using the higher tier HEM remain less than the measured concentrations by at least a magnitude (ten times less). However, for the same reasons as described above, since the measured concentrations from AMTIC represent all sources, even those not attributed to a COU, EPA does not apply any adjustment factor based on the EPA analysis to the modeled concentrations relied upon for the 1,1,2-trichloroethane risk evaluation. Rather, EPA uses findings from both the Padilla study and EPA's analysis as two separate lines of evidence that demonstrate while EPA's modeling is conservative, it is not overly conservative and can be relied upon for deriving risk estimates and informing risk determination and regulatory decision-making.

EPA also coordinated internally across Divisions and EPA Programmatic Offices (Office of Air and Radiation (OAR), in particular) to identify any ambient air monitoring data which may have been submitted under regulatory requirements or in response to information requests, data collection requests, or other means. In the case of 1,1,2-trichloroethane, specific monitoring data (*e.g.*, fenceline monitoring) was not identified through coordination with OAR.

Since EPA's systematic review did not identify any U.S. or Canadian studies specifically measuring 1,1,2-trichloroethane in the ambient air, and coordination with OAR did not identify any 1,1,2-trichloroethane specific ambient air monitoring data, EPA relies on real-time monitoring data reported to the AMTIC archive to contextualize concentrations of 1,1,2-trichloroethane in the ambient air. The AMTIC archive is a comprehensive monitoring dataset with information primarily from U.S. EPA's ambient monitoring network which is operated across the United States, although state specific monitoring activities and results are sometimes submitted to AMTIC and included in the data pulls from the AMTIC archive. The AMTIC archive monitoring information is summarized and presented in Section 5.1.1 to contextualize ambient air concentrations of 1,1,2-trichloroethane for this ambient air pathway exposure assessment. The AMTIC archive monitoring information is not used to derive risk estimates or relied upon for risk determination, or regulatory decision-making due to the inability to tie monitored concentrations to a single COU. While this limits EPA's ability to use monitoring data within a risk context, monitoring data can provide support in the weight of scientific evidence to provide additional confidence in modeled results and use of those modeled results, which are directly associated with COUs, in the risk context.

The AMTIC archive information was also used by EPA to ground-truth modeled concentrations from higher tiers of analysis in this ambient air pathway exposure assessment for 1,1,2-trichloroethane. This was accomplished by conducting the alternate receptor analysis described in detail in Section 5.2. To summarize this analysis, EPA used the latitude, longitude, and elevation of each AMTIC monitoring site to define alternate receptor locations. EPA then modeled industry reported releases to determine concentrations of 1,1,2-trichloroethane at each of the AMTIC monitoring sites. The results, therefore, represent the modeled ambient concentration of 1,1,2-trichloroethane at each AMTIC monitoring site attributable to COUs and can be directly compared to the real-time monitored concentrations at those same monitoring sites. To ensure EPA captures appropriate comparisons, EPA compares both facility-specific modeled concentrations and multi-facility aggregated modeled concentrations to the monitored concentrations at each impacted monitoring site.

Finally, EPA considered the 2020 AirToxScreen results to further contextualize ambient concentrations of 1,1,2-trichloroethane in this ambient air pathway exposure assessment. The 2020 AirToxScreen results are presented and summarized in Section 5.1.2. Although the 2020 AirToxScreen results represent modeled concentrations from approximately 37 source types (including point source,

secondary formation, mobile sources, off-road sources, biogenic sources, etc.) the evaluation represents a published evaluation and therefore is included as part of the monitoring information in this ambient air pathway exposure assessment. Like other monitoring information, the 2020 AirToxScreen results summarize aggregated concentrations from all sources of 1,1,2-trichloroethane and cannot be tied to a specific COU. Therefore, EPA uses the 2020 AirToxScreen results to identify primary sources of 1,1,2-trichloroethane to the ambient air and further contextualize ambient concentrations of 1,1,2-trichloroethane but does not use the results to derive risk estimates or inform risk determination or regulatory decision-making.

5.1.1 AMTIC Archive Dataset (2018–2022)

The entire data pull from the AMTIC archive dataset relied upon for this ambient air pathway exposure assessment for 1,1,2-trichloroethane is provided in the supplemental file *Draft AMTIC Monitoring Data for 1,1,2-Trichloroethane* ([U.S. EPA, 2026d](#)). Across the entire AMTIC archive dataset considered for this ambient air pathway exposure assessment, EPA identified 226 AMTIC monitoring sites which reported monitoring 1,1,2-trichloroethane one or more times between 2018 and 2022. *Draft AMTIC Monitoring Data for 1,1,2-Trichloroethane* ([U.S. EPA, 2026d](#)).

Total sample size (n) across the entire AMTIC archive dataset evaluated was 46,675 for 1,1,2-trichloroethane. The reported minimum detection limit for 1,1,2-trichloroethane across the entire AMTIC archive dataset ranged from 0.005 to 1.64 $\mu\text{g}/\text{m}^3$. Across the total samples reported for 1,1,2-trichloroethane, 45,626 samples (97.7%) reported 1,1,2-trichloroethane concentrations below the minimum detection limit (MDL) and 41,939 samples (89.9%) reported 1,1,2-trichloroethane concentrations as zero.

Overall, there were 854 reported maximum and mean monitored values across the entire AMTIC archive dataset evaluated for 1,1,2-trichloroethane. The reported maximum monitored concentrations ranged from 0 to 51.85 $\mu\text{g}/\text{m}^3$ and the reported mean monitored concentrations ranged from 0 to 2.74 $\mu\text{g}/\text{m}^3$. Table 5-1 presents a summary of the five highest-monitored maximum concentrations reported to the AMTIC archive (24-hour samples) and the associated mean concentration for the respective monitoring site. These five concentrations provide a snapshot of the trend of maximum concentrations and represent a broader area than a single location always monitoring the highest concentration. The two highest values occur at two different monitoring sites (but in proximity to each other) with both monitored concentrations around 50 $\mu\text{g}/\text{m}^3$. The third highest monitored concentrations was measured at the same monitoring site as the highest but more than 50 percent less than the highest monitored concentration. The fourth highest is at a different monitoring site (not in proximity to the sites with the highest concentrations) but again is over 50 percent less than the third highest. The fifth highest is again at a different monitoring site not in proximity to other sites but again nearly 50 percent less than the fourth highest monitored concentration. Since the five highest values occur in at least a few different locations.

Table 5-1. Top Five Maximum Concentrations ($\mu\text{g}/\text{m}^3$) Reported to AMTIC

Monitoring Site ID	Year	Mean Conc. ($\mu\text{g}/\text{m}^3$)	Max Conc. ($\mu\text{g}/\text{m}^3$)	N	Zero Count	Percent Non-Detects
421010055	2018	0.94	51.85	59	54	91.5
421010063	2018	2.74	49.60	59	43	72.9
421010055	2019	0.42	23.42	61	58	95.1
211570021	2021	0.58	10.68	60	13	21.7
220190008	2022	0.30	6.25	62	27	43.5

Although monitoring information is not relied upon to derive risk estimates or inform risk determination or regulatory decision-making in the *Draft Risk Evaluation for 1,1,2-Trichloroethane* ([U.S. EPA, 2026r](#)), EPA utilizes the monitoring data in this air assessment to provide a broad overview of potential exposures of the general population or terrestrial species to measured concentrations of 1,1,2-trichloroethane in the ambient air. EPA also utilizes this monitoring data to ground-truth modeled concentrations in Section 5.2.5.

5.1.2 AirToxScreen Analysis

To further contextualize ambient air concentrations, EPA considered the latest published modeling results from EPA's 2020 AirToxScreen analysis. Figure 5-1 shows the aggregated total modeled concentrations of 1,1,2-trichloroethane across the U.S. from all source categories. The 2020 AirToxScreen results represent the modeled concentrations based on the 2020 NEI release dataset which are aggregated and summarized by census block for the AirToxScreen analysis.

Figure 5-1 includes an overlay of 29 TRI facilities (white triangles) identified in the release assessment in Section 4 which reported releases of 1,1,2-trichloroethane to the ambient air under COUs. These 29 facilities are the same facilities EPA evaluates with the modeling analyses described in Section 5.2. This TRI facility overlay allows EPA to consider where the TRI facilities reporting releases of 1,1,2-trichloroethane to the ambient air are located relative to the 2020 AirToxScreen modeled concentrations. This overlay also provides EPA a way to check, or ground-truth, modeled concentrations from the modeling analyses presented in Section 5.2. However, since the 2020 AirToxScreen results rely on all 2020 NEI reported releases of 1,1,2-trichloroethane (most of which do not fall under COUs), interpreting Figure 5-1 and direct comparison of TRI vs. AirToxScreen findings is limited. Overall, the overlay of TRI facilities demonstrates all TRI facilities evaluated for COUs in this ambient air assessment are in areas where high concentrations of 1,1,2-trichloroethane were also modeled in AirToxScreen. However, the AirToxScreen findings (shading/coloring) also show evidence of high concentrations in locations where there are no TRI facilities located. This indicates some NEI facilities contribute to high modeled concentrations although review of the 2020 NEI reported releases, comparison to TRI reported releases, and limited analyses of the NEI dataset (all presented in Section 5.2) did not identify additional NEI facilities under COUs that contribute to high concentrations in areas where TRI facilities under COUs are not found. Therefore, the likely contributors to the higher concentrations found in AirToxScreen in areas where there were no TRI facilities are NEI facilities which do not fall under COUs and therefore are not evaluated in this ambient air assessment.

The highest modeled concentrations in Figure 5-1 are represented by the teal/blue-green color coding and range from 1.0×10^{-02} and $1.0 \times 10^{-04} \mu\text{g}/\text{m}^3$. Based on the 2020 AirToxScreen results, the primary sources contributing to the highest modeled concentrations of 1,1,2-trichloroethane are point sources. This aligns well with the TRI facility overlay which shows the highest modeled concentrations of 1,1,2-

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trichloroethane in the 2020 AirToxScreen analysis tend to occur around industrial facilities which reported releases of 1,1,2-trichloroethane to the TRI database. This is particularly prevalent in the South coastal regions of Texas and Louisiana where there are several groups of TRI facilities reporting 1,1,2-trichloroethane releases to the ambient air located in areas of teal/blue-green color.

The range of highest modeled concentrations in Figure 5-1 from the 2020 AirToxScreen analysis align well with modeled concentrations from both the TRI and limited NEI modeling analyses presented in Section 5.2. While the 2020 AirToxScreen results represent total aggregated modeled concentrations from all source types, the finding from the 2020 AirToxScreen that the primary contributing sources are point sources and the alignment with facility-specific (and multi-facility aggregate) modeled concentrations in this ambient air pathway exposure assessment for 1,1,2-trichloroethane provides additional confidence in the modeling approaches used in this ambient air pathway exposure assessment. These factors also support EPA's use of the results from the modeling analyses presented in Section 5.2 for purposes of deriving risk in the *Draft Risk Evaluation for 1,1,2-Trichloroethane* ([U.S. EPA, 2026r](#)).

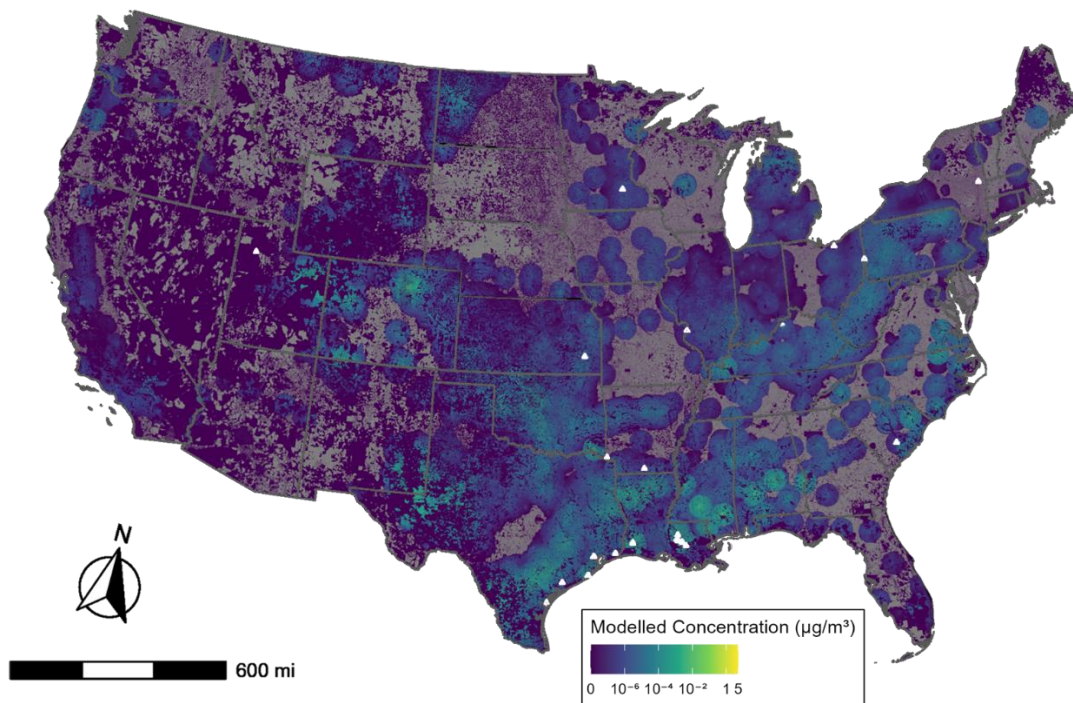


Figure 5-1. Block Results of 2020 AirToxScreen Modeled Concentrations Based on 2020 NEI Release Dataset

Note: White triangles represent location of facilities reporting releases to TRI.

5.2 Modeling Approaches and Estimates for Ambient Air Concentrations

EPA applied the tiered approaches and methodologies described in detail in Appendix F.2 to model facility releases and estimate concentrations of 1,1,2-trichloroethane in ambient air for this ambient air pathway exposure assessment. A visual depiction of this tiered approach is presented in Figure 5-2.

All the approaches, methodologies, and models presented in Figure 5-2 have undergone public comment and peer review by EPA's Scientific Advisory Committee on Chemicals (SACC) for TSCA purposes. Relevant comments and peer review recommendations received during those reviews are integrated into the approaches and methods described in Appendix F.2 and this ambient air pathway exposure assessment for 1,1,2-trichloroethane.

Each tier of analysis used in this ambient air pathway exposure assessment is described in the following sections:

- Tier 1 (Section 5.2.1);
- Tier 2 (Section 5.2.2);
- Tier 3-TRI Dataset (Section 5.2.3);
- Tier 3-NEI Datasets (Section 5.2.4); and
- Alternate Receptor Analysis (Section 5.2.5).

Each section is further broken down to present methodology and inputs (or reference to input files) necessary to allow replication of modeling and transparency for the respective tier of analysis, and general discussion of results and conclusions. Since assumptions, strengths, limitations, and uncertainties associated with each tier of analysis are described in detail in Appendix F.2, they are not repeated in detail in the body of this section. However, assumptions are described in each of the tier's respective section. Additionally, where relevant, EPA acknowledges some of the conservative assumptions associated with a respective tier and includes a brief discussion on what they are and considers how they further inform whether additional, more refined analyses are or are not necessary or warranted.

EPA implemented a multi-step process to determine whether additional, more refined analyses are necessary. First, EPA identified releases and modeled those releases to get facility-specific modeled concentrations of 1,1,2-trichloroethane in the ambient air. Facility-specific modeled concentrations were then converted to exposure concentrations using the approaches described in Section 5.3 (for general population) or Section 5.4 (for terrestrial species). Next, EPA used the exposure concentrations from modeling, the points of departure (PODs) presented in the *Draft Human and Environmental Hazard Assessment for 1,1,2-Trichloroethane* ([U.S. EPA, 2026l](#)) and associated risk equations and calculations presented in the *Draft Risk Evaluation for 1,1,2-Trichloroethane* ([U.S. EPA, 2026r](#)) to calculate risk estimates for acute non-cancer, chronic non-cancer, and cancer effects. Finally, the calculated risk estimates were compared to the relative benchmarks for the respective health effect presented in the *Draft Human and Environmental Hazard Assessment for 1,1,2-Trichloroethane* ([U.S. EPA, 2026l](#)) and the *Draft Risk Evaluation for 1,1,2-Trichloroethane* ([U.S. EPA, 2026r](#)) to determine whether additional, more refined analyses were necessary or warranted for each tier of analysis. Table 5-2 (general population) and Table 5-3 (terrestrial species) summarize how EPA applied the calculated risk estimates to inform additional, more refined analyses for this ambient air assessment.

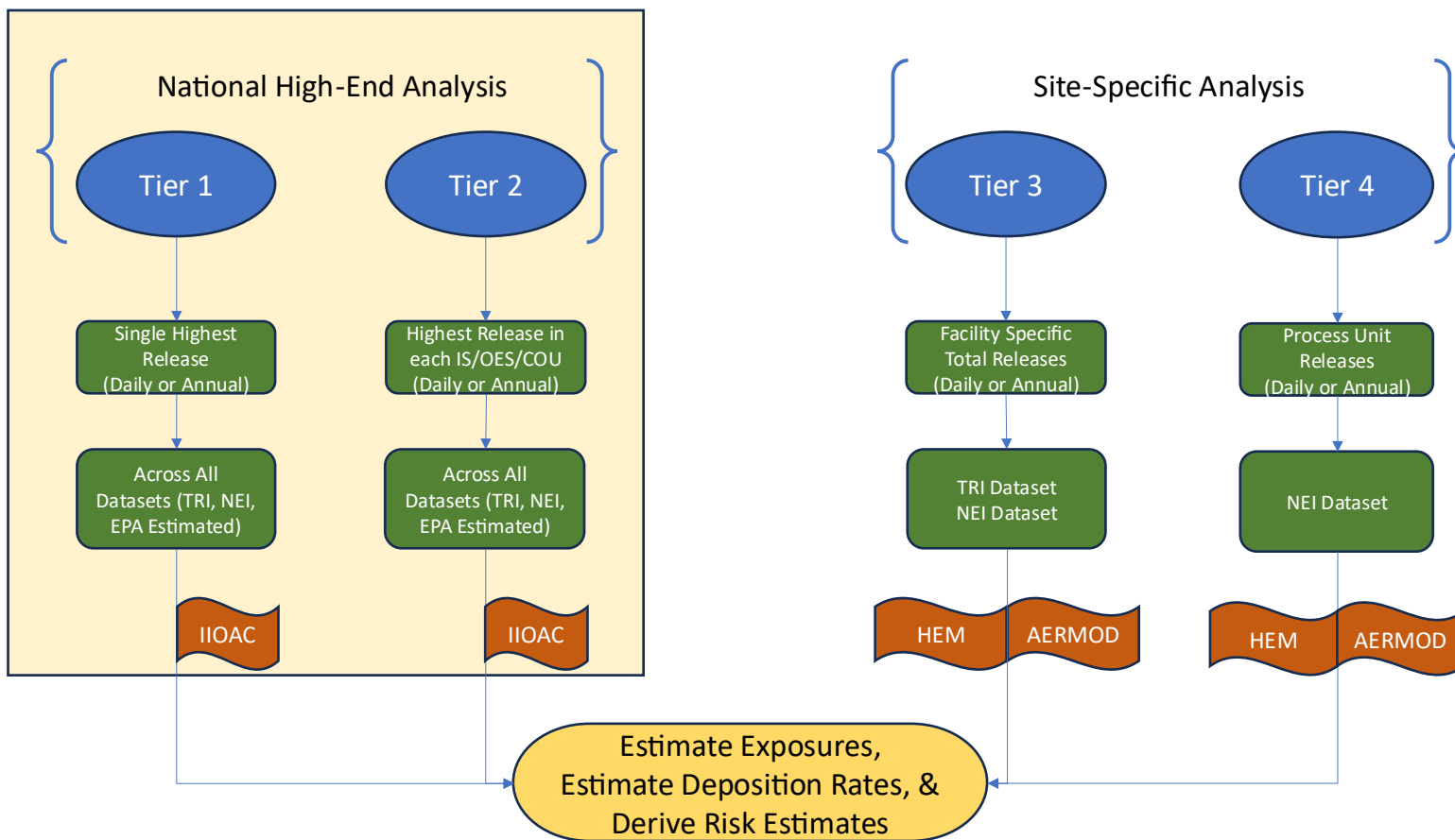


Figure 5-2. Tiered Approach for Modeling Releases and Estimating Concentrations of 1,1,2-Trichloroethane in Ambient Air

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EPA initially relied upon the high-end, ninety-fifth percentile modeled concentration outputs from the respective models to derive preliminary risk estimates which are compared to relative benchmarks presented in the *Draft Human and Environmental Hazard Assessment for 1,1,2-Trichloroethane* ([U.S. EPA, 2026l](#)). This informed the decision to move on to a more refined analysis for the ambient air assessment. For this 1,1,2-trichloroethane air assessment, EPA compares preliminary risk estimates to the benchmark of 100 for acute effects, 300 for chronic non-cancer effects, and $1\text{E}-06$ for cancer effects. While 1×10^{-06} is used as the cancer benchmark to inform progression to higher tiers of analysis, the target cancer risk range of 1×10^{-04} to 1×10^{-06} is used in the *Draft Risk Evaluation for 1,1,2-Trichloroethane* ([U.S. EPA, 2026r](#)) for purposes of risk characterization and to inform risk determination and regulatory decision-making. EPA acknowledges this is a conservative approach but also helps ensure high-end exposures are not missed and are protective of the general population (including fenceline communities and PESS).

Table 5-2. Application of Risk Estimates to Inform Refined Analyses (General Population)

Hazard	Calculated MOE	Calculated Cancer Risk	Refined Analysis?
Acute non-cancer	Greater than or equal to relative benchmark	N/A	No
	Less than relative benchmark	N/A	Yes
Chronic non-cancer	Greater than or equal to relative benchmark	N/A	No
	Less than relative benchmark	N/A	Yes
Cancer	N/A	Less than or equal to relative benchmark	No
	N/A	Greater than relative benchmark	Yes

MOE = Margin of Exposure

Table 5-3. Application of Risk Estimates to Inform Refined Analyses (Wildlife Populations)

Hazard	Calculated Risk Quotient (RQ)	Refined Analysis?
Acute non-cancer	$RQ \leq 1$	No
	$RQ \geq 1$	Yes
Chronic non-cancer	$RQ \leq 1$	No
	$RQ \geq 1$	Yes
Cancer	Not evaluated	N/A

RQ = Risk Quotient

Acute and Chronic Non-Cancer (General Population)

Where calculated MOEs for acute or chronic non-cancer effects are greater than or equal to the relative benchmark for the hazard effect, results suggest inhalation exposure to 1,1,2-trichloroethane via the ambient air pathway is not expected to pose an identified acute or chronic non-cancer risk to the general population. Therefore, EPA may determine additional, more refined analyses beyond that tier is not necessary or warranted.

Where calculated MOEs for acute or chronic non-cancer effects are less than the relative benchmark for the hazard effect, results suggest inhalation exposure to 1,1,2-trichloroethane via the ambient air pathway may pose an identified acute or chronic non-cancer risk to the general population. Therefore, EPA will conduct additional, more refined analyses either within the same tier or move to the next highest tier of analysis, as necessary or warranted.

Chronic Cancer (General Population)

Where calculated cancer risks for cancer effects are less than or equal to the relative benchmark for cancer effects, results suggest inhalation exposure to 1,1,2-trichloroethane via the ambient air pathway is not expected to pose an identified cancer risk to the general population. Therefore, EPA may determine additional, more refined analyses beyond that tier is not necessary or warranted.

Where calculated MOEs for acute or chronic non-cancer effects are greater than the relative benchmark for cancer effects, results suggest inhalation exposure to 1,1,2-trichloroethane via the ambient air pathway may pose an identified cancer risk to the general population. Therefore, EPA will conduct additional, more refined analyses, either within the same tier or move to the next highest tier of analysis, as necessary or warranted.

Acute and Chronic Non-Cancer (Wildlife Populations)

Where calculated risk quotients for acute or chronic non-cancer effects are less than or equal to one for the hazard effect, results suggest inhalation exposure to 1,1,2-trichloroethane via the ambient air pathway is not expected to cause an identified acute or chronic non-cancer effect in terrestrial species. Therefore, EPA may determine additional, more refined analyses beyond that tier is not necessary or warranted.

Where calculated RQs for acute or chronic non-cancer effects are less than the relative benchmark for the hazard effect, results suggest inhalation exposure to 1,1,2-trichloroethane via the ambient air pathway may cause an identified acute or chronic non-cancer effect in terrestrial species. Therefore, EPA will conduct additional, more refined analyses either within the same tier or move to the next highest tier of analysis, as necessary or warranted.

Chronic Cancer (Wildlife Populations)

EPA does not evaluate cancer effects for wildlife populations. This is the general practice for risk assessments since life expectancy and home ranges across terrestrial species varies considerably and migratory patterns or behaviors make life-time exposures to a single facility's releases unlikely.

Limitations of the Multi-Step Process

For non-cancer and cancer effects, references to "not expected to pose an identified risk" or "may pose identified risk" are not intended to be interpreted as a final determination of risk. Rather, the references are used to inform additional, refined analysis as part of the tiered structure applied in this 1,1,2-trichloroethane ambient air assessment. Any additional, refined analyses conducted for 1,1,2-trichloroethane are designed to ensure potential high-end exposures (and associated risk estimates) are not missed. Furthermore, additional, refined analyses are designed to ensure exposure scenarios and inhalation exposures are representative of general population exposures to 1,1,2-trichloroethane via the ambient air pathway considering conservative aspects of the associated tier of analysis. Only results of the final tier of analysis conducted for each hazard effect are carried into the *Draft Risk Evaluation for 1,1,2-Trichloroethane* ([U.S. EPA, 2026r](#)) with the intention of deriving risk estimates used to inform risk characterization, risk determination, and regulatory decision-making.

Supporting Documents, Files, and Results

Modeling files and results from all tiers of analyses are included and provided in the respective supplemental files. Exposure results from the final tier of analysis associated with a given population are summarized, discussed, and relied upon for exposure characterization in Section 5.3 (for general population) and Section 5.4 (for wildlife populations).

Although all tiers of analysis completed for this ambient air exposure assessment are discussed and characterized in this *Chemistry, Fate, Release, and Exposure Assessment for 1,1,2-Trichloroethane* ([U.S. EPA, 2026f](#)) document, only the results from the final tier of analysis are carried into to the *Draft Risk Evaluation for 1,1,2-Trichloroethane* ([U.S. EPA, 2026r](#)) for purposes of deriving risk estimates, characterizing risks, and informing risk determination and regulatory decision-making. Furthermore, risk estimates derived from the final tier of analysis results are only provided in the *Draft Risk Evaluation for 1,1,2-Trichloroethane* ([U.S. EPA, 2026r](#)).

5.2.1 Tier 1 Analysis for 1,1,2-Trichloroethane

The Tier 1 analysis methodology presented in Figure 5-2 and described in Appendix F.2 as applied to this ambient air pathway exposure assessment for 1,1,2-trichloroethane uses EPA's Integrated Indoor/Outdoor Calculator (IIOAC) to estimate daily and annual average, high-end and mean ambient air concentrations at three radial distances from the release point (100, 100 to 1,000, and 1,000 meters). The highest single fugitive and single stack releases across all facilities, all years, and all release datasets considered are used as direct inputs to the IIOAC model. Additional conservative default and user defined parameters are also used as direct inputs to the IIOAC model providing highly conservative, upper-bounding modeled concentrations of 1,1,2-trichloroethane in ambient air. Since 1,1,2-trichloroethane is volatile, has the potential to volatilize from surface soils based on its low Henry's Law constant, and is not expected to be present in land-applied biosolids, EPA does not evaluate deposition from ambient air to water or soil in this Tier 1 analysis.

Supporting Documents, Files, Results

Appendix F.2.1: Methodology, strengths, limitations, assumptions, uncertainties
Supplemental Files:

Modeling Files: *Draft Tier 1 Ambient Air Analysis Model Files for 1,1,2-Trichloroethane Draft Tier 1 Ambient Air Analysis* ([U.S. EPA, 2026w](#))

All Results: *Draft Tier 1 Ambient Air Analysis-Results and Risk Calcs for 1,1,2-Trichloroethane Draft Tier 1 Ambient Air Analysis-Results and Risk Calcs for 1,1,2-Trichloroethane* ([U.S. EPA, 2026v](#))

5.2.1.1 Summary of Findings

Findings from the highly conservative Tier 1 analysis and EPA's decision whether additional, refined analysis are or are not necessary or warranted based on modeled concentrations and calculated risk estimates are presented in Table 5-4 (general population) and Table 5-5 (wildlife populations).

Table 5-4. Tier 1 Findings and Analysis Decision Tree (General Population)

Hazard	Calculated MOE	Calculated Cancer Risk Estimate	Refined Analysis
Acute non-cancer	Greater than or equal to relative benchmark	N/A	Not further evaluated
Chronic non-cancer	Less than relative	N/A	Tier 2-Refined Analysis

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Hazard	Calculated MOE	Calculated Cancer Risk Estimate	Refined Analysis
	benchmark		
Cancer	N/A	Greater than relative benchmark	Tier 2-Refined Analysis
MOE = Margin of Exposure			

Table 5-5. Tier 1 Findings and Analysis Decision Tree (Wildlife Populations)

Hazard	Calculated Risk Quotient	Refined Analysis
Acute non-cancer	≤ 1	Not further evaluated
Chronic non-cancer	≤ 1	Not further evaluated

Acute Non-Cancer (General Population): Results from the Tier 1 analysis did not show preliminary risk estimates less than the benchmark of 100 for acute non-cancer effects and therefore no additional, refined analysis was performed. The Tier 1 results for acute non-cancer effects are carried into the *Draft risk evaluation for 1,1,2-Trichloroethane* ([U.S. EPA, 2026r](#)) to derive risk estimates and inform risk determination and regulatory decision-making.

Chronic Non-Cancer (General Population): Results from the Tier 1 analysis showed preliminary risk estimates less than the benchmark of 300 for chronic non-cancer effects and therefore EPA conducted a Tier 2 refined analysis. The Tier 1 results for chronic non-cancer effects led to a refined analysis but the Tier 1 results are not carried into the *Draft risk evaluation for 1,1,2-Trichloroethane* ([U.S. EPA, 2026r](#)) to derive risk estimates or inform risk determination and regulatory decision-making.

Cancer (General Population): Results from the Tier 1 analysis showed preliminary risk estimates greater than the benchmark of $1E-06$ for cancer effects and therefore EPA conducted a Tier 2 refined analysis. The Tier 1 analysis for cancer effects led to a refined analysis but the Tier 1 results are not carried into the *Draft risk evaluation for 1,1,2-Trichloroethane* ([U.S. EPA, 2026r](#)) to derive risk estimates or inform risk determination and regulatory decision-making.

Acute Non-Cancer (Wildlife Populations): Results from the Tier 1 analysis did not show preliminary risk quotients greater than 1 for acute non-cancer effects and therefore no additional, refined analysis was performed. The Tier 1 results for acute non-cancer effects are carried into the *Draft risk evaluation for 1,1,2-Trichloroethane* ([U.S. EPA, 2026r](#)) to derive risk estimates and inform risk determination and regulatory decision-making.

Chronic Non-Cancer (Wildlife Populations): Results from the Tier 1 analysis did not show preliminary risk estimates greater than 1 for chronic non-cancer effects and therefore no additional, refined analysis was performed. The Tier 1 results for chronic non-cancer effects are carried into the *Draft risk evaluation for 1,1,2-Trichloroethane* ([U.S. EPA, 2026r](#)) to derive risk estimates and inform risk determination and regulatory decision-making.

5.2.1.2 Methods and Inputs

EPA modeled a series of conservative exposure scenarios within the IIOAC model in the Tier 1 analysis for 1,1,2-trichloroethane. Details on the exposure scenarios, releases, and associated inputs are presented below. The meteorological station used for this Tier 1 analysis represents the meteorological station resulting in the highest modeled concentration across the 14 meteorological stations included within

IIOAC based on a sensitivity analysis conducted following development of the IIOAC model. Additional information on recommended inputs, outputs, sensitivity analyses, etc. for IIOAC can be found in the IIOAC users guide ([U.S. EPA, 2019e](#)).

Exposure Scenarios Modeled

- Release
 - Maximum single release across all datasets (kg/site-day)
- Release Datasets
 - TRI (2019–2023)
 - NEI (2017 and 2020)
 - EPA Estimated Releases (5 OESs)
- Release Type
 - Fugitive
 - Stack
- Release Pattern
 - Consecutive
- Distances Evaluated
 - 100 m
 - 100–1,000 m
 - 1,000 m
- Meteorological Station
 - South (Coastal): Surface and Upper Air Stations at Lake Charles, Louisiana
- Operating Scenarios
 - 365 days per year
 - 250 days per year
- Topography
 - Urban
 - Rural
- Particle Size
 - No particles (vapor only)

Releases Evaluated

Table 5-6 summarizes the maximum single fugitive and single stack releases for each release dataset described in Section 4. The maximum single fugitive release is 14,996 pounds/year (6,801 kg/yr). This release is an EPA estimated release and associated with primary NAAICS codes for “Cleaning and Degreasing Solvents”. However, this EPA estimated release is classified as either all fugitive or all stack releases. Since this release cannot be attributed with certainty to either fugitive or stack releases, EPA uses the next highest fugitive release across the datasets evaluated for the Tier 1 analysis. The next maximum single fugitive release is 9,500 pounds/year (4,309 kilograms/year). This is an industry reported fugitive release to the TRI dataset from a facility located in Louisiana. This release is associated with the 2020 TRI reporting year and the primary NAAICS code for “Other Basic Inorganic Chemical Manufacturing”.

The maximum single stack release is 15,940 pounds/year (7,230 kilograms/year). This release is an industry reported release to NEI from a facility located in Minnesota. This release is associated with the 2017 NEI reporting year and the primary NAAICS code for “Machine Shops”.

Table 5-6. Maximum Single Release

TRI		NEI (2017)		NEI (2020)		EPA Estimated		Units
Fugitive	Stack	Fugitive	Stack	Fugitive	Stack	Fugitive	Stack	
9,500	8,021	7,455	15,940	9,174	3,500	14,996	14,996	lb/yr
4,309	3,638	3,382	7,230	4,161	1,588	6,801	6,801	kg/yr
11.8	10.0	9.3	19.8	11.4	4.3	18.6	18.6	kg/site-day ^a
17.2	14.6	13.5	28.9	16.6	6.4	27.2	27.2	kg/site-day ^b
TRI = Toxic Release Inventory; NEI = National Emissions Inventory								
^a Releases based on 365 days of operation								
^b Releases based on 250 days of operation								

Although the facility-reported information for the maximum single fugitive and stack releases used for the Tier 1 modeling do not align either spatially or temporally, for purposes of the Tier 1 analysis, EPA assumed these releases occur from a single facility, at the same time, and the same year. This results in highly conservative, upper-bounding exposure concentrations (and associated risk estimates) and ensures higher releases and exposures (and associated risk estimates) are not missed. This also provides EPA high confidence that the exposures (and associated risk estimates) are protective of all receptors. However, since the releases do not align either spatially or temporally (and therefore do not happen at the same time), EPA has low confidence in the accuracy of the modeled concentration (how close the modeled concentration is to a true exposure value) and representativeness of an actual exposure of the general population.

Stack and Fugitive Area Source Parameter Inputs

Table 5-7 summarizes the default stack and fugitive parameters integrated into the IIOAC model and used by EPA for the Tier 1 analysis. EPA applied a 100 m² user defined area for the fugitive source. The default parameters used for the Tier 1 analysis represent low, slow moving, non-buoyant plumes which limit dispersion prior to reaching the exposed populations breathing zone. This adds conservatism to modeled concentrations of 1,1,2-trichloroethane in the ambient air for this Tier 1 analysis.

Table 5-7. IIOAC Default Stack and Fugitive Source Parameter Inputs

Stack Release Parameters	Value	Fugitive Release Parameters	Value
Stack height (m)	10	Length (m)	10
Stack diameter (m)	2	Width (m)	10
Exit velocity (m/sec)	5	Angle (°)	0
Exit temperature (K)	300	Release height (m)	3.05

5.2.1.3 Modeled Concentrations and Findings

The Tier 1 analysis for 1,1,2-trichloroethane includes eight different exposure scenarios modeled under a variety of topographical and facility operating conditions. EPA reviewed the results across the series of exposure scenarios to identify the highest estimated fugitive and stack concentrations of 1,1,2-trichloroethane. The highest fugitive and stack concentrations were then added together to get a total exposure concentration of 1,1,2-trichloroethane to which the general population could be exposed.

The purpose of considering the highest estimated fugitive and stack concentrations individually was to inform whether one or both release types are driving general population exposures to 1,1,2-

trichloroethane. The purpose of considering total concentrations was to characterize total potential exposure of the general population to 1,1,2-trichloroethane.

Table 5-8 summarizes the highest modeled concentrations from the Tier 1 analysis. Table 5-8 also summarizes findings from comparing the associated risk estimates to relative benchmarks to inform whether additional, more refined analysis are necessary or warranted. The daily average modeled concentrations are used to calculate risk estimates which are compared to the relative benchmark (MOE) for acute non-cancer hazard effects because both are based on short-term exposures. The annual average modeled concentrations are used to calculate risk estimates which are compared to the relative benchmarks for chronic non-cancer (MOE) and cancer (cancer risk) effects since these are based on longer-term exposure. The highest modeled concentrations from the Tier 1 analysis and associated findings presented in Table 5-8 occurred at 100 meters from the modeled release point.

Table 5-8. Comparison: Tier 1 Modeled Concentrations to Relative Benchmark

Release Type	Modeled Concentration ($\mu\text{g}/\text{m}^3$)		Comparison to Relative Benchmark		
	Daily Avg.	Annual Avg.	Acute (Benchmark = 100)	Chronic (Benchmark = 300)	Cancer (Benchmark = $1\text{E}-06$)
Fugitive	31.08	21.29	$\geq$ Benchmark	< Benchmark	> Benchmark
Stack	2.66	1.82	$\geq$ Benchmark	> Benchmark	> Benchmark
Total	33.74	23.11	$\geq$ Benchmark	< Benchmark	> Benchmark

Conclusions from the Tier 1 Analysis

Based on these conclusions, EPA determined the Tier 1 analysis is not the final tier of analysis for chronic non-cancer effects for general population. Therefore, the modeled annual average concentrations from the Tier 1 analysis led to a refined Tier 2 analysis but the Tier 1 result will not be carried into the *Draft Risk Evaluation for 1,1,2-Trichloroethane* ([U.S. EPA, 2026r](#)) for purposes of deriving risk estimates or informing risk determination and regulatory decision-making for chronic non-cancer effects from inhalation exposure of the general population to 1,1,2-trichloroethane via the ambient air pathway.

Inhalation exposure of the general population via the ambient air pathway resulting from industrial releases of 1,1,2-trichloroethane to the ambient air showed preliminary risks for cancer effects. Therefore, EPA determined additional, refined Tier 2 analyses were necessary or warranted. This is based on consideration of the conservative aspects of the Tier 1 analysis and the finding that these highly conservative, upper bounding modeled annual average concentrations resulting from fugitive and total releases from the Tier 1 analysis resulted in calculated risk estimates (cancer risk) greater than the relative benchmark for cancer effects. The refined Tier 2 analyses reconsidered conservative aspects of the Tier 1 analyses to provide modeled annual average concentrations which are more representative of general population exposures to 1,1,2-trichloroethane.

Based on these conclusions, EPA determined the Tier 1 analysis is not the final tier of analysis for cancer effects for the general population. Therefore, the modeled annual average concentrations from the Tier 1 analysis led to a refined Tier 2 analysis but the Tier 1 results will not be carried into the *Draft Risk Evaluation for 1,1,2-Trichloroethane* ([U.S. EPA, 2026r](#)) for purposes of deriving risk estimates or informing risk determination and regulatory decision-making for cancer effects from inhalation exposure of the general population to 1,1,2-trichloroethane via the ambient air pathway.

Inhalation exposure of terrestrial species via the ambient air pathway resulting from industrial releases of 1,1,2-trichloroethane to the ambient air did not show preliminary risks for acute or chronic non-cancer effects. Therefore, EPA determined additional, refined analyses are not necessary or warranted. This is based on consideration of the conservative aspects of the Tier 1 analysis and the finding that none of the highly conservative, upper bounding modeled daily average concentrations from the Tier 1 analysis resulted in calculated risk quotients (RQs) greater than one for acute or chronic non-cancer effects. Based on these conclusions, EPA determined the Tier 1 analysis is the final tier of analysis for acute non-cancer and cancer effects for terrestrial species. Therefore, the modeled daily average concentrations from the Tier 1 analysis will be carried into the *Draft Risk Evaluation for 1,1,2-Trichloroethane* ([U.S. EPA, 2026r](#)) for purposes of deriving risk estimates and informing risk determination and regulatory decision-making for acute non-cancer effects from inhalation exposure of terrestrial species to 1,1,2-trichloroethane via the ambient air pathway.

5.2.1.4 Evidence Integration and Weight of Scientific Evidence for Tier 1 Analysis

EPA acknowledges the inputs used and assumptions made for the Tier 1 analysis result in highly conservative, upper bounding modeled estimates of concentrations to which the general population and terrestrial species are exposed. The conservatism described in Appendix E and integrated into the Tier 1 analysis for 1,1,2-trichloroethane (e.g., highest releases across all datasets, conservative model inputs, releases/results which do not align spatially or temporally, etc.) give EPA low confidence in the accuracy of the estimated air concentrations and the representativeness of actual general population or terrestrial species exposures. However, these same conservatisms give EPA robust confidence that high-end exposures are not missed and are health protective.

General Population

Overall, EPA has robust confidence in the conclusions reached from this Tier 1 analysis for general population. Since the highly conservative, upper bounding daily average exposure estimates do not result in calculated risk estimates less than the relative benchmark for acute non-cancer effects, EPA has robust confidence additional, more refined analyses beyond this Tier 1 analysis are not necessary or warranted to evaluate acute non-cancer effects. Since the highly conservative, upper bounding annual average exposure estimates do result in calculated risk estimates less than the relative benchmark for chronic non-cancer effects and greater than the relative benchmark for cancer effects, EPA has robust confidence additional, more refined analyses beyond this Tier 1 analysis are necessary or warranted to evaluate chronic non-cancer and cancer effects. Based on these confidence statements, EPA has robust confidence additional, refined Tier 2 analyses are necessary or warranted for further evaluating general population exposures to 1,1,2-trichloroethane for chronic non-cancer and cancer effects when exposed individuals reside in, or frequent locations in, proximity to industrial facilities releasing 1,1,2-trichloroethane to the ambient air.

Wildlife Populations

Overall, EPA has robust confidence in the conclusions reached from this Tier 1 analysis for terrestrial species. Since the highly conservative, upper bounding daily average exposure estimates do not result in calculated risk quotients greater than one for acute non-cancer effects, EPA has robust confidence additional, more refined analyses beyond this Tier 1 analysis are not necessary or warranted to evaluate acute non-cancer effects. Since the highly conservative, upper bounding annual average exposure estimates do not result in calculated risk quotients greater than one for chronic non-cancer effects, EPA has robust confidence additional, more refined analyses beyond this Tier 1 analysis are not necessary or warranted to evaluate chronic non-cancer effects.

5.2.2 Tier 2 Analysis

The Tier 2 analysis methodology presented in Figure 5-2 and described in Appendix F.2 as applied to this ambient air pathway exposure assessment for 1,1,2-trichloroethane uses EPA's Integrated Indoor/Outdoor Calculator (IIOAC) to estimate daily and annual average, high-end and mean ambient air concentrations at three radial distances from the release point (100, 100 to 1,000, and 1,000 meters). The Tier 2 analysis uses the highest single fugitive and single stack release across all facilities, all years, and all release datasets, but refines those releases within each industry sector (IS) to which facilities are categorized in Section 4 based on primary NAICS codes. Since releases can vary greatly across different industry sectors, this Tier 2 analysis refinement provides industry sector-specific results which allow for clearer identification of individual industry sectors which may or may not pose an identified risk to the general population for specific hazard effects. The remaining components of the Tier 2 analysis mirror those of the Tier 1 analysis, including conservative default and user defined inputs to IIOAC. Results of the Tier 2 analysis remain highly conservative, upper-bounding modeled concentrations of 1,1,2-trichloroethane in ambient air but are refined to the IS level. Like the Tier 1 analysis, the modeled Tier 2 concentrations are used to calculate preliminary risks estimates which are compared to the respective, relative benchmarks for chronic non-cancer and cancer effects to inform whether additional, more refined analyses are necessary or warranted.

Supporting Documents, Files, Results

Appendix F.2.2: Methodology, strengths, limitations, assumptions, uncertainties

Appendix F.6: Release summary for Tier 2 Analysis

Supplemental Files:

Modeling Files: Draft Tier 2 Ambient Air Analysis Modeling Files for 1,1,2-Trichloroethane
([U.S. EPA, 2026y](#))

All Results: Draft Tier 2 Ambient Air Analysis-Results and Risk Calcs for 1,1,2-Trichloroethane
([U.S. EPA, 2026x](#))

5.2.2.1 Methods and Inputs

EPA modeled a series of conservative exposure scenarios within the IIOAC model in the Tier 2 analysis for 1,1,2-trichloroethane. The methods and inputs for the Tier 2 analysis were the same as the Tier 1 analysis except for the following refinements:

1. Industry sector level analysis based on a review of the releases evaluated
2. Independent modeling and analysis for the TRI dataset (2019 through 2023), the 2017 NEI dataset, and the 2020 NEI dataset
3. Modeling the maximum single fugitive and stack release across all facilities within each industry sector

5.2.2.1 Summary of Findings

Findings from the highly conservative Tier 2 analysis and EPA's decision whether additional, refined analysis are or are not necessary or warranted based on modeled concentrations and calculated risk estimates are presented in Table 5-9 (general population).

Table 5-9. Tier 2 Findings and Analysis Decision Tree (General Population)

Hazard	Calculated MOE	Calculated Cancer Risk Estimate	Refined Analysis
Chronic non-cancer	Less than relative benchmark (11 IS) ^a	N/A	Tier 3-Refined Analysis
Cancer	N/A	Greater than relative	Tier 3-Refined Analysis

Hazard	Calculated MOE	Calculated Cancer Risk Estimate	Refined Analysis
		benchmark (21 IS) ^b	
MOE = Margin of Exposure; IS =Industry sector ^a Calculated MOEs less than the relative benchmark for chronic non-cancer effects were identified for 11 different industry sectors across all TRI and NEI datasets evaluated. ^b Calculated cancer risk estimates greater than the relative benchmark for cancer effects were identified for 21 different industry sectors across all TRI and NEI datasets evaluated.			

Chronic Non-Cancer (General Population)

Results from the Tier 2 analysis showed preliminary risks to the general population for chronic non-cancer effects and therefore EPA conducted a Tier 3 refined analysis. The Tier 2 results for chronic non-cancer effects led to a refined analysis but are not carried into the *Draft risk evaluation for 1,1,2-Trichloroethane* ([U.S. EPA, 2026r](#)) to derive risk estimates or inform risk determination and regulatory decision-making.

Cancer (General Population)

Results from the Tier 2 analysis showed preliminary risks to the general population for cancer effects and therefore EPA conducted a Tier 3 refined analysis. The Tier 2 analysis for cancer effects led to a refined analysis but are not carried into the *Draft risk evaluation for 1,1,2-Trichloroethane* ([U.S. EPA, 2026r](#)) to derive risk estimates or inform risk determination and regulatory decision-making.

5.2.2.2 Modeled Concentrations and Findings

The Tier 2 analysis for 1,1,2-trichloroethane includes eight different exposure scenarios modeled under a variety of topographical and facility operating conditions modeled in IIOAC. EPA reviewed the results across the series of exposure scenarios to identify the highest estimated fugitive and stack concentrations of 1,1,2-trichloroethane for each industry sector and each dataset evaluated. The highest fugitive and stack concentrations were then added together to get a total exposure concentration of 1,1,2-trichloroethane to which the general population is exposed.

Table 5-10 summarizes the number of industry sectors (by dataset) where the highest modeled concentrations resulted in calculated risk estimates that were less than the relative benchmark for chronic non-cancer effects or greater than the relative benchmark for cancer effects. The annual average modeled concentrations were used to calculate risk estimates compared to the relative benchmarks since these were based on longer-term exposure. The findings presented in Table 5-10 occurred at 100 meters from the modeled release point and were used to determine whether additional, more refined analyses were necessary or warranted.

Table 5-10. Number of Industry Sectors with Calculated Risk Estimates Below/Above Relative Benchmark

Dataset	Total Number of Industry Sectors	Below Chronic Non-Cancer Relative Benchmark	Above Cancer Relative Benchmark
TRI (95th Percentile)	9	5	8
TRI (Mean)	9	5	8
2017 NEI (95th Percentile)	51	10	16
2017 NEI (Mean)	51	10	16

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Dataset	Total Number of Industry Sectors	Below Chronic Non-Cancer Relative Benchmark	Above Cancer Relative Benchmark
2020 NEI (95th Percentile)	51	7	16
2020 NEI (Mean)	51	7	15
TRI = Toxic Release Inventory; NEI = National Emissions Inventory; 95th percentile = 95th percentile modeled concentration across the total distribution of modeled concentrations; Mean = Mean modeled concentration across the distribution of modeled concentrations			

Conclusions from the Tier 2 Analysis

Chronic Non-Cancer and Cancer Effects (General Population): Inhalation exposure of the general population via the ambient air pathway resulting from industrial releases of 1,1,2-trichloroethane to the ambient air showed preliminary risks for chronic non-cancer effects for multiple industry sectors and multiple release datasets evaluated. Therefore, EPA determined additional, refined Tier 3 analyses were necessary or warranted. This is based on consideration of the conservative aspects of the Tier 2 analysis and the finding that these highly conservative, upper bounding modeled annual average concentrations resulted in calculated risk estimates (MOEs) less than the relative benchmark for chronic non-cancer and cancer effects.

Based on these conclusions, EPA determined the Tier 2 analysis is not the final tier of analysis for chronic non-cancer and cancer effects for general population. Therefore, the modeled annual average concentrations from the Tier 2 analysis led to a refined Tier 3 analysis and, thus, the results of the Tier 2 analysis were not carried into the *Draft Risk Evaluation for 1,1,2-Trichloroethane* ([U.S. EPA, 2026r](#)) for purposes of deriving risk estimates or informing risk determination and regulatory decision-making for chronic non-cancer effects from inhalation exposure of the general population to 1,1,2-trichloroethane via the ambient air pathway.

5.2.2.3 Evidence Integration and Weight of Scientific Evidence for Tier 2 Analysis

EPA acknowledges the inputs used and assumptions made for the Tier 2 analysis result in highly conservative, upper bounding modeled estimates of concentrations to which the general population is exposed. The conservatisms described in Appendix E and integrated into the Tier 2 analysis for 1,1,2-trichloroethane (e.g., highest releases across each industry sector for each dataset, conservative model inputs, releases/results which do not align spatially or temporally, etc.) give EPA low confidence in the exposure scenarios evaluated and the representativeness of actual general population exposures. However, these same conservatisms give EPA robust confidence that high-end exposures are not missed and the Tier 2 results are protective of the general population (including fenceline communities and PESS). Additional confidence is provided with the Tier 2 analysis since EPA independently modeled all three release datasets (TRI, 2017 NEI, and 2020 NEI) and refined the modeling to the industry sector level.

General Population

Overall, EPA has robust confidence in the conclusions reached from this Tier 2 analysis for general population. Since the highly conservative, upper bounding annual average exposure estimates do result in calculated risk estimates less than the relative benchmark for chronic non-cancer effects, EPA has robust confidence additional, more refined analyses beyond this Tier 2 analysis are necessary or warranted to evaluate chronic non-cancer effects. Since the highly conservative, upper bounding annual average exposure estimates do result in calculated risk estimates greater than the relative benchmark for cancer effects, EPA has robust confidence additional, more refined analyses beyond this Tier 2 analysis

are necessary or warranted to evaluate cancer effects. Based on these confidence statements, EPA has robust confidence additional, refined Tier 3 analyses are necessary or warranted for further evaluating general population exposures to 1,1,2-trichloroethane for chronic non-cancer and cancer effects when exposed individuals reside in, or frequent locations in, proximity to industrial facilities releasing 1,1,2-trichloroethane to the ambient air.

5.2.3 Tier 3 Analysis-TRI Release Dataset

The Tier 3 analysis methodology presented in Figure 5-2 and described in Appendix F.2 was applied to the ambient air pathway exposure assessment for 1,1,2-trichloroethane. The Tier 3 analysis uses EPA's Human Exposure Model (HEM) to estimate daily and annual average, high-end (95th percentile) ambient air concentrations of 1,1,2-trichloroethane. Estimated concentrations were evaluated for multiple user-defined radial distances, all facility-specific census blocks within the HEM modeling domain for each facility, and multi-facility aggregate census blocks within the HEM modeling domain for all facilities evaluated. Each of these analyses are described and presented individually and then integrated together to characterize inhalation exposures of general population to 1,1,2-trichloroethane due to industrial releases to the ambient air.

The Tier 3 analysis-TRI Release Dataset considers five years of TRI reported releases (2019 through 2023) as presented in Section 4. The single highest fugitive and stack releases for each facility across all five years of TRI release data considered were used as inputs to the HEM. Results of the Tier 3 analysis-TRI Release Dataset remain conservative, upper-bounding modeled concentrations of 1,1,2-trichloroethane in ambient air. The modeled concentrations are used to calculate risks estimates which are compared to the relative benchmarks for chronic non-cancer and cancer effects to inform whether additional, more refined analyses are necessary or warranted.

The Tier 3 Analysis-TRI Release Dataset provides multiple refinements to the Tier 1 and Tier 2 analyses described in Sections F.2.1 and F.2.2 and presented for 1,1,2-trichloroethane in Sections 5.2.1 and 5.2.2.

Those refinements include

4. Shifting from a national or industry sector level analysis to site-specific level analyses for all facilities reporting releases to the TRI release dataset described in Section 4.
5. Assessing modeled concentrations at twelve user defined radial distances in the HEM instead of the three pre-defined radial distances integrated into the IIOAC model.
6. Using local meteorological data for each facility rather than a single regional meteorological station for all facilities.
7. Considering local population data and elevation information to determine topographic and terrain effects on modeled ambient concentrations.
8. Evaluating modeled concentrations, population, and demographic analyses at the census block level.

The Tier 3 Analysis-TRI Release Dataset retain some conservative inputs and assumptions from the Tier 1 and Tier 2 analyses, including

1. Considering the highest single facility reported fugitive and stack releases across all years of the TRI release data evaluated.
2. Applying a series of conservative default stack and fugitive area source parameters described in Section 5.2.1.2 and summarized in Table 5-7 as inputs to the HEM.

Supporting Documents, Files, Results

Appendix F.2.3: Methodology, strengths, limitations, assumptions, uncertainties
Supplemental Files:

- A. Modeling Files: Draft Tier 3 Ambient Air Analysis-TRI Dataset Modeling Files for 1,1,2-Trichloroethane ([U.S. EPA, 2026ac](#))
- B. All Results: Draft Tier 3 Ambient Air Analysis-TRI Dataset Results Summary for 1,1,2-Trichloroethane ([U.S. EPA, 2026ab](#))
- C. Additional Information-Read Me File: Draft Tier 3 Ambient Air Analysis-TRI Dataset Read Me for 1,1,2- 13246885
- D. All Releases: Tier 3 Ambient Air Analysis TRI and NEI Release Data summary by OES ([U.S. EPA, 2026aa](#))

5.2.3.1 Methods and Inputs

EPA modeled a series of conservative exposure scenarios within the HEM in the Tier 3 analysis-TRI Release Dataset for 1,1,2-trichloroethane. Running the HEM for the Tier 3 analysis-TRI Release Dataset required EPA to create at least four separate input files to define all aspects of the release and exposure scenarios to be modeled. These input files include: the facility list options file, HAP emissions file, emissions location file, and emissions variation file for each dataset and refinement evaluated. These input files describe a variety of factors to be considered during modeling including, but not limited to, releases modeled, facility locations, pollutants evaluated, facility operating conditions, and desired output information. These input files are created outside of the HEM model and then imported into the HEM prior to modeling.

Prior to running the HEM, EPA also was required to update two toxicity library files located in the HEM/Resources files with the hazard PODs from the *Draft Human and Environmental Hazard Assessment for 1,1,2-Trichloroethane* ([U.S. EPA, 2026I](#)). Those two files were the dose response library file and the target organ endpoints file. Since these toxicity library files are reference files the HEM pulls from during modeling, if any hazard POD changes after running the HEM then EPA would need to re-run the entire model to get updated exposure and risk information output from the HEM.

Exposure Scenarios Modeled:

- Release
 - The highest individual site-specific release (fugitive and stack) across all TRI reporting years
- Release Dataset
 - TRI (2019 – 2023)
- Release Type
 - Fugitive
 - Stack
 - Release Pattern
 - Emissions variance, based on reported operating days
 - Radial Distances Evaluated
 - 30 m
 - 60 m
 - 100 m
 - 250 m
 - 500 m
 - 750 m
 - 1,000 m

- 2,500 m
- 5,000 m
- 10,000 m
- 25,000 m
- 50,000 m
- Meteorological Station
 - 2019 meteorological data from AERMODs AERMET module (integrated into HEM v 5.0)
 - Local Surface and Upper Air Stations based on facility latitude/longitude
- Operating Scenarios
 - Facility operating days per year as presented in the Release Assessment
- Topography
 - Based on Census data referenced within HEM
- Particle Size
 - No particles (vapor only)

Releases Modeled

The Tier 3 Analysis-TRI Release Dataset used the single highest facility-specific fugitive and stack release reported to TRI across all years of TRI reported releases for each facility to ensure high-end releases are not missed. There were a total of 29 facilities reporting releases of 1,1,2-trichloroethane to the ambient air for one or more years between 2019 and 2023. These facilities are shown in Figure 5-3 and were categorized into 6 OES (and six associated COUs) (Section 4).

Although each facility-specific release is modeled separately in this Tier 3 analysis, EPA summarized the range of the highest fugitive and stack releases captured by the TRI dataset evaluated in Table 5-11. The releases are summarized by OES (and associated COUs). Table 5-11 includes the number of facilities reporting releases in each OES to track how many of the 29 facilities are in each OES. The use of OES and number of facilities within an OES are carried through much of the Tier 3 analyses conducted for 1,1,2-trichloroethane for summary purposes, including a final link to COU in conclusions and exposure characterization.

June 2026

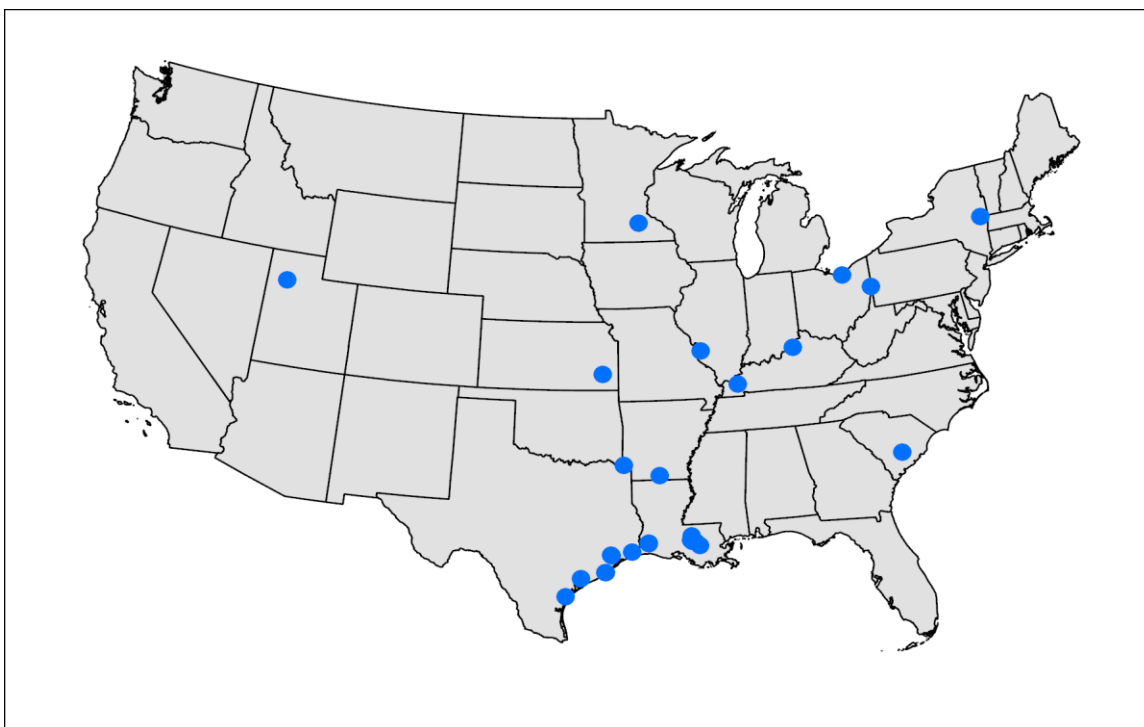


Figure 5-3. TRI Facilities Reporting Releases of 1,1,2-Trichloroethane (2019–2023)

The 29 facilities presented in Figure 5-3 were categorized into five separate OES (and six associated COUs) in Section 4. Although a cross walk of OES to COUs is described in detail in Section 4 a summary of that cross walk for ambient air is provided in bullet form here, for reference.

OES: Manufacturing as a byproduct at chemical manufacturing facilities

- COU: Domestic manufacture

OES: Processing as a reactant (intermediate)

- COU: Processing-Processing as a reactant intermediate in: plastic manufacturing

- COU: Processing-Processing as a reactant intermediate in: petrochemical manufacturing

- COU: Processing-Processing as a reactant intermediate in: all other chemical product manufacturing

OES: Open Top Vapor Degreasing

- COU: Industrial use-Solvents (for cleaning and degreasing)

OES: Waste handling, treatment, and disposal (incineration)

- COU: Disposal

OES: Waste handling, treatment, and disposal (landfill)

- COU: Disposal

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Table 5-11. Release Summary by OES/COU for TRI Release Dataset Across All 5 Years Evaluated

OES/COU	Number of Facilities	Fugitive/ Stack	TRI	
			Min (kg/yr)	Max (kg/yr)
Manufacturing (byproduct)/Domestic Manufacture	13	Fugitive	0	4,309
		Stack	0	2,404
Processing as a Reactant (Intermediate)/ Processing - Processing as a Reactant - Intermediate in: Plastic manufacturing; Petrochemical manufacturing; All other chemical product manufacturing	4	Fugitive	7	320
		Stack	0	57
Open Top Vapor Degreasing/Industrial Use-Solvents (for cleaning and degreasing)	1	Fugitive	0	304
		Stack	0	3,638
Waste Handling, Treatment, and Disposal (incineration)/Disposal	5	Fugitive	0.001	64
		Stack	0	3
Waste Handling, Treatment, and Disposal (landfill)/Disposal	6	Fugitive	0	162
		Stack	0	4
OES = Occupational Exposure Scenario; COU= Condition of Use; TRI = Toxic Release Inventory; Min = Minimum modeled concentration within the OES/COU; Max = Maximum modeled concentration within the OES/COU.				

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EPA acknowledges that the highest individual facility releases modeled for this analysis align spatially (from the same facility) but may not align temporally (the highest fugitive release may occur in a different year than the highest stack release). However, as with other tiers of analysis, EPA assumed the highest releases happen the same year. This results in conservative, high-end exposures (and associated risk estimates) providing EPA confidence the exposures (and associated risk estimates) are protective of the general population (including fenceline communities and PESS).. However, since the releases may not align temporally (and therefore do not happen at the same time), EPA has low confidence in the exposure scenario.

Stack and Fugitive Area Source Parameter Inputs

EPA uses the same default stack and fugitive parameters described in Section 5.2.1.2 and summarized in Table 5-7 for this Tier 3 analysis.

Meteorological Data Inputs

The HEM uses local meteorological data for each facility modeled. The input files for the 1,1,2-trichloroethane Tier 3 Analysis-TRI Release Dataset directed the HEM to identify the nearest meteorological station for each TRI facility based on the latitude and longitude of the TRI facility. The input files also directed the HEM to consider local population data and USGS elevation information to determine topographic and terrain effects on concentrations. All these factors provide site specific exposures (and associated risk estimates) which are representative of local general population exposures.

Since the HEM uses local meteorological data and local Census block information, the 1,1,2-trichloroethane Tier 3 Analysis-TRI Release Dataset only evaluate the TRI release dataset and does not evaluate EPA estimated releases. The reason for this is because the EPA estimated releases are based on generic scenarios and therefore have no facility-specific information to either inform applicable local meteorology or impacted local Census blocks.

Radial Distances Evaluated

EPA modeled ambient concentrations of 1,1,2-trichloroethane using the HEM at 12 radial distances from the release point (between 30 and 50,000 meters). The HEM models ambient concentrations at 16 receptors, placed every 22.5°, around each of the 12 radial distances modeled. This provides a 360°-degree representation of exposures at each radial distance around each facility evaluated. It also captures variable wind directions and upwind and downwind concentrations for all local meteorological conditions evaluated for each day and each facility evaluated.

Figure 5-4 provides a visual picture of the radial distances and the receptor placement (1–16) around each radial distance applied in the HEM radial distance analysis. Figure 5-4 is a simplified visual picture of the radial distance analysis and only shows 4 radial distance rings although for this 1,1,2-trichloroethane assessment 12 radial distances are evaluated. Additionally, Figure 5-4 only shows receptor placement around one radial distance ring, however, the same receptor placement occurs around each radial distance ring (every 22.5°) for this 1,1,2-trichloroethane assessment.

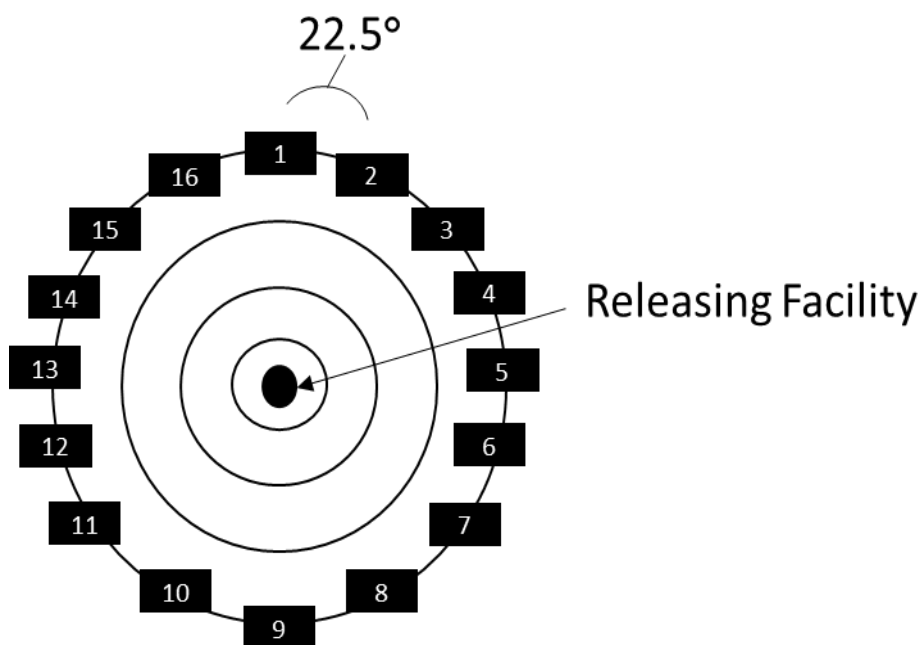


Figure 5-4. Simplified Radial Distance Diagram with Receptor Placement

Census Block Analyses

The census block analysis is conducted in two phases. The first phase is referred to as the facility-specific census block analysis. This phase provides modeled concentrations of 1,1,2-trichloroethane at the centroid of each census block within the modeling domain around each individual facility evaluated. The modeling domain for 1,1,2-trichloroethane is 30 to 50,000 meters from the modeled release point which is assumed to be at the facility reported latitude and longitude in the TRI dataset.

The second phase is referred to as the multi-facility aggregate census block analysis. This phase requires post-processing of the HEM individual facility output files and is performed through the HEM interface. The post-processing aggregates modeled concentrations of 1,1,2-trichloroethane for all facilities in proximity to another facility (within 50,000 meters of each other). The aggregated concentrations are calculated at the centroid of each census block within the modeling domain and included in a new output file created by the HEM which is placed in the original model run output file folder. Both census block analyses show the number of people impacted by industrial releases of 1,1,2-trichloroethane to the ambient air and can further inform exposure (and associated risk) characterization.

5.2.3.1 Summary of Findings

Findings from the conservative Tier 3 analysis and EPA's decision whether additional, refined analysis are or are not necessary or warranted based on modeled concentrations and calculated preliminary risk estimates are presented in Table 5-12 (general population).

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Table 5-12. Tier 3 Analysis-TRI Release Dataset Results and Analysis Decision Tree (General Population)

Analysis Tier	Hazard	Calculated MOE	Calculated Cancer Risk Estimate	Refined Analysis
Tier 3-Radial Distances	Chronic non-Cancer	Less than relative benchmark (6 OES)	N/A	Tier 3-Facility Census Block
	Cancer	N/A	Greater than relative benchmark (6 OES)	Tier 3-Facility Census Block
Tier 3-Facility Census Block	Chronic non-Cancer	Greater than relative benchmark (6 OES)	N/A	Not further evaluated
	Cancer	N/A	Greater than relative benchmark (1 OES)	Not further evaluated ^a
Tier 3-Multi Facility Aggregate Census Block and Population Analysis	Cancer	N/A	Greater than relative benchmark (2 OES)	Not further evaluated ^a
MOE = Margin of Exposure; OES = Occupational Exposure Scenario ^a Based on findings and further investigation/refinement within the Tier 3 analyses, EPA determined a Tier 4-analysis was not necessary or warranted for 1,1,2-trichloroethane. Some limited refinements from the TRI release analyses were still conducted with the TRI release dataset as described in Section 5.2.3 and the NEI release datasets described in Section 5.2.4 to further characterize exposure and findings.				

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Radial Distance Analyses

EPA found modeled exposures for 15 of the 29 TRI facilities across all five OES evaluated resulted in calculated risk estimates less than the relative benchmark for chronic non-cancer effects. The radial distances associated with these findings vary but occurred out to 250 meters from the release point modeled.

EPA found modeled exposures for 19 of the 29 TRI facilities across all five OES evaluated resulted in calculated risk estimates greater than the relative benchmark for cancer effects. The radial distances associated with these findings vary but occurred out to 1,000 meters from the release point modeled.

Based on these findings, EPA determined additional, refined analysis to the Tier 3 facility-specific census block analysis was necessary or warranted. The purpose of this refinement was to determine whether individuals within the general population reside at radial distances (or in populated census blocks) where modeled concentrations resulted in calculated risk estimates less than the relative benchmark (MOE) for chronic non-cancer effects or greater than the relative benchmark (cancer risk) for cancer effects.

Facility-Specific Census Block Analysis

EPA found modeled exposures for no TRI facilities (0 of the 29) across any of the five OES evaluated resulted in calculated risk estimates less than the relative benchmark for chronic non-cancer effects. Therefore, EPA determined additional analysis was not necessary or warranted for chronic non-cancer effects resulting from industrial releases of 1,1,2-trichloroethane to the ambient air.

EPA found modeled exposures for 1 of the 29 TRI facilities across all five OES evaluated resulted in calculated risk estimates greater than the relative benchmark for cancer effects. This facility is categorized under the OES: “Open Top Vapor Degreasing” (COU: Industrial use solvents (for cleaning and degreasing)). Additional investigation into this facility found the facility used 1,1,2-trichloroethane as a cleaning and degreasing solvent from at least 2017 through 2019, but stopped use of 1,1,2-trichloroethane after 2019 for business reasons. The facility’s discontinued use of 1,1,2-trichloroethane in turn eliminated any releases and exposures of the general population to 1,1,2-trichloroethane after 2019 from this facility. Therefore, EPA determined additional analysis was not necessary or warranted for cancer effects resulting from industrial releases of 1,1,2-trichloroethane to the ambient air.

Multi-Facility Aggregate Census Block Analysis

EPA found modeled exposures for three census blocks within the modeling domains of all 29 TRI facilities across all six OES evaluated resulted in calculated risk estimates greater than the relative benchmark for cancer effects. Two of the three census blocks are associated with the same single facility (no other facilities within a 50 km proximity) where the modeled exposures for the Tier 3-facility-specific census block analysis resulted in calculated risk estimates greater than the relative benchmark for cancer. Discontinued use of 1,1,2-trichloroethane by this facility after 2019 eliminated any releases and exposures of the general population to 1,1,2-trichloroethane after 2019 from this facility.

The third census block is associated with two facilities within approximately 3,200 meters proximity to each other. Both facilities are categorized under the OES: “Manufacturing as a byproduct at chemical manufacturing facilities” (COU: Domestic manufacture). Individually, neither facility had modeled concentrations which resulted in risk estimates greater than the relative benchmark for cancer effects based on the facility-specific census block analysis. Considering the conservative inputs and assumptions for the Tier 3-TRI release dataset analyses, EPA further investigated these two facilities and confirmed the modeled releases considered for this multi-facility aggregate census block analysis

aligned spatially but not temporally (did not occur the same year). EPA conducted additional, refined multi-facility aggregate census block analyses for these two facilities which aligned releases temporally across all five years of TRI release data considered. EPA's additional, refined multi-facility aggregate census block analyses for these two facilities found that, when releases were aligned temporally, there were no years where either the facility-specific or multi-facility aggregate census block analyses modeled exposures resulted in calculated risk estimates greater than the relative benchmark for cancer effects.

Based on these findings, EPA determined additional, refined analyses beyond the Tier 3 multi-facility aggregate census block and population analyses were not necessary or warranted. None-the-less, EPA conducted limited additional, refined Tier 3 analyses for cancer effects using the 2017 and 2020 NEI release datasets (see Section 5.2.4). Findings from the Tier 3 Analysis-NEI Release Datasets did not change the findings or conclusions reached from the Tier 3 Analysis-TRI Release Dataset.

Tier 3 Analysis Results Conclusion

In summary, based on the results of the Tier 3 Analysis-TRI Release Dataset, consideration of additional lines of evidence, and multi-facility aggregate exposures, EPA determined additional, more refined analyses beyond the Tier 3 Analysis-TRI Release Dataset were not necessary or warranted. Limited additional, refined analyses using the 2017 and 2020 NEI release datasets did not change findings or conclusions reached with the Tier 3 Analysis-TRI Release Dataset. Therefore, EPA determined the Tier 3 Analysis-TRI Release Dataset was the final tier of analysis needed or warranted for this 1,1,2-trichloroethane general population exposure assessment for the ambient air pathway. Results from the Tier 3 Analysis-TRI Release Dataset were carried into the *Draft Risk Evaluation for 1,1,2-Trichloroethane* ([U.S. EPA, 2026r](#)) and relied upon to derive risk estimates, characterize risks, and inform risk determination and regulatory decision-making.

5.2.3.2 Modeled Concentrations and Findings

Radial Distance Analysis Results

Table 5-13 and Table 5-14 summarize the highest 95th percentile facility-specific modeled concentrations by OES at each radial distance evaluated. The 95th percentile modeled concentrations were selected by EPA for the 1,1,2-trichloroethane ambient air assessment to ensure high-end exposures are not missed. These represent the 95th percentile modeled concentrations across the entire distribution of daily and annual average modeled concentrations at each receptor point around each radial distance for all 29 TRI reporting facilities evaluated.

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Table 5-13. Highest 95th Percentile Modeled Concentration ($\mu\text{g}/\text{m}^3$) by OES (20 meters to 750 meters)

OES	# of Facilities in OES	30	60	100	250	500	750
Manufacturing as a byproduct	13	114.2	41.1	20.2	4.9	1.6	0.9
Processing as a reactant (intermediate)	4	10.1	5.4	2.8	0.7	0.2	0.1
Open top vapor degreasing	1	5.1	2.8	1.4	0.4	0.2	0.1
Waste handling, treatment, and disposal (incineration)	5	4.0	1.9	1.0	0.3	0.1	0.1
Waste handling, treatment, and disposal (landfill)	6	3.3	1.6	0.7	0.1	0.04	0.02
OES = occupational exposure scenario							

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Table 5-14. Highest 95th Percentile Modeled Concentration (ug/m³) by OES (1,000 meters to 50,000 meters)

OES	# of Facilities in OES	1,000	2,500	5,000	10,000	25,000	50,000
Manufacturing as a byproduct	13	5.6E-01	1.4E-01	4.9E-02	1.7E-02	4.3E-03	1.5E-03
Processing as a reactant (intermediate)	4	7.8E-02	1.8 E-02	5.8E-03	1.9E-03	4.3E-04	1.4E-04
Open top vapor degreasing	1	8.4E-02	3.2 E-02	1.4E-02	6.1E-03	1.6E-03	6.0E-04
Waste handling, treatment, and disposal (incineration)	5	3.0E-02	6.8E-03	2.2E-03	7.3E-04	1.7E-04	5.8E-05
Waste handling, treatment, and disposal (landfill)	6	1.3E-02	2.8E-03	8.7E-04	2.8E-04	6.6E-05	2.2E-05
OES = occupational exposure scenario							

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Since these modeled concentrations in Table 5-13 and Table 5-14 are summarized by OES, and nearly all of the OES have more than one facility included, the highest concentrations within a given OES at one radial distance may not be from the same facility as the highest modeled concentration at another radial distance (e.g., for manufacturing as a byproduct, the highest modeled concentration at 30 meters radial distance may be from Facility A, while the highest modeled concentrations at 60 and 100 meters may be from Facility B). This is purely a consequence of summarizing the results from the large output files provided by HEM into a manageable single table and does not impact on the individual facility-specific aspects of this Tier 3 analysis. None-the-less, while the concentrations as summarized in Table 5-13 and Table 5-14 may not align spatially across all radial distances, EPA's evaluation of the results (from the raw output files and supplemental files) as presented herein is conducted on a facility-by-facility basis and therefore do align spatially.

Table 5-15 and Table 5-16 summarize findings where modeled concentrations presented in Table 5-13 and Table 5-14 result in calculated risk estimates less than the relative benchmark for chronic non-cancer effects (Table 5-15) or greater than the relative benchmark for cancer effects (Table 5-16). Findings are presented by OES and distance and used to inform whether additional, more refined analyses are necessary or warranted.

Conclusions from this Tier 3 Radial Distance Analysis

Chronic non-cancer effects (general population): Inhalation exposure of the general population via the ambient air pathway resulting from industrial releases of 1,1,2-trichloroethane to the ambient air showed preliminary risks for chronic non-cancer effects at multiple radial distances for all five OES out to 250 meters from the modeled release point. Therefore, EPA determined additional, refined Tier 3 analyses using a facility-specific census block analysis were necessary or warranted. The purpose of the additional, refined analyses was to determine whether one or more exposed individuals reside, and therefore may be exposed to 1,1,2-trichloroethane releases, in areas where modeled concentrations resulted in calculated risk estimates less than the benchmark (MOE) for chronic non-cancer effects due to industrial releases of 1,1,2-trichloroethane from TRI reporting facilities to the ambient air.

Cancer effects (general population): Inhalation exposure of the general population via the ambient air pathway resulting from industrial releases of 1,1,2-trichloroethane to the ambient air showed preliminary risks for cancer at multiple radial distances for all five OES out to 1,000 meters from the modeled release point. Therefore, EPA determined additional, refined Tier 3 analyses using a facility-specific census block analysis were necessary or warranted. The purpose of the additional, refined analyses was to determine whether one or more exposed individuals reside, and therefore may be exposed to 1,1,2-trichloroethane releases, in areas where modeled concentrations resulted in calculated risk estimates greater than the benchmark (MOE) for cancer effects due to industrial releases of 1,1,2-trichloroethane from TRI reporting facilities to the ambient air.

Table 5-15. Comparison: Tier 3 Calculated MOE to Relative Benchmark for Chronic Non-Cancer Effects (MOE=300)

OES	# of Facilities in OES	30	60	100	250	500	750	1,000	2,500
Manufacturing as a byproduct	13	< Benchmark				> Benchmark			
Processing as a reactant (intermediate)	4	< Benchmark			> Benchmark				
Open top vapor degreasing	1	< Benchmark		> Benchmark					
Waste handling, treatment, and disposal (incineration)	5	< Benchmark	> Benchmark						
Waste handling, treatment, and disposal (landfill)	6	< Benchmark	> Benchmark						
MOE = Margin of Exposure; OES = Occupational Exposure Scenario									

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Table 5-16. Comparison: Tier 3 Calculated Cancer Risk to Relative Benchmark for Cancer Effects (cancer risk = 1×10^{-6} ^a)

OES	# of Facilities in OES	30	60	100	250	500	750	1,000	2,500
Manufacturing as a byproduct	13	> Benchmark							< Benchmark
Processing as a reactant (intermediate)	4	> Benchmark				< Benchmark			
Use of cleaning and degreasing solvents	1	> Benchmark				< Benchmark			
Waste handling, treatment, and disposal (incineration)	5	> Benchmark			< Benchmark				
Waste handling, treatment, and disposal (landfill)	6	> Benchmark			< Benchmark				
OES = Occupational Exposure Scenario									
^a EPA uses the 1×10 ⁻⁶ benchmark for purposes of informing whether additional, more refined analyses are necessary or warranted. However, EPA considers the range of cancer risks between 1×10 ⁻⁴ and 1×10 ⁻⁶ for purposes of calculating risk estimates and risk characterization in the risk evaluation.									

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Facility-Specific Census Block Analysis Results

The facility-specific census block analysis for 1,1,2-trichloroethane utilized the TRI-Max3-noamtic_facility_max_risk_and_hi output file from the HEM which is included in the supplemental file *Draft Tier 3 Ambient Air Analysis-TRI Dataset Modeling Files* ([U.S. EPA, 2026ac](#)).

Since the 1,1,2-trichloroethane assessment utilizes the MOE approach rather than a hazard index approach for evaluating non-cancer effects, EPA back calculated the maximum modeled concentrations in a populated census from the TRI-Max3-noamtic_facility_max_risk_and_hi output file. These back-calculated exposure concentrations are then used to calculate risk estimates for chronic non-cancer effects (MOE) and cancer effects (cancer risk) to inform whether additional, more refined analyses are necessary or warranted.

Table 5-17 summarizes, by OES, the maximum modeled concentrations associated with a populated census block. The maximum modeled concentrations represent the single highest modeled concentration across all facilities categorized under the respective OES. Although summarized by OES, EPA reviewed the single maximum modeled concentrations for each of the 29 facilities evaluated for this facility-specific census block analysis. The maximum modeled concentration is used in this analysis to derive provisional risk estimates which inform if more refined analysis within an individual OES is necessary or warranted.

Table 5-17 also summarizes, by OES, the number of facilities within each OES where calculated risk estimates, based on the maximum modeled concentrations, are less than the relative benchmark for chronic non-cancer effects or greater than the relative benchmark for cancer effects. This information is used to determine whether additional, more refined analyses are necessary or warranted.

Findings for chronic non-cancer effects

EPA found the highest maximum modeled concentrations associated with a populated census block for each of the five OES evaluated resulted in calculated risk estimates (MOE) greater than or equal to the relative benchmark for chronic non-cancer effects. Since these conservative, highest maximum modeled concentrations within an OES resulted in calculated risk estimates greater than the relative benchmark for chronic non-cancer effects, all other single facility maximum modeled concentrations within an OES will also result in calculated risk estimates (MOE) greater than or equal to the relative benchmark for chronic non-cancer effects for all OES evaluated. Therefore, EPA determined additional, more refined analyses for chronic non-cancer effects was not necessary or warranted.

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Table 5-17. Maximum 95th Percentile Modeled Concentration Associated with a Populated Census Block by OES

OES	Census Block	Number of Facilities in OES			Maximum Concentration Across OES in Populated Census Block ($\mu\text{g}/\text{m}^3$)
		Total	Less than relative benchmark for chronic non-cancer effects	Greater than relative cancer benchmark for cancer effects	
Manufacturing as a byproduct at chemical manufacturing facilities	0032001012	13	0	0	3.2E-01
Processing as a reactant (intermediate)	9527021022	4	0	0	1.9E-01
Open top vapor degreasing	0709011023	1	0	1	4.9E-01
Waste handling, treatment and disposal (incineration)	0302002040	5	0	0	3.8E-03
Waste handling, treatment and disposal (landfill)	0113032028	6	0	0	1.1E-03
OES = Occupational Exposure Scenario					

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June 2026

Findings for cancer effects

EPA found the highest maximum modeled concentration associated with a populated census block for five of the six OES evaluated resulted in calculated risk estimates (cancer risk) less than or equal to the 1×10^{-6} benchmark for cancer effects. Since these conservative, highest maximum modeled concentrations within these five OES resulted in calculated risk estimates less than the relative benchmark for cancer effects, all other single facility maximum modeled concentrations within these five OES will also result in calculated risk estimates (MOE) less than or equal to the relative benchmark for cancer effects for these five OES. Therefore, EPA determined additional, more refined analyses for cancer effects were not necessary or warranted for these five OES.

EPA found the highest maximum modeled concentration associated with a populated census block for one of the six OES evaluated resulted in calculated risk estimates (cancer risk) greater than the relative benchmark for cancer effects. This OES is *Open top vapor degreasing (COU: Use of solvents (cleaning and degreasing))*. This one OES included a single facility (K&G Manufacturing) located in Minnesota. Results from both the radial distance analysis and the facility-specific census block analysis for this facility are visually shown in Figure 5-5.

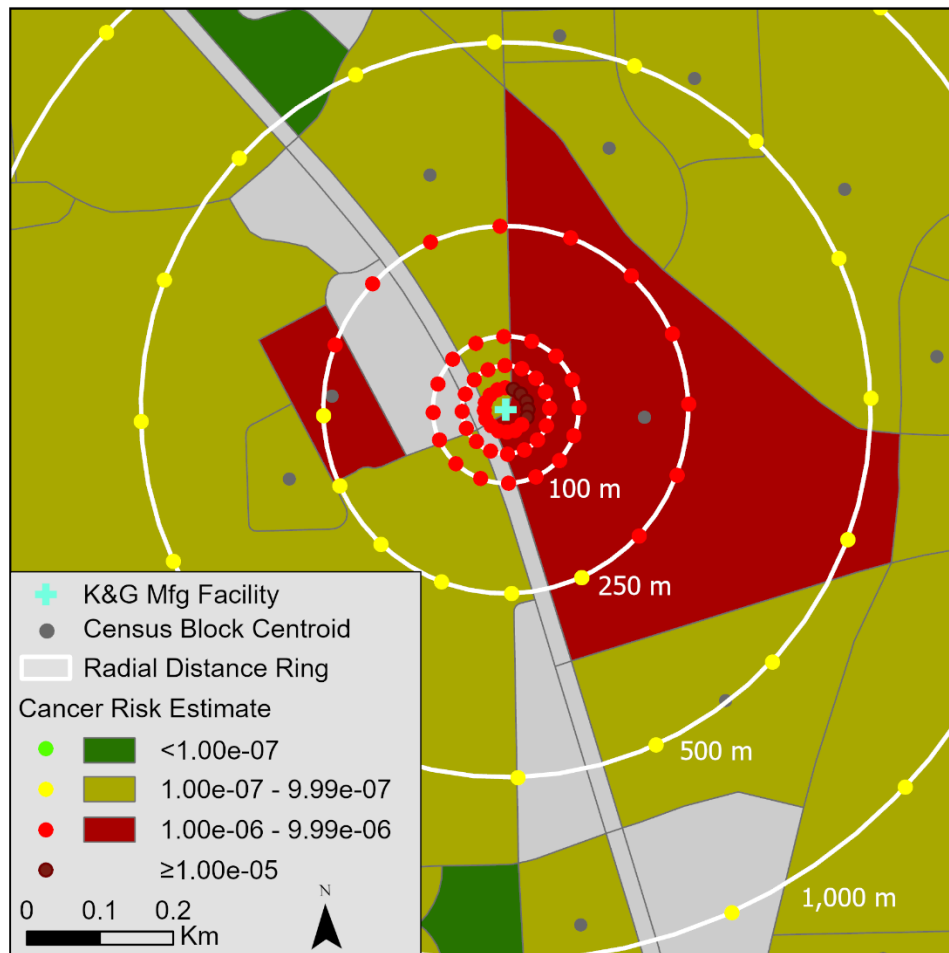


Figure 5-5. Radial and Facility-Specific Census Block Results for K&G Manufacturing.

Colored points represent calculated cancer risk estimates at each radial point. Colored polygons represent estimated cancer risk for populated census blocks as calculated at its centroid. Gray polygons represent unpopulated census blocks.

Since results from both the radial distance analysis and facility-specific census block analysis show calculated risk estimates greater than the relative benchmark for cancer effects and are associated with this single facility, EPA determined additional, more refined analysis focused on this one facility was necessary or warranted. Therefore, EPA further investigated this facility looking at annual TRI and NEI reported releases from this facility, latitude and longitude of the facility, and land use analysis around the facility. The purpose of this investigation was to determine if the maximum modeled concentration is representative of actual exposures of the general population to 1,1,2-trichloroethane from this facility's releases.

When EPA looked at the TRI reported releases for this facility, EPA found the maximum modeled concentration in Table 5-17 resulting in the calculated cancer risk estimate (cancer risk) greater than the relative benchmark for cancer effects was due to releases for the 2019 TRI reporting year. Further investigation into TRI releases across the remaining TRI reporting years considered for 1,1,2-trichloroethane (2020-2024) found this facility reported 0 releases of 1,1,2-trichloroethane for the 2020 TRI reporting year and did not report any releases of 1,1,2-trichloroethane for the 2021-2024 TRI reporting years. Cross-checking this facility in the 2017 and 2020 NEI release datasets considered, EPA found the facility reported 1,1,2-trichloroethane releases in the 2017 NEI but did not report any releases of 1,1,2-trichloroethane in the 2020 NEI.

EPA contacted this facility regarding its use of 1,1,2-trichloroethane as a cleaning and degreasing solvent. Through that discussion, EPA learned the facility used 1,1,2-trichloroethane as a cleaning and degreasing solvent between 2017 and 2019 but ceased use of 1,1,2-trichloroethane after that time for business reasons. This statement aligns with what was found through EPA's investigation of the TRI and NEI release datasets where there were no reported releases from this facility as of 2020. Based on this information, EPA concluded that although TRI reported releases of 1,1,2-trichloroethane in 2019 resulted in calculated risk estimates (cancer risk) greater than the relative benchmark for cancer effects, the discontinued use of 1,1,2-Trichloroethane after 2019 by this facility eliminated exposure (and associated risk estimates) of the general population to 1,1,2-Trichloroethane from this facility after 2019.

When EPA investigated the K&G Manufacturing facility's TRI reported latitude and longitude and conducted a land use analysis for this facility around the TRI reported latitude and longitude, EPA found there did not appear to be a facility at that location. EPA then expanded the land use analysis to include a larger land area and found the actual facility location appeared to be more than 2,000 meters (2 km) south of the TRI reported latitude and longitude as shown in Figure 5-6. While this does not impact the radial distance analyses associated with this facility the Tier 3 facility-specific census block analyses for this facility relies heavily on the reported latitude and longitude. As described in Appendix F.2.3, a slight shift of latitude and longitude for a given facility can impact the overall findings tied to the facility-specific census block analyses. While the 2 km shift south for the actual facility location and modeled release point does not change the overall maximum modeled concentration resulting in a calculated risk estimate (cancer risk) greater than the relative benchmark for cancer effects, it significantly changes the findings relative to the census blocks impacted by this facility's releases and the number of individuals exposed. The changes associated with census blocks impacted by this facility's releases and number of individuals exposed are discussed in Section 5.2.4 when EPA conducts a limited refined analysis and modeling using the 2017 and 2020 NEI release datasets.

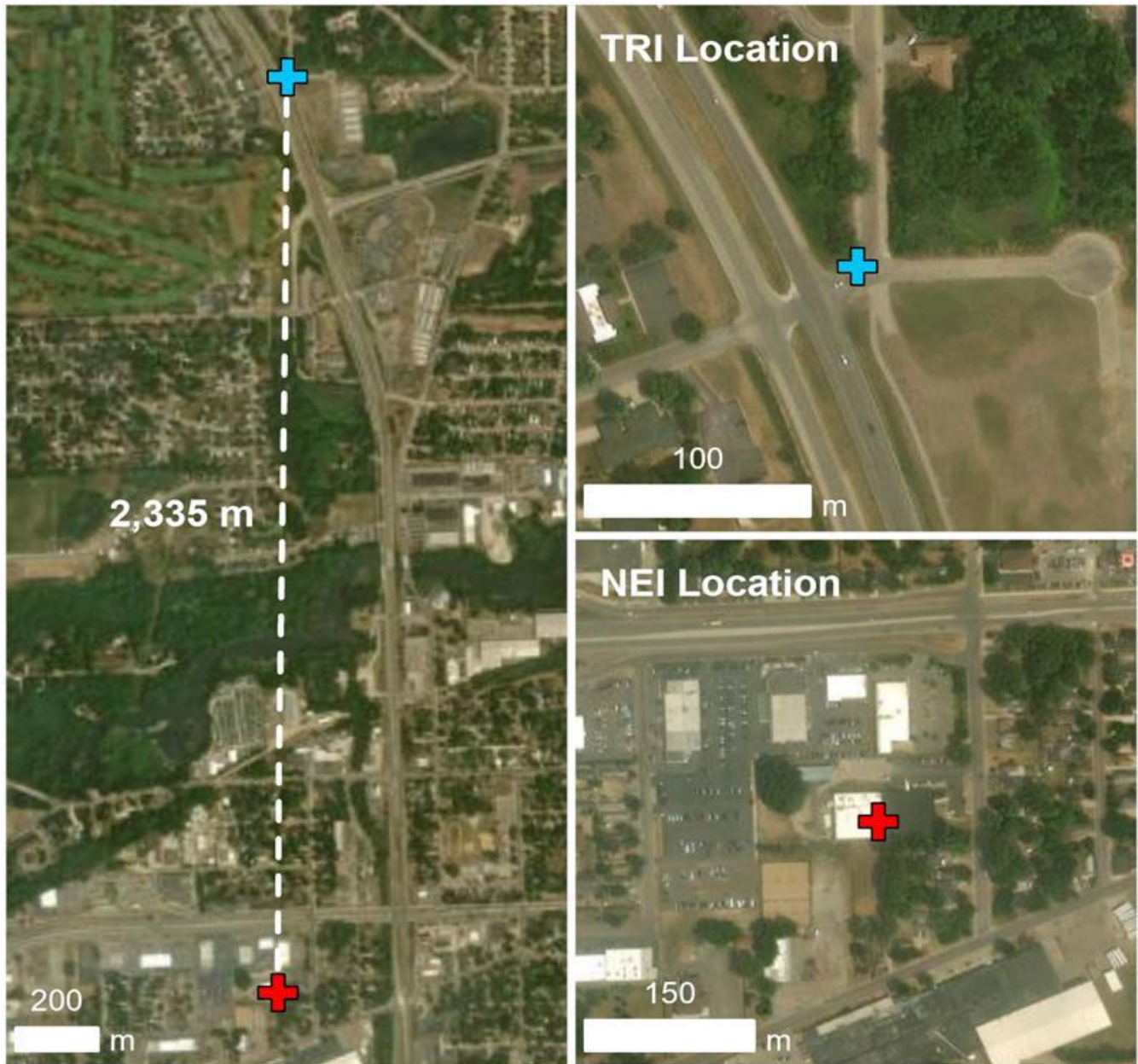


Figure 5-6. Single Facility Location vs. TRI-Reported Latitude and Longitude

Conclusions from this Tier 3 Facility-Specific Census Block Analysis

Chronic non-cancer effects (general population): Inhalation exposure of the general population via the ambient air pathway resulting from industrial releases of 1,1,2-trichloroethane to the ambient air did not show preliminary risks for chronic non-cancer effects for any of the six OES (and associated COUs) evaluated. This is based on consideration of the conservative aspects of the Tier 3 facility-specific census block analysis and the finding that none of the highest maximum modeled concentrations in a populated census block resulted in calculated risk estimates (MOEs) less than the relative benchmark for chronic non-cancer effects. Since these conservative, highest maximum modeled concentrations within each OES (and associated COUs) did not result in calculated risk estimates less than the relative benchmark for chronic non-cancer effects, all other single facility maximum modeled concentrations within an OES will also not result in calculated risk estimates (MOE) less than or equal to the relative benchmark for chronic non-cancer effects for all OES (and associated COUs) evaluated. Therefore, EPA determined additional, more refined analyses for chronic non-cancer effects was not necessary or warranted.

Cancer effects (general population): Inhalation exposure of the general population via the ambient air pathway resulting from industrial releases of 1,1,2-trichloroethane to the ambient air did not show preliminary risks for cancer effects for five of the six OES (and associated COUs) evaluated. This is based on consideration of the conservative aspects of the Tier 3 facility-specific census block analysis and the finding that none of the highest maximum modeled concentrations in a populated census block for those five OES (and associated COUs) resulted in calculated risk estimates (cancer risk) greater than the relative benchmark for cancer effects. Since these conservative, highest maximum modeled concentrations within each OES (and associated COUs) did not result in calculated risk estimates greater than the relative benchmark for cancer effects, all other single facility maximum modeled concentrations within those five OES (and associated COUs) will also not result in calculated risk estimates cancer risk) greater than the relative benchmark for cancer effects for those five OES (and associated COUs). Therefore, EPA determined additional, more refined analyses for cancer effects was not necessary or warranted for those five OES (and associated COUs).

Inhalation exposure of the general population via the ambient air pathway resulting from industrial releases of 1,1,2-trichloroethane to the ambient air did show preliminary risks for cancer effects for one of the five OES (and associated COUs) evaluated (OES: Open-top vapor degreasing; COU: Use of solvents (cleaning and degreasing)). This is based on consideration of the conservative aspects of the Tier 3 facility-specific census block analysis and the finding that the highest maximum modeled concentrations in a populated census block for that OES (and associated COU) resulted in calculated risk estimates (cancer risk) greater than the relative benchmark for cancer effects. Based on this finding, EPA further investigated this OES to ensure the findings are representative of current general population exposures. This investigation found the OES was *Open top vapor degreasing* and the associated COU was *Use of solvents (cleaning and degreasing)*. There was a single facility (K&G Manufacturing) categorized into this OES (and associated COU). EPA's investigation therefore focused on the K&G Manufacturing facility and revealed the facility discontinued use of 1,1,2-trichloroethane after 2019 for business reasons. EPA's investigation into reported releases of 1,1,2-trichloroethane from this facility in both the TRI and NEI datasets support this claim, revealing after 2019 the facility no longer reported any releases of 1,1,2-trichloroethane to TRI or NEI in any year currently available. Although preliminary risks were identified between 2017 and 2019, the discontinued use of 1,1,2-trichloroethane after 2019 eliminated any releases, exposures, or preliminary risks to the general population from 1,1,2-trichloroethane from this facility after 2019. Since this is the only facility in this OES (and associated COU), there are no longer preliminary risks under this OES (and associated COU). Therefore, EPA determined additional, more refined analysis for cancer effects was not necessary or warranted for this

OES (and associated COU).

Overall Conclusion: Facility-specific census block analysis: Based on the findings of the facility-specific census block analysis for 1,1,2-trichloroethane, EPA determined additional, more refined analysis were not necessary or warranted for either chronic non-cancer effects or cancer effects. Additionally, EPA determined the Tier 3 TRI Dataset-Facility-specific Census Block Analysis is the final tier of analysis for chronic non-cancer and cancer effects for general population exposures. Therefore, the modeled annual average concentrations from the Tier 3 analyses, which is representative of a chronic long term and lifetime exposure concentration for individuals who spend their entire lives in the location where the modeled concentration occurs, will be carried into the *Draft Risk Evaluation for 1,1,2-Trichloroethane* ([U.S. EPA, 2026r](#)) for purposes of deriving risk estimates and informing risk determination and regulatory decision-making for chronic non-cancer and cancer effects from inhalation exposure of the general population to 1,1,2-trichloroethane via the ambient air pathway.

Multi-Facility Aggregate Analyses Results

EPA conducted a multi-facility aggregate analysis using the HEM based on the TRI release dataset results from the HEM. The purpose of this multi-facility aggregate analysis was to capture total exposures from all facilities impacting a given census block or general population exposure rather than a single facility impact based on the radial distance or facility-specific census block analyses. The multi-facility aggregate analysis is accomplished through post-processing actions provided for in the HEM user interface. Results include multi-facility aggregate exposure concentrations across all populated census blocks within the modeling domain around all 29 TRI facilities evaluated. It also includes a demographic and population breakdown which can be used to inform exposures, characterization, and PESS. Based on the facility-specific census block analysis findings, this multi-facility aggregate census block analysis focuses on cancer effects and does not evaluate or summarize chronic non-cancer effects.

As with the facility-specific census block analyses, multi-facility aggregate analysis required back calculating exposure concentrations from the MIR-HI_all receptors output file results from the HEM post-processing work. These exposure concentrations represent the multi-facility aggregate modeled concentrations to which the general population are exposed. The multi-facility aggregate modeled concentrations are modeled at the centroid of each census block within the modeling domain and may not represent direct exposure to everyone residing or frequenting locations within the census block. This potential limitation is discussed in detail in the methodology section of Appendix F.2.3.

The multi-facility aggregate modeled concentrations are used to calculate risk estimates which are then compared to the relative benchmark for cancer effects to inform whether additional, more refined analyses are necessary or warranted. Findings from this comparison show three census blocks where the multi-facility aggregate modeled concentrations resulted in calculated risk estimates greater than the relative benchmark for cancer effects. These are presented in Table 5-18. Since aggregated exposures are not attributable to a single OES/COU, the results are summarized by census block.

Table 5-18. Multi-Facility Aggregate Modeled Concentrations Within a Populated Census Block

FIPS	Block ID	Longitude	Latitude	Population	Concentration (ug/m3)	# of Facilities Impacting Census Block	Distance of Census Block from Nearest Facility (m)
22019	0032001012	-93.2957	30.2334629	9	0.34	2	1,392
27131	0709011023	-93.2904	44.3140972	52	0.49	1	190
27131	0709013015	-93.2958	44.3144671	61	0.35	1	238

Two of the three census blocks in Table 5-18 (Block IDs: 0709011023 and 0709013015) are associated with the same single facility (K&G) in Minnesota described in the facility-specific census block analysis. As shown in Figure 5-3, there are no other TRI reporting facilities within 50 km of the K&G facility. Therefore, the multi-facility aggregate modeled concentrations are equal to the facility-specific modeled concentration in each impacted census block. The centroids of these two census blocks are located 190 and 238 meters from the modeled release point (facility center based on the TRI reported latitude and longitude). As shown in Figure 5-5, the findings for the centroids of these census blocks align with findings from the radial distance analysis as the centroids fall between the 100- and 250-meters radial distance rings modeled in the radial distance analyses. As described in the facility-specific analysis discussion, further investigation into this facility revealed it discontinued using 1,1,2-trichloroethane in 2019 and therefore general population exposures to 1,1,2-trichloroethane from this facility were eliminated as of 2020.

The third census block (Block ID: 0032001012) in Table 5-18 is associated with two facilities located in Louisiana. Based on the HEM output files, the two facilities impacting this census block were facility IDs 70669PPGNDCOLUM (PPG) and 70669GRGGL1600V (GRG). Both of these facilities are categorized under the same *OES: Manufacturing as a byproduct at chemical manufacturing facilities (COU: Domestic manufacturing)*. The PPG facility is north of the GRG facility and the modeled facility centers are located approximately 3,700 meters apart. The centroid of the impacted census block is located 1,392 meters northeast of the modeled release point for the PPG facility. Based on the 2020 census data and the HEM output file, nine individuals reside within this single impacted census block.

Since the multi-facility aggregate modeled concentration in census block 0032001012 resulted in calculated risk estimates greater than the relative benchmark for cancer effects, EPA determined additional, refined analyses was necessary or warranted, focusing on these two facilities. The additional, refined analyses included investigation into various physical characteristics and location of the two facilities, relative contribution from each facility to the modeled aggregate concentration, and a detailed evaluation of individual facility releases and associated modeling of those releases.

To begin, neither the PPG facility nor the GRG facility had individual modeled concentrations from the facility-specific census block analysis which resulted in calculated risk estimates greater than the relative benchmark for cancer effects. The single maximum modeled concentration from the facility-specific census block analysis for the PPG facility was $3.17\text{E}-01 \mu\text{g}/\text{m}^3$ and occurred in Block ID: 0032001012 (the same Block ID as presented in Table 5-18). The single maximum modeled concentration from the facility-specific census block analysis for the GRG facility was $7.9\text{E}-02 \mu\text{g}/\text{m}^3$ and occurred in Block ID: 0027022003. Although not in the same census block, these facility-specific concentrations show the PPG facility's single maximum modeled concentration is four times greater than the GRG facility's indicating the PPG facility is expected to be the primary contributor to the multi-facility aggregate modeled concentration.

Since the multi-facility aggregate analysis involves post-processing of individual facility-specific census block files, EPA looked in the facility-specific census block output files for both the PPG and GRG facilities to identify the maximum modeled concentration in Block ID: 0032001012. As stated above, for PPG, this concentration was $3.17\text{E}-01 \mu\text{g}/\text{m}^3$. For the GRG facility, the modeled concentration in Block ID: 0032001012 was $2.69\text{E}-02 \mu\text{g}/\text{m}^3$. Based on these concentrations, the PPG facility PPG contributes approximately ninety-two percent of the total multi-facility aggregate exposure presented in Table 5-18, while the GRG facility contributes the remaining eight percent. This indicates one facility (PPG) is driving the multi-facility aggregate modeled concentration which results in calculated risk estimates

greater than or equal to the relative benchmark for cancer effects. This aligns with other aggregate analyses conducted where one or two facilities tend to drive multi-facility aggregate modeled concentrations (and associated calculated risk estimates), while other facilities which may be in proximity tend to have marginal contributions.

Considering the conservative nature of this Tier 3 analysis, EPA acknowledges the multi-facility aggregate concentration presented in Table 5-18 for the PPG/GRG facilities may overestimate exposures to the general population in that census block. This conservatism, in part, is due to EPA modeling the single highest fugitive and stack releases for each facility across all five TRI reporting years evaluated for this Tier 3 analysis (2019 – 2023) and EPA's assumption that these single highest releases align temporally (occur during the same year). To address the potential overestimate of exposures based on these conservative assumptions, EPA compared the five years of reported releases for the PPG and GRG facilities. The purpose of this comparison is to check the temporal alignment of the TRI reported releases modeled for these two facilities

Table 5-19 summarizes the annual releases for the PPG and GRG facilities for all five years of TRI releases considered and aligns the reported releases temporally. The highest fugitive and stack releases modeled for this Tier 3 analysis for each facility are highlighted in yellow and show none of the highest releases modeled occurred in the same year. Since both the facility-specific census block analysis and the multi-facility aggregate census block analysis assume the releases occurred the same year, the modeled concentration in Table 5-18 represents an overestimate of exposure to the general population in that census block.

Table 5-19. Annual Stack and Fugitive Releases for Each Facility Impacting Block 32001012

Facility ID	TRI Reporting Year	Total Fugitive Releases (kg/yr) ^a	Total Stack Releases (kg/yr)
70669GRGGL1600V	2019	90	0
	2020	86	0
	2021	1,269	0
	2022	115	0
	2023	113	0
	2024	113	0
70669PPGNDCOLUM	2019	4,173	308
	2020	4,309	322
	2021	4,128	635
	2022	4,173	2,132
	2023	4,264	2,404
	2024	4,082	2,585
^a Bolded values represent the highest reported releases across the original five years of release data modeled for the initial analysis (2019 through 2023). Although fugitive releases for the PPG facility were highest in 2024, those releases were not final at the time of the initial analysis for which results are presented but were modeled once finalized and do not change the overall findings (when temporally aligned, none of the modeled concentrations (facility-specific or aggregate) result in modeled concentrations greater than the benchmark for cancer effects).			

Since none of the releases modeled aligned temporally, EPA conducted a refined multi-year analysis

using the HEM for just these two facilities. The refined multi-year analysis included both a facility-specific census block analysis and a multi-facility aggregate census block analysis for cancer effects. These multi-year analyses modeled the temporally aligned releases for these two facilities in HEM for each of the 5 years of TRI data evaluated. This refinement removes the conservative assumptions associated with modeling the highest release across all years and the assumption they occurred the same year. The results, therefore, are representative of actual exposures to the general population based on the actual releases reported for the respective years. EPA further refined this analysis by setting the modeling distance to 50,000 meters (50 km) for these HEM runs instead of letting the HEM interpolate estimates beyond 3,000 meters. This provides EPA with direct modeled concentrations across the entire modeling domain.

Table 5-20 summarizes results from the additional, refined multi-year facility-specific census block analysis summarized by year for both PPG and GRG. These values are extracted from the max risk and hi output files from the HEM and represent the single maximum facility-specific modeled concentrations across all census blocks within the modeling domain of each facility and are aligned temporally. Based on these results, the maximum concentration for each of the five years occurs in the same census block as found with the original facility-specific census block analysis for PPG and GRG. When these concentrations were used to calculate risk estimates for each of the five years, none of the temporally aligned modeled concentrations for either facility resulted in calculated risk estimates greater than the relative benchmark for cancer effects. This was the same as the findings from the original facility-specific census block analysis.

Table 5-21 summarizes results from the additional, refined multi-year, multi-facility aggregate census block analysis for both facilities, by year. These values are extracted from the MIR-HI all receptors output files from the HEM and represent the two highest maximum multi-facility aggregate modeled concentrations across all census blocks within the modeling domain for each facility and are aligned temporally. Based on these results, the maximum multi-facility aggregate modeled concentrations occurred in the same two census blocks for each of the five years evaluated (Block IDs: 0032001012 and 0032001038). Block ID: 0032001012 had the highest multi-facility aggregate modeled concentrations for each of the five years evaluated and was the same Block ID with the highest multi-facility aggregate modeled concentration in the original multi-facility aggregate census block analysis. Additionally, the refined multi-year, multi-facility aggregate modeled concentrations in Block ID: 0032001012 presented in Table 5-21 were about 1.5 to 2 times greater than the next highest multi-facility aggregate modeled concentrations in Block ID: 0032001038 across all five years of TRI releases evaluated. When the multi-year, multi-facility aggregate modeled concentrations were used to calculate risk estimates for each of the five years, none of the temporally aligned, multi-facility aggregate modeled concentrations resulted in calculated risk estimates greater than the relative benchmark for cancer effects. This is a different finding than the original multi-facility aggregate census block analysis, and supports EPA's determination that additional, refined analysis was necessary or warranted to ensure the multi-facility aggregate census block analysis provides representative exposures of the general population to 1,1,2-trichloroethane from these two facilities.

Table 5-20. Modeled Facility-Specific Maximum Concentration for Cancer Effects by Year and Census Block (PPG and GRG)

Year	Facility ID	Concentration ($\mu\text{g}/\text{m}^3$)	Census Block ID	Latitude	Longitude
2019	70669GRGGL1600V	0.01	0027022003	30.2437457	-93.2955104
	70669PPGNDCOLUM	0.25	0032001012	30.2334629	-93.29567
2020	70669GRGGL1600V	0.01	0027022003	30.2437457	-93.2955104
	70669PPGNDCOLUM	0.26	0032001012	30.2334629	-93.29567
2021	70669GRGGL1600V	0.07	0027022003	30.2437457	-93.2955104
	70669PPGNDCOLUM	0.26	0032001012	30.2334629	-93.29567
2022	70669GRGGL1600V	0.01	0027022003	30.2437457	-93.2955104
	70669PPGNDCOLUM	0.30	0032001012	30.2334629	-93.29567
2023	70669GRGGL1600V	0.01	0027022003	30.2437457	-93.2955104
	70669PPGNDCOLUM	0.31	0032001012	30.2334629	-93.29567

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Table 5-21. Modeled Multi-Facility Aggregate Maximum Modeled Concentration by Year and Census Block (PPG and GRG)

Year	Census Block ID	Population	Latitude	Longitude	Concentration (µg/m3)
2019	0032001012	9	30.2334629	-93.29567	0.25
	0032001038	8	30.2161903	-93.303924	0.18
2020	0032001012	9	30.2334629	-93.29567	0.26
	0032001038	8	30.2161903	-93.303924	0.18
2021	0032001012	9	30.2334629	-93.29567	0.28
	0032001038	8	30.2161903	-93.303924	0.19
2022	0032001012	9	30.2334629	-93.29567	0.30
	0032001038	8	30.2161903	-93.303924	0.21
2023	0032001012	9	30.2334629	-93.29567	0.32
	0032001038	8	30.2161903	-93.303924	0.22

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Conclusions from the Tier 3 Multi-facility Aggregate Census Block Analysis

Cancer effects (general population): Inhalation exposure of the general population via the ambient air pathway resulting from industrial releases of 1,1,2-trichloroethane to the ambient air showed preliminary risks for cancer effects for two of the six OES (and associated COUs) evaluated. This is based on consideration of the conservative aspects of the Tier 3 multi-facility aggregate census block analysis and the finding that a total of three census blocks where maximum aggregate modeled concentrations at the centroid of these populated census blocks resulted in calculated risk estimates (cancer risk) greater than the relative benchmark for cancer effects. Therefore, EPA determined investigation and additional, refined analyses were necessary or warranted focusing on these three census blocks.

Two of the three census blocks were impacted by a single facility (K&G Manufacturing) categorized under the *OES: Open top vapor degreasing (COU: Industrial use-solvents (for cleaning and degreasing))* with no other facilities within 50 km. Further investigation into this facility found the facility discontinued use of 1,1,2-trichloroethane after 2019 which effectively eliminated any releases and exposures (and associated risks) of the general population to 1,1,2-trichloroethane from the K&G Manufacturing facility. Therefore, EPA determined additional, more refined analysis was not necessary for this facility under the *OES: Open top vapor degreasing (COU: Industrial use-solvents (for cleaning and degreasing))*.

The third census block was impacted by two facilities (PPG and GRG) categorized under the *OES Manufacturing as a byproduct at chemical manufacturing facilities (COU: Domestic manufacture)* with no other facilities within 50 km. Further investigation into these two facilities found the assumption that reported releases occurred the same year resulted in an overly conservative modeled concentration at the centroid of the impacted census block as none of the releases from PPG or GRG occurred the same year. Temporally aligning the releases and re-running the multi-facility aggregate census block analysis for these two facilities resulted in representative aggregate modeled concentrations at the centroid of the impacted census block across all five years of releases considered. Temporally aligning the releases also found there were no longer any multi-facility aggregate modeled concentrations at the centroid of the impacted census block which resulted in calculated risk estimates greater than the relative benchmark for cancer effects. Therefore, EPA determined additional, more refined analysis was not necessary for these facilities under the *OES: Manufacturing as a byproduct at chemical manufacturing facilities (COU: Domestic manufacture)*.

Overall Conclusions for the Tier 3 Analysis-TRI Release Dataset

The multiple lines of evidence together from this Tier 3 Analysis-TRI Release Dataset including radial distance analysis, facility-specific census block analysis, multi-facility aggregate census block analysis, and detailed investigation into certain findings (with additional more refined Tier 3 analyses where necessary or warranted) led EPA to the following conclusions regarding chronic non-cancer and cancer effects associated with general population exposures to 1,1,2-trichloroethane from industrial releases of 1,1,2-trichloroethane via inhalation of ambient air.

Chronic non-cancer effects: EPA determined the Tier 3 Analysis-TRI Release Dataset was the final tier of analysis needed or warranted to evaluate inhalation exposure of the general population via the ambient air pathway resulting from industrial releases of 1,1,2-trichloroethane to the ambient air for chronic non-cancer effects. Results from the radial distance analysis found multiple facilities and OES with modeled concentrations which resulted in calculated risk estimates less than the relative benchmark for chronic non-cancer effects as far as 250 meters from modeled release points. However, further refinement using the facility-specific census block analysis found there were no conservative, upper bounding modeled annual average concentrations in any populated census block which resulted in

calculated risk estimates less than the relative benchmark for chronic non-cancer effects. This indicated while there were exposures which resulted in calculated risk estimates less than the relative benchmark for chronic non-cancer effects at radial distances as far as 250 meters from the release point, there was no general population residing or frequenting locations at those distances. Therefore, EPA determined the Tier 3-TRI release dataset analysis is the final tier of analysis needed or warranted for this 1,1,2-trichloroethane general population exposure assessment for the ambient air pathway for chronic non-cancer effects. Results from the Tier 3-TRI Release Dataset analyses for chronic non-cancer effects will be carried into the *Draft Risk Evaluation for 1,1,2-Trichloroethane* ([U.S. EPA, 2026r](#)) and relied upon to derive risk estimates, characterize risks, and inform risk determination and regulatory decision-making.

Cancer effects: EPA determined the Tier 3 Analysis-TRI Release Dataset was the final tier of analysis needed or warranted to evaluate inhalation exposure of the general population via the ambient air pathway resulting from industrial releases of 1,1,2-trichloroethane to the ambient air for cancer effects based on the radial distance and facility-specific census block analyses. Results from the radial distance analysis found multiple facilities and OES with modeled concentrations which resulted in calculated risk estimates greater than the relative benchmark for cancer effects as far as 1,000 meters from modeled release points. Further refinement using the facility-specific census block analysis found one OES: *Open top vapor degreasing (COU: Industrial use-solvents (for cleaning and degreasing))* where facility-specific modeled concentrations resulted in calculated risk estimates greater than the relative benchmark for cancer effects. This OES is associated with a single facility and further investigation into that single facility found it discontinued use of 1,1,2-trichloroethane after 2019. The discontinued use of 1,1,2-trichloroethane by this facility eliminated any releases and exposures of the general population to 1,1,2-trichloroethane after 2019 from this facility. Therefore, EPA determined the Tier 3-TRI release dataset analysis is the final tier of analysis needed or warranted for this 1,1,2-trichloroethane general population exposure assessment for the ambient air pathway for cancer effects. Results from the Tier 3-TRI Release Dataset analyses for cancer effects will be carried into the *Draft Risk Evaluation for 1,1,2-Trichloroethane* ([U.S. EPA, 2026r](#)) and relied upon to derive risk estimates, characterize risks, and inform risk determination and regulatory decision-making.

EPA determined the Tier 3 Analysis-TRI Release Dataset was the final tier of analysis needed or warranted to evaluate aggregate inhalation exposure of the general population via the ambient air pathway resulting from industrial releases of 1,1,2-trichloroethane to the ambient air for cancer effects based on the multi-facility aggregate analyses conducted. Results of the multi-facility aggregate census block analysis found two OES where multi-facility aggregate modeled concentrations resulted in calculated risk estimates greater than the relative benchmark for cancer effects. The first OES was OES: *Open top vapor degreasing (COU: Industrial use-solvents (for cleaning and degreasing))*. This OES is associated with the same single facility described in the facility-specific census block analysis that discontinued use of 1,1,2-trichloroethane after 2019. There were no other facilities within 50 km of this single facility and the discontinued use of 1,1,2-trichloroethane eliminated releases and exposures of the general population to 1,1,2-trichloroethane after 2019 from this facility. The second OES was OES: *Manufacturing as a byproduct at chemical manufacturing facilities (COU: Domestic manufacture)*. This OES is associated with two facilities (categorized under the same OES). Investigation into releases from these two facilities found the original Tier 3 assumption that modeled releases occurred in the same year resulted in overly conservative aggregate modeled concentrations from these two facilities since none of the releases occurred in the same year. EPA conducted additional, refined multi-facility aggregate census block analyses for these two facilities which temporally aligned annual releases across all five years of release data considered. Findings from this refinement showed that when the facility releases were aligned temporally, there were no multi-facility aggregate modeled concentrations in any populated census block within the modeling domain which resulted in calculated risk estimates greater

than the relative benchmark for cancer effects. Therefore, EPA determined the Tier 3-TRI release dataset analysis is the final tier of analysis needed or warranted for this 1,1,2-trichloroethane aggregate general population exposure assessment for the ambient air pathway for cancer effects. Results from the Tier 3-TRI Release Dataset analyses for cancer effects will be carried into the *Draft Risk Evaluation for 1,1,2-Trichloroethane* (U.S. EPA, 2026r) and relied upon to derive risk estimates, characterize risks, and inform risk determination and regulatory decision-making.

5.2.3.3 Evidence Integration and Weight of Scientific Evidence

EPA acknowledges the inputs used and assumptions made for the modeling in this Tier 3 analysis-TRI Release Dataset remain conservative, upper bounding (95th percentile) estimates of concentrations to which the general population are exposed. However, the conservatism for this Tier 3 analysis are reduced, relative to the Tier 1 and Tier 2 analyses, since the Tier 3 analysis uses local meteorological data, site-specific industry reported releases, local topography and elevation, and several other factors as model inputs. Additional refinements made throughout the Tier 3 analysis-TRI Release Dataset further reduce conservative assumptions through temporal alignment of releases where necessary or warranted, rerunning models for those temporally aligned releases, and site-specific land use analyses. Through these refinements, results are more representative of actual general population exposures relative to the Tier 1, Tier 2, and initial Tier 3 analyses. Additionally, through these refinements, EPA's confidence in the exposure scenarios evaluated in the Tier 3 Analysis-TRI Release Dataset increases to moderate. EPA's confidence in the results of this Tier 3 analysis remain robust as the refinements ensure high-end releases, exposures, and associated risks are not missed, the analysis remains health protective and provide more representative actual general population exposures.

Overall, EPA has robust confidence in the conclusion reached from this Tier 3 analysis that additional, refined analysis is not necessary for purposes of exposure characterization, deriving risk estimates with these results, use of these results for risk determination, and regulatory decision-making. None-the-less, EPA conducts a limited refinement to the Tier 3 analysis-TRI Release Dataset by using NEI reported release data (see Section 5.2.4) to further support the results found and conclusions reached.

5.2.4 Tier 3 Analysis-NEI Release Datasets

This Tier 3 Analysis-NEI Release Dataset was conducted to further support the Tier 3 Analysis-TRI Release Dataset results. This Tier 3 Analysis-NEI Release Dataset is a limited refinement to ensure higher releases which may be reported to NEI datasets (but not TRI) and associated exposures were not missed. This analysis compares the top ten reported releases across the three release datasets considered (TRI, 2017 NEI, and 2020 NEI) (Section 5.2.4.2) and uses the HEM to conduct facility-specific census block analyses using the top ten reported releases to the 2017 and 2020 NEI release datasets (Section 5.2.4.3). This Tier 3 Analysis-NEI Release Dataset focuses on cancer effects. This Tier 3 Analysis-NEI Release Dataset does not include discussion of the results from the radial distance analysis (although included in the modeled results) and does not consider of multi-facility aggregate census block analyses for the NEI datasets since the modeled releases are limited to the top ten releases in the 2017 and 2020 NEI datasets and not entire NEI datasets (over 420 facilities in each NEI release dataset).

Supporting Documents, Files, Results

Appendix F.2.3: Methodology, strengths, limitations, assumptions, uncertainties

Supplemental Files:

- A. *Modeling Files: Draft Tier 3 Ambient Air Analysis-TRI Dataset Modeling Files for 1,1,2-Trichloroethane* ([U.S. EPA, 2026ac](#))
- B. *All Results: Draft Tier 3 Ambient Air Analysis-TRI Dataset Results Summary for 1,1,2-Trichloroethane* ([U.S. EPA, 2026ab](#))
- C. *Additional Information-Read Me File: Draft Tier 3 Ambient Air Analysis-TRI Dataset Read Me for 1,1,2-Trichloroethane* ([U.S. EPA, 2026z](#))
- D. *All Releases: Tier 3 Ambient Air Analysis TRI and NEI Release Data summary by OES* ([U.S. EPA, 2026ad](#))

5.2.4.1 Summary of Findings

Results from the Tier 3 Analysis-NEI Release Datasets did not change the findings or conclusions reached in the Tier 3 Analysis-TRI Release Dataset but provide additional support for the conclusions reached in the Tier 3 Analysis-TRI Release Dataset. Therefore, EPA determined the Tier 3 Analysis-TRI Release Dataset remains the final tier of analysis needed or warranted for this 1,1,2-trichloroethane general population exposure assessment for the ambient air pathway. Results from the Tier 3 Analysis-TRI Release Dataset will be carried into the *Draft Risk Evaluation for 1,1,2-Trichloroethane* ([U.S. EPA, 2026r](#)) and relied upon to derive risk estimates, characterize risks, and inform risk determination and regulatory decision-making.

5.2.4.2 Methods and Inputs

Release Comparison

EPA compared the top 10 facility-wide reported releases across all three datasets evaluated (TRI, 2017 NEI, and 2020 NEI). These comparisons are presented in Table 5-22 (fugitive), Table 5-23 (stack), and Table 5-24 (total).

Generally, when the release datasets were compared the TRI dataset captured a smaller number of facilities but still captured the range of releases reported to the 2017 and 2020 NEI datasets. Additional investigation into the individual release datasets found while the NEI datasets capture many more facilities than TRI, the majority of NEI facilities reported very low releases of 1,1,2-trichloroethane (less than 10 kg/yr). Considering this and the findings from the Tier 3 Analysis-TRI Release Dataset, EPA concluded the TRI dataset for the Tier 3 analysis of 1,1,2-trichloroethane was representative of and captures results that would be found if either of the NEI datasets were modeled.

EPA acknowledges there was limited overlap within the top ten facilities when trying to compare releases across the three datasets. Even across the 2017 and 2020 NEI datasets, only four of the top ten NEI facilities fall into both datasets top ten reported releases. However, the reported releases for those four facilities are similar across the 2017 and 2020 NEI reporting years.

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Table 5-22. Top 10 Fugitive Releases (kg/yr) from TRI, 2017 NEI, and 2020 NEI

Facility	TRI	2017 NEI	2020 NEI
K&G	304	816	NR
Westlake2	4,264	3,382	4,161
Shintech	320	319	[103]
WestlakeCV	1,269	NA	NA
Olin-Freeport	855	NA	NA
Occidental-Geisner	115	NA	NA
Formosa	94	NA	NA
WestlakeVC	5	NA	NA
WestlakeVI	276	NA	NA
Blue Cube-Plaquemine	263	NA	NA
Leaf River	NR	2,502	2,764
GP-Monticello	NR	2,032	2,023
GP	NR	1,923	[41]
Westrock	NR	9	NA
Blue Cube-Freeport	NR	757	819
IP-Bogalusa	NR	1,094	NA
IP-Valliant	NR	1,056	NA
IP-Mansfield	NR	NA	0.3
IP-Company	NR	NA	1,043
WestRock-Mahrt	NR	NA	906
UCC-Texas	NR	NA	0.1
Range	5 – 4,264	9 – 3,382	0 – 4,161
NR: Release not reported; NA: Not applicable (not in top 10); TRI = Toxic Release Inventory; NEI = National Emissions Inventory			

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Table 5-23. Top 10 Stack Releases (kg/yr) from TRI, 2017 NEI, and 2020 NEI

Facility	TRI	2017 NEI	2020 NEI
K&G	3,638	7,230	NR
Westlake2	2,404	151	136
Shintech	57	2,799	[50]
WestlakeCV	0	NA	NA
Olin-Freeport	236	NA	NA
Occidental-Geisner	831	NA	NA
Formosa	717	NA	NA
WestlakeVC	717	NA	NA
WestlakeVI	78	NA	NA
Blue Cube-Plaquemine	6	NA	NA
Leaf River	NR	5	NR
GP-Monticello	NR	24	20
GP	NR	4	[10]
Westrock	NR	1,651	
Blue Cube-Freeport	NR	416	233
IP-Bogalusa	NR	35	35
IP-Valliant	NR	48	31
IP-Mansfield	NR	NA	1,232
IP-Company	NR	NA	9
WestRock-Mahrt	NR	NA	NR
UCC-Texas	NR	NA	849
Range	0 – 3,638	4 – 7,230	9 – 1,232
NR: Release not reported; NA: Not applicable (not in top 10); TRI = Toxic Release Inventory; NEI = National Emissions Inventory			

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Table 5-24. Top Ten Total Releases (kg/yr) from TRI, 2017 NEI, and 2020 NEI

Facility	TRI	2017 NEI	2020 NEI
K&G	3,943	8,047	NR
Westlake2	6,668	3,533	4,297
Shintech	377	3,118	[153]
WestlakeCV	1,269	NA	NA
Olin-Freeport	1,090	NA	NA
Occidental-Geisner	946	NA	NA
Formosa	811	NA	NA
WestlakeVC	722	NA	NA
WestlakeVI	354	NA	NA
Blue Cube-Plaquemine	269	NA	NA
Leaf River	NR	2,508	2,764
GP-Monticello	NR	2,056	2,043
GP	NR	1,927	[51]
Westrock	NR	1,660	NA
Blue Cube-Freeport	NR	1,173	1,052
IP-Bogalusa	NR	1,129	1,059
IP-Valliant	NR	1,104	1,147
IP-Mansfield	NR	NA	1,232
IP-Company	NR	NA	1,052
WestRock-Mahrt	NR	NA	906
UCC-Texas	NR	NA	849
Range	269 – 6,668	1,104 – 8,047	849 – 4,297
NR: Release not reported; NA: Not applicable (not in top 10); TRI = Toxic Release Inventory; NEI = National Emissions Inventory			

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EPA also acknowledges that the 2017 NEI dataset has reported fugitive and stack releases for the K&G facility which are approximately two times higher than the highest reported release for the same facility in the TRI dataset (2019-2023). Considering these releases independently, the higher 2017 NEI stack release for the K&G facility was the highest reported stack release across all three datasets considered and was the stack release modeled for both the Tier 1 and Tier 2 analyses conducted for 1,1,2-trichloroethane and presented in Sections 5.2.1 and 5.2.2. The 2017 NEI fugitive release for the K&G facility was ten times less than the highest fugitive release across all three datasets considered and therefore was not modeled in the Tier 1 or Tier 2 analysis. Furthermore, this facility discontinued use of 1,1,2-trichloroethane after 2019 and therefore did not report releases of 1,1,2-trichloroethane to the 2020 NEI dataset. Overall, the findings and conclusions reached by the Tier 3 Analysis-TRI Release Dataset which resulted in calculated risk estimates greater than the relative benchmark for cancer effects (for the K&G facility) were not missed by modeling the TRI dataset instead of the NEI dataset even though the 2017 NEI stack release for K&G manufacturing was higher than the modeled TRI release.

Two other TRI facilities overlap with a top ten releasing facility from either the 2017 or 2020 NEI dataset. Those two facilities are Westlake2, and Shintech. The Westlake2 facility in the NEI datasets is

the same as the “PPG” facility identified in Section 5.2.3.1 in the TRI dataset. For this facility, the highest fugitive and highest stack releases are reported to the TRI dataset, and therefore the highest reported releases across all three datasets are modeled in the Tier 3 analysis-TRI Release Dataset.

Shintech reported stack and fugitive releases to the 2017 NEI dataset and all five years of the TRI dataset. Although Shintech did report releases to the 2020 NEI dataset, the releases did not fall into the top 10 releases for the 2020 NEI dataset. For comparison purposes, EPA includes the 2020 NEI reported releases in brackets in Table 5-22 (fugitive), Table 5-23 (stack), and Table 5-24 (total) for the Shintech facility. Neither the fugitive nor stack releases reported by Shintech to any of the three datasets considered were the highest releases reported across the three datasets and modeled in the Tier 1 or Tier 2 analyses. Regardless, direct comparison of the Shintech releases across all three datasets to which it reported releases showed the highest fugitive releases reported to all three datasets are nearly identical. Therefore, findings from modeling the Shintech fugitive release from the TRI dataset was representative of modeling either the 2017 or 2020 NEI dataset fugitive release. The 2017 NEI stack releases for Shintech are a magnitude greater than those reported to either TRI or the 2020 NEI. The reason for this discrepancy is not known, but the magnitude difference between the single year 2017 NEI reported release and the single year 2020 NEI reported stack release as well as all 5 years of TRI reported releases may indicate the 2017 reported release is not representative of current facility operations. Considering this possibility, EPA compared the 2020 TRI reported releases to the 2020 NEI reported releases for the Shintech facility to temporally align the fugitive and stack releases. For the 2020 reporting year, the TRI reported releases were 243 kg/yr (fugitive) and 50 kg/yr (stack); compared to the 2020 NEI reported releases of 150 kg/yr (fugitive) and 50 kg/yr (stack). This temporal alignment shows releases are nearly identical (fugitive) or identical (stack) and similar to the highest TRI reported releases modeled when aligned temporally in the Tier 3 analysis-TRI Release Dataset.

Facility-Specific Census Block Analysis

The methods and inputs used for the Tier 3 Analysis-NEI Release Datasets are identical to those described for the Tier 3 Analysis-TRI Release Dataset, except the releases modeled were the top ten total facility releases from the 2017 and 2020 NEI datasets.

Since the 2017 and 2020 NEI datasets are independently reported facility releases for a single year, the releases modeled for each dataset align both spatially and temporally for each facility and each year modeled. However, comparison of results across all three release datasets may not align temporally (although when facilities overlap across datasets, the releases align spatially) and should be considered when drawing conclusions from such comparison. Regardless, the primary purpose of modeling the top ten releases from the 2017 and 2020 NEI datasets in the facility-specific census block analysis is to ensure potential higher releases than those reported in the TRI dataset evaluated were not missed, which is independent of temporally aligned releases. Additionally, the purpose of modeling the top ten releases from the 2017 and 2020 NEI datasets is to provide additional evidence and confidence that the results from the Tier 3 Analysis-TRI Release Dataset are representative of general population exposures to 1,1,2-trichloroethane and appropriate to use for purposes of deriving risk estimates, risk characterization, and informing risk determination and regulatory decision-making.

5.2.4.3 Modeled Concentrations and Findings

Table 5-25 summarizes the facility-specific maximum modeled concentration in a populated census block by facility for the 2017 NEI dataset. These concentrations are extracted from the max risk and hi output files from the HEM for each NEI facility evaluated and represent the maximum modeled concentration in a populated census block for each of the top ten facilities evaluated across all census

5568 blocks within the modeling domain of each facility.

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5570 Table 5-26 summarizes the facility-specific maximum modeled concentration in a populated census
5571 block by facility for the 2020 NEI dataset. These concentrations are extracted from the max risk and hi
5572 output files from the HEM for each NEI facility evaluated and represent the maximum modeled
5573 concentration in a populated census block for each of the top ten facilities evaluated across all census
5574 blocks within the modeling domain of each facility.

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5576 The information in Table 5-25 and Table 5-26 was used to calculate risk estimates and compare findings
5577 to those of the Tier 3 Analysis-TRI Release Dataset to determine if additional, more refined analyses
5578 were necessary or warranted due to new findings from evaluating the NEI datasets. Results from
5579 modeling the top ten releases reported to the 2017 NEI dataset showed two facilities with modeled
5580 concentrations which result in calculated risk estimates greater than the relative benchmark for cancer
5581 effects in a populated census block. Those two facilities were the K&G facility (Facility ID 7107411)
5582 and the Georgia Pacific facility (Facility ID 7442111). None of the top ten releases reported to the 2020
5583 NEI dataset showed modeled concentrations which result in calculated risk estimates greater than the
5584 relative benchmark for cancer effects in a populated census block. Based on these findings, EPA further
5585 investigated the K&G and Georgia Pacific facilities in relation to the 2017 NEI release dataset.

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5587 The K&G facility was the same facility which reported the highest stack release across all three datasets
5588 which was modeled in the Tier 1 and Tier 2 analyses. Findings from the Tier 1 and Tier 2 analyses led to
5589 additional, more refined Tier 3 analyses using the TRI dataset. Findings from the radial distance,
5590 facility-specific census block analysis, and multi-facility aggregate census block analysis from the Tier 3
5591 Analysis-TRI Release Dataset continued to show modeled concentrations that resulted in calculated risk
5592 estimates greater than the relative benchmark for cancer effects for the K&G facility (based on the 2019
5593 TRI reported releases) which led to additional, refined analysis and investigation into the K&G facility.

Table 5-25. Modeled Facility-Specific Maximum Concentration for Top Ten Releases (2017 NEI)

Year	Facility ID	Concentration ($\mu\text{g}/\text{m}^3$)	Census Block ID	Latitude	Longitude
2017	7107411	1.8	0709021018	44.29319	-93.2922
2017	7354911	2.0E-02	UHON000043	30.2335	-93.2935
2017	13610611	2.0E-03	9529011003	30.21994	-91.205
2017	8216311	5.0E-03	9501022046	31.25532	-89.0564
2017	8232711	6.8E-02	9601003037	31.63297	-90.0822
2017	7442111	10.4	9567004062	32.2265	-88.0246
2017	1003411	3.1E-02	9503021013	34.88825	-85.7864
2017	17735411	2.0E-03	6644001110	28.91812	-95.3348
2017	7203811	5.3E-02	9508004007	30.77948	-89.8552
2017	8522011	5.0E-03	0984003054	34.00319	-95.1023
NEI = National Emissions Inventory					

Table 5-26. Modeled Facility-Specific Maximum Concentration for Top Ten Releases (2020 NEI)

Year	Facility ID	Concentration ($\mu\text{g}/\text{m}^3$)	Census Block ID	Latitude	Longitude
2020	7354911	2.5E-02	UHON000043	30.2335	-93.2935
2020	8216311	5.0E-03	9501022046	31.25532	-89.0564
2020	8232711	6.7E-02	9601003037	31.63297	-90.0822
2020	7225811	1.0E-03	9503002079	32.12625	-93.5513
2020	8522011	5.0E-03	0984003054	34.00319	-95.1023
2020	7203811	4.9E-02	9508004007	30.77948	-89.8552
2020	7212311	9.9E-02	0208011001	32.42723	-86.4672
2020	17735411	2.0E-03	6644001110	28.91812	-95.3348
2020	1000211	2.8E-02	0312002027	32.18762	-85.0326
2020	3967011	1.0E-03	7262002003	29.37773	-94.9541
NEI = National Emissions Inventory					

As described in Section 5.2.3.1, EPA's investigation into the TRI releases from the K&G facility in the Tier 3 Analysis-TRI Release Dataset found the TRI reported latitude and longitude for the facility was 2 km north of the actual facility location. Although findings from the facility-specific census block analysis in the Tier 3 Analysis-TRI Release Dataset still found modeled concentrations in populated census blocks which resulted in risk estimates greater than the relative benchmark for cancer effects, the modeled concentrations at the centroid of the impacted census blocks were not representative of actual general population exposures in populated census blocks from this facility because the release point modeled for that analysis did not align with the actual facility location.

The 2017 NEI reported latitude and longitude for this facility aligned with the actual facility location, therefore the results of the facility-specific census block analyses using the 2017 NEI latitude and longitude were more representative of actual exposures of the general population to 1,1,2-trichloroethane. Modeling of the 2017 NEI releases for K&G showed sixteen census blocks or user defined receptors with modeled concentrations which resulted in calculated risk estimates greater than the relative benchmark for cancer effects. These findings are shown in Figure 5-7. One of the user defined receptors where modeled concentrations resulted in calculated risk estimates greater than the relative benchmark for cancer effects was a school northeast of the facility (see Figure 5-6 where there is a large dirt-running track NE of the facility). The school is a user-defined receptor included in the HEM census data file and identified in Figure 5-7. While the modeled concentration at the centroid of the census block where the school is located did not result in calculated risk estimates greater than the relative benchmark for cancer effects, the modeled concentration at the user-defined school receptor point did result in calculated risk estimates greater than the relative benchmark for cancer effects.

Separate from the findings from both the Tier 3 Analysis-TRI Release Dataset and the Tier 3 Analysis-NEI Release Datasets, however, as described in Section 5.2.3.1, review of releases and outreach to the K&G facility found K&G Manufacturing discontinued use of 1,1,2-trichloroethane after 2019. This claim is supported by the 2020-2024 TRI release dataset and the 2020 NEI release datasets. The K&G facility reported zero releases for the 2020 TRI reporting year and did not report any releases for any of the 2021 through 2024 TRI reporting years or the 2020 NEI release dataset. Discontinued use of 1,1,2-trichloroethane by the K&G facility resulted in elimination of general population exposure to 1,1,2-trichloroethane from industrial releases of 1,1,2-trichloroethane from this facility after 2019 including at the school location.

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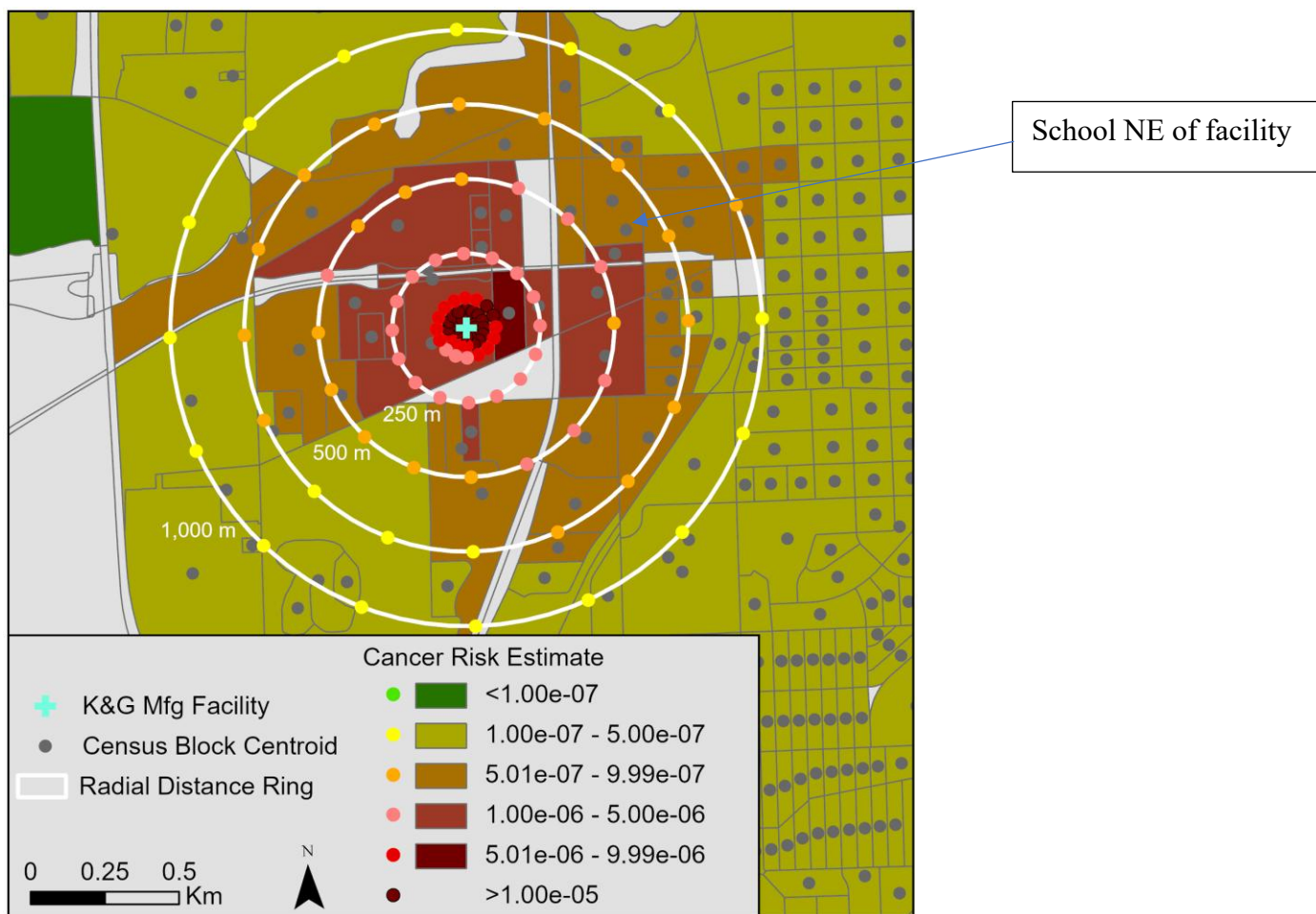


Figure 5-7. K&G facility-specific census block analysis based on 2017 NEI release dataset.

Colored points represent calculated cancer risk estimates at each radial point. Colored polygons represent estimated cancer risk for populated census blocks as calculated at its centroid. Gray polygons represent unpopulated census blocks.

The Georgia Pacific facility did not have TRI reported releases of 1,1,2-trichloroethane for any of the TRI reporting years considered (2019-2023) which were identified by EPA. This prohibited EPA from making a direct comparison of TRI reported releases for this facility to either 2017 or 2020 NEI release datasets evaluated. Although the Georgia Pacific facility releases to the 2017 and 2020 NEI datasets were considered for the Tier 1 and Tier 2 analyses, since neither the fugitive nor stack releases reported were the highest across all three datasets, this facility's releases were not modeled directly in the Tier 1 or Tier 2 analyses. Since Georgia Pacific did not have reported releases for any of the TRI reporting years, its releases were not modeled in the Tier 3 analysis-TRI Release Dataset. However, since higher releases were identified and modeled for associated OES/COUs the results from the Tier 1 through Tier 3 analyses releases, exposures, and associated risk estimates from the Georgia Pacific facility was represented by each tier of analysis.

The Georgia Pacific facility reported releases of 1,1,2-trichloroethane to both the 2017 and 2020 NEI datasets. Therefore, EPA compared the NEI reported releases which are shown in Table 5-22, Table 5-23, and Table 5-24. For the 2017 NEI reported releases, 99.8 percent of the total reported releases for the Georgia Pacific facility were attributed to fugitive releases (1,923 kg/yr of the total 1,927 kg/yr reported). The remaining 0.2 percent of the total releases were attributed to stack releases (4 kg/yr of the total 1,927 kg/yr).

For the 2020 NEI reported releases, the Georgia Pacific facility reported significantly less total releases compared to the 2017 NEI releases. Specifically, total releases reported to the 2020 NEI dataset were two orders of magnitude less than the 2017 NEI dataset (1,927 from the 2017 NEI dataset and 51 kg/yr from the 2020 NEI dataset). This decrease in total reported releases was due to a sharp decrease in reported fugitive releases between 2017 (1,923 kg/yr) and 2020 (41 kg/yr). Reported stack releases between 2017 to 2020 increased slightly from 4 kg/yr to 10 kg/yr, respectively. The reason for the significant decrease in reported fugitive releases and total releases in the 2020 NEI dataset from this Georgia Pacific facility is unknown but significant enough that EPA expects the 2020 NEI reported releases are more representative of current facility operations. Based on this assumption, the reported releases and associated modeled concentrations from the Georgia Pacific facility no longer result in calculated risk estimates above the relative benchmark for cancer effects. This conclusion is supported by EPA's evaluation of the TRI release dataset where this Georgia Pacific facility did not have any TRI reported releases of 1,1,2-trichloroethane for any of the TRI reporting years considered (2019 through 2023). Therefore, releases from the Georgia Pacific facility are expected to remain low as found in the 2020 NEI release dataset.

Modeling of the 2017 NEI releases for the Georgia Pacific facility showed two census blocks with modeled concentrations which resulted in calculated risk estimates greater than the relative benchmark for cancer effects. These findings are shown in Figure 5-8. Modeling of the 2020 NEI release dataset for this same facility did not show any census blocks with modeled concentrations which resulted in calculated risk estimates greater than the relative benchmark for cancer effects. The maximum single facility-specific census block from the HEM output file for the Georgia Pacific facility where modeled concentrations result in calculated risk estimates greater than the relative benchmark for cancer effects for the 2017 NEI dataset was located directly on facility property where individuals do not reside or frequent (the red colored polygon census block). Therefore, that modeled concentration at that centroid was not representative of general population exposure due to releases from this facility. EPA then looked at the second highest census block (block number: 9567004037, at latitude 32.2350671 and longitude -88.0216579) and found that modeled concentration also resulted in calculated risk estimates greater than the relative benchmark for cancer effects based on the 2017 NEI dataset. This census block was due north of the highest census block and is represented by the thin peach colored polygon in Figure

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5-8. The centroid of that census block did not appear to be on facility property, had a reported population of six people, and the modeled concentration was nearly two orders of magnitude lower than the highest modeled concentration presented in Table 5-24 ($0.555 \mu\text{g}/\text{m}^3$ compared to $10.4 \mu\text{g}/\text{m}^3$).

While the 2020 census data within the HEM reported a population of 6 people for this thin census block EPA was not able to identify where the population may reside. Additionally, when this census block latitude and longitude was mapped in Google Maps (see Figure 5-9), EPA did not identify with certainty residential locations around the centroid of this census block. The nearest possible residential location is highlighted with the measuring tool in Figure 5-9 and is about 380 meters away (1,249 feet) from the centroid of the census block. However, that location is in a different, unpopulated census block and not in the narrow roadway-based census block in Figure 5-8. Taken together, the findings for the Georgia Pacific facility indicate even though there were modeled concentrations which resulted in calculated risk estimates greater than the relative benchmark for cancer effects based on the 2017 NEI dataset, these findings did not occur based on the 2020 NEI dataset. Additionally, based on the land use analysis and evidence presented in Figure 5-8 and Figure 5-9, EPA believes there is no population residing or frequenting either of the two census blocks where modeled concentrations result in calculated risk estimates greater than the benchmark for cancer effects.

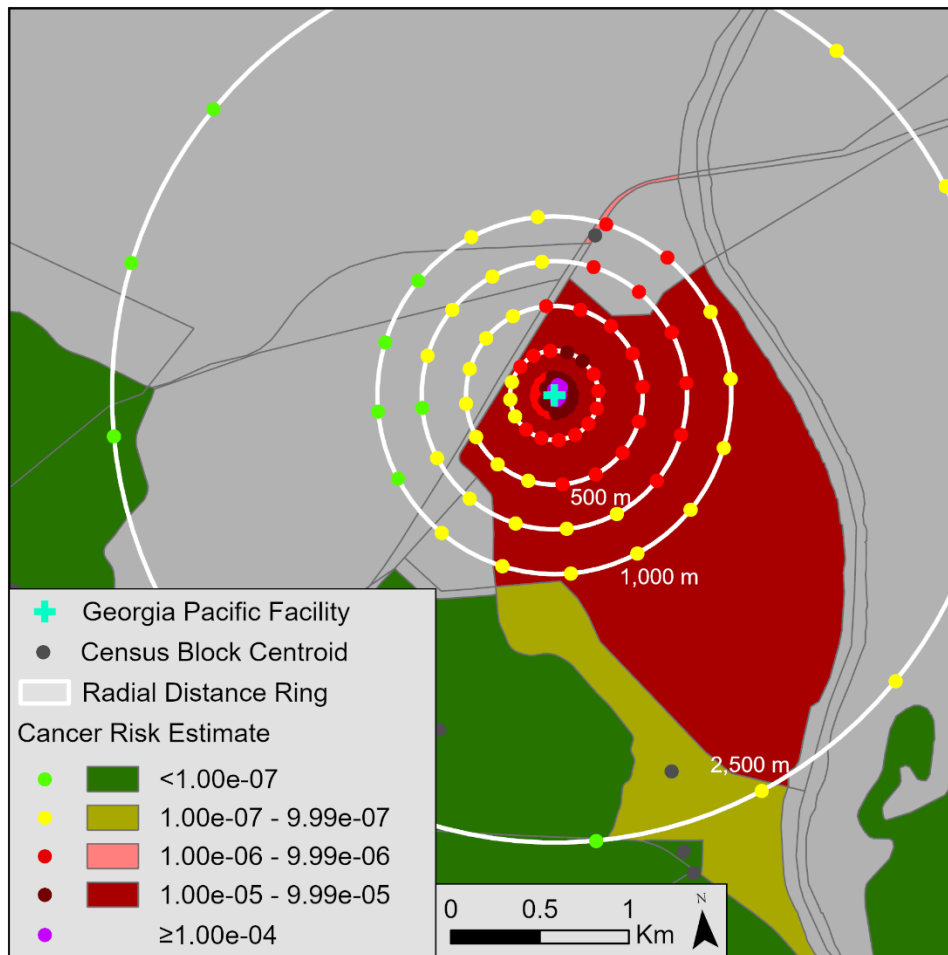


Figure 5-8. Georgia Pacific facility-specific census block analysis based on 2017 NEI release dataset.

Colored points represent calculated cancer risk estimates at each radial point. Colored polygons represent estimated cancer risk for populated census blocks as calculated at its centroid. Gray polygons

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represent unpopulated census blocks.

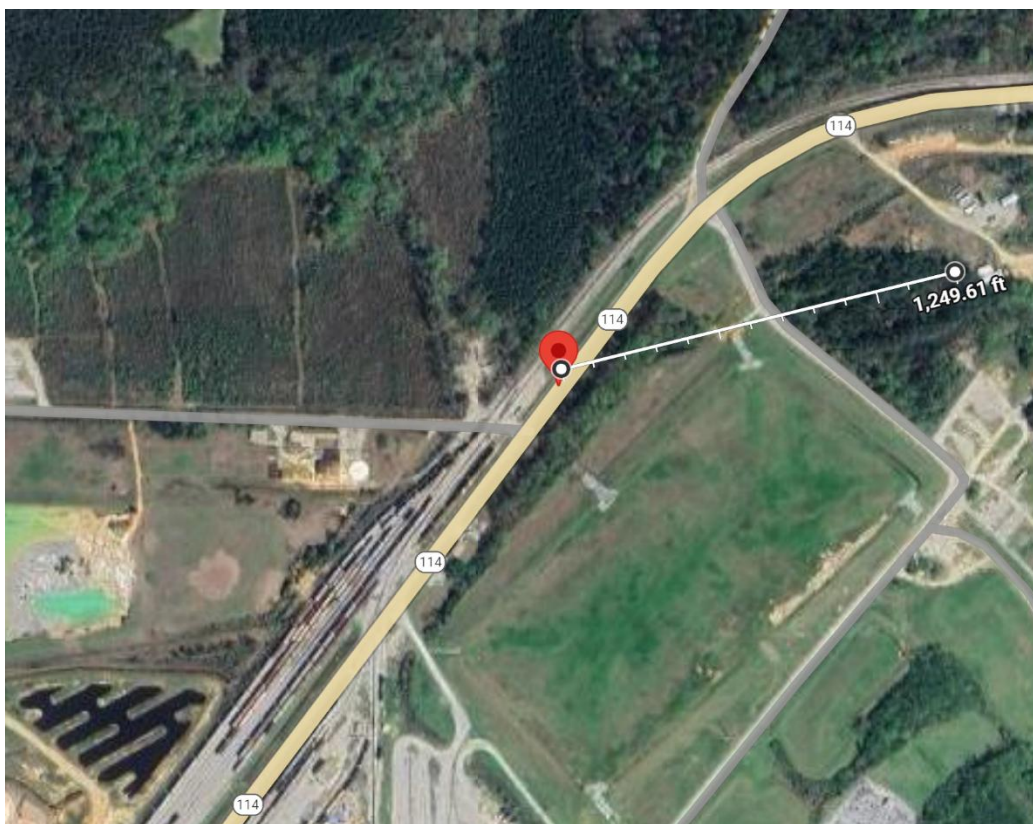


Figure 5-9. Second highest census block around Georgia Pacific Facility

Conclusions for the Tier 3 Analysis-NEI Release Datasets

Cancer effects: The Tier 3 Analysis-NEI Release Dataset was an additional, refined analysis EPA conducted for 1,1,2-trichloroethane. This analysis was limited to evaluating the top ten releases reported in the 2017 and 2020 NEI release datasets with the purpose of ensuring high-end releases and exposures were not missed by the Tier 3 Analysis-TRI Release Dataset where EPA considered five years of TRI reported releases (2019 through 2023). Comparison of the top ten reported releases across all three datasets considered in the Tier 3 analysis showed the range of releases captured by the TRI dataset also captured and was representative of the range of releases in both the 2017 and 2020 NEI datasets. Therefore, high-end releases or exposures were not missed in the Tier 3 Analysis-TRI Release Dataset.

Results from modeling in the Tier 3 Analysis-NEI Release Datasets showed two facilities (K&G and Georgia Pacific) where modeled concentrations resulted in calculated risk estimates greater than the relative benchmark for cancer effects in populated census blocks. The K&G facility releases and findings were also captured by the Tier 3 Analysis-TRI Release Dataset and therefore were not missed. However, the Tier 3 Analysis-NEI Release Datasets refined the reported facility latitude and longitude to the actual facility location. Based on the correct facility latitude and longitude the results found an eight-fold increase in populated census blocks (two census blocks to sixteen census blocks) where modeled concentrations resulted in calculated risk estimates greater than the relative benchmark for cancer effects, including a census block with a school. However, as described in Section 5.2.3.1, the K&G facility discontinued use of 1,1,2-trichloroethane after 2019, and therefore there is no longer general population exposures to 1,1,2-trichloroethane due to industrial releases from the K&G facility.

The Georgia Pacific facility releases were considered in the Tier 1 and Tier 2 analysis, although they did not represent the highest releases across all three datasets for either analysis and therefore were not directly modeled. Since there were no TRI reported releases from the Georgia Pacific facility, the facility was not modeled in the Tier 3 Analysis-TRI Release Dataset. However, when comparing the releases across all three release datasets considered, the levels of NEI reported releases from the Georgia Pacific facility were within the range of releases modeled and did not exceed any modeled releases.

Modeling of the 2017 NEI reported releases from Georgia Pacific did find modeled concentrations which resulted in calculated risk estimates greater than the relative benchmark for cancer effects in two populated census blocks. However, visual investigations and land use analyses via Google Maps did not identify any residential locations within these two census blocks. The 2020 NEI reported releases were two orders of magnitude less than the 2017 reported releases and well below any of the top ten facilities modeled based on the 2020 NEI releases dataset. Furthermore, none of the releases from the top ten facilities from the 2020 NEI release dataset had modeled concentrations which resulted in calculated risk estimates greater than the relative benchmark for cancer effects. Taken together these findings suggest the current operating conditions of the Georgia Pacific facility are unlikely to cause general population exposures to 1,1,2-trichloroethane which result in calculated risk estimates greater than the relative benchmark for cancer effects due to industrial releases from this Georgia Pacific facility.

EPA believes the findings from the Tier 3 analysis using the TRI dataset (2019 – 2023 reporting years) and the focused refinements of the TRI analysis along with the limited analysis of the top 10 NEI releases reported to the 2017 and 2020 NEI datasets provide appropriately conservative and representative exposure results for the general population. Additionally, the limited analysis of the top 10 NEI releases for 2017 and 2020 add support to the findings from the Tier 3 Analysis-TRI Release Dataset that no additional, refined analysis are necessary or warranted to inform exposure/risk characterization, derive risk estimates, or to make a risk determination. Therefore, no additional modeling was performed for the 1,1,2-trichloroethane ambient air exposure/risk assessment.

5.2.4.4 Evidence Integration and Weight of Scientific Evidence

EPA acknowledges the inputs used and assumptions made for the modeling for this Tier 3 analysis-NEI Release Dataset remain conservative, upper bounding (95th percentile) estimates of concentrations to which the general population is exposed in the radial distance analysis and the maximum estimate of concentrations across all census blocks within the modeling domain (30 to 50,000 meters) for each facility to which the general population is exposed in the facility-specific and multi-facility aggregate census block analyses. However, the conservatism for this Tier 3 analysis is reduced, relative to the Tier 1 and Tier 2 analyses, since the Tier 3 analysis uses local meteorological data, site-specific industry reported releases, local topography and elevation, and several other factors as model inputs. Additional refinements made for the Tier 3 Analysis-NEI Release Dataset and comparison of results across multiple release datasets increase EPA's confidence in the exposure scenarios evaluated to moderate. EPA's confidence in the results from the Tier 3 Analysis-NEI Release Datasets remain robust by ensuring high-end releases, exposures, and associated risks are not missed and that the analysis remains protective of the general population (including fenceline communities and PESS).

Overall, EPA has robust confidence in the conclusion reached from this Tier 3 analysis-NEI Release Datasets that additional, refined analysis is not necessary or warranted. EPA also has robust confidence this Tier 3 Analysis-NEI Release Datasets does not change the overall findings from the Tier 3 Analysis-TRI Release Dataset and provides added support to that results from the Tier 3 Analysis-TRI Release Dataset are appropriate to use for purposes of exposure characterization, deriving risk estimates as well as informing risk determination, and regulatory decision-making.

5.2.5 Alternate Receptor Analysis

The alternate receptor analysis modeled facility reported releases from the TRI release dataset to obtain modeled concentrations at each AMTIC monitoring site within the modeling domain of all TRI facilities evaluated. These modeled concentrations were then directly compared to monitored concentrations at each of the AMTIC monitoring sites to ground-truth EPA's modeled concentrations. The alternate receptor analysis compares both facility-specific modeled concentrations as well as multi-facility aggregate modeled concentrations to the real-time monitored concentrations at each impacted AMTIC monitoring site. The AMTIC archive dataset included monitored results from 2019 through 2022 thus aligning with the TRI reporting years (2019 through 2023) in the TRI release dataset.

As described in Section 5.1.1, EPA identified 226 AMTIC monitoring sites which reported monitoring for 1,1,2-trichloroethane between 2018 and 2022. These are presented in Figure 5-10 (red triangles) along with the 29 TRI facilities (blue circles) evaluated for the alternate receptor analysis.

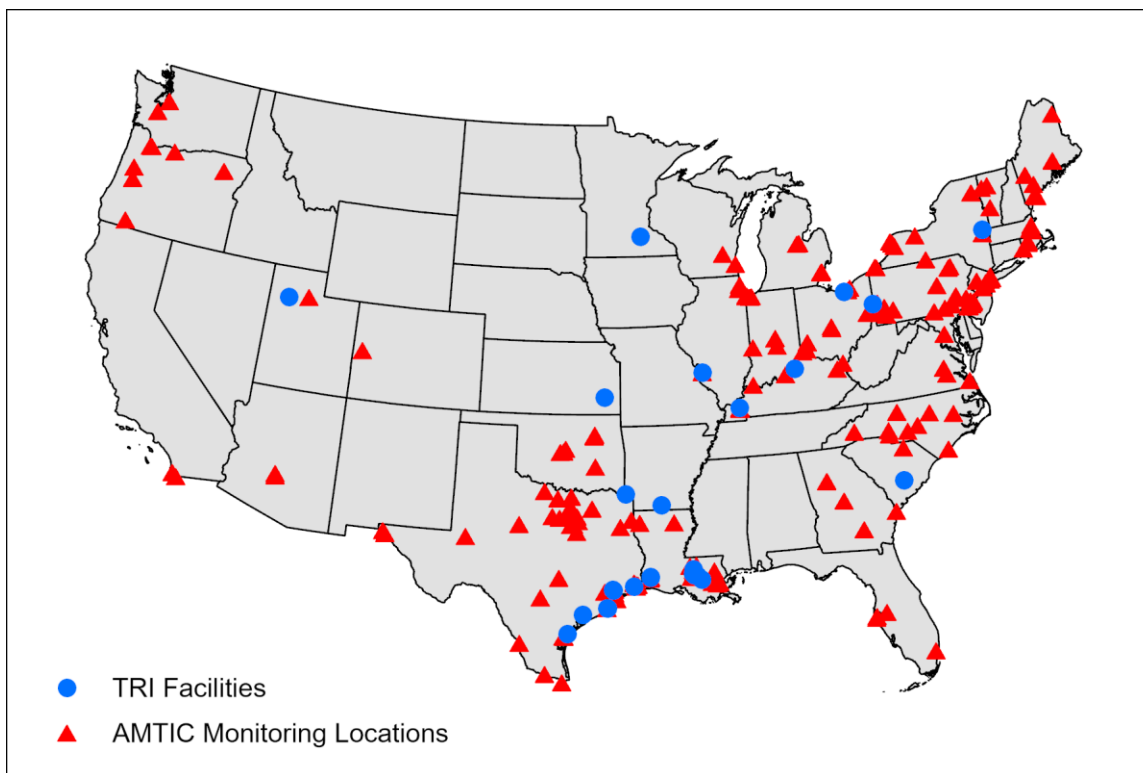


Figure 5-10. Map of TRI facilities evaluated and AMTIC monitoring sites within modeling domain

5.2.5.1 Summary of Findings

Maximum modeled concentrations from the alternate receptor analysis using the HEM at each alternate receptor location (AMTIC monitoring site) generally aligned with the monitored maximum and mean concentrations obtained from the AMTIC archive. Multi-facility aggregate maximum modeled concentrations from the HEM also generally aligned with the monitored maximum and mean concentrations at AMTIC monitoring sites impacted by one or more TRI facilities evaluated. Overall, both facility-specific and multi-facility aggregate maximum modeled concentrations from the alternate receptor analysis using HEM were less than monitored mean and maximum concentrations at the respective AMTIC monitoring site impacted. Based on these findings, EPA determined while EPA's modeling approach in the Tier 3 Analysis-TRI Release Dataset was conservative, it is not overly conservative and can be relied upon for exposure/risk characterization and deriving risk estimates as

well as informing risk determination, and regulatory decision-making.

Supporting Documents, Files, Results

Supplemental Files:

Modeling Files: Draft Tier 3 Ambient Air Analysis-TRI Dataset Modeling Files for 1,1,2-

Trichloroethane ([U.S. EPA, 2026ac](#))

All Results: Draft Tier 3 Ambient Air Analysis-TRI Dataset Results Summary for 1,1,2-Trichloroethane

([U.S. EPA, 2026ab](#))

Additional Information-Read Me File: Draft Tier 3 Ambient Air Analysis-TRI Dataset Read Me for

1,1,2-Trichloroethane ([U.S. EPA, 2026z](#))

All Results Summary: Draft AMTIC Monitoring Data for 1,1,2-Trichloroethane ([U.S. EPA, 2026d](#))

5.2.5.2 Methods and Inputs

EPA used the HEM input files from the Tier 3 Analysis-TRI Release Dataset for the HEM alternate receptor analysis. The only change to these files expanded the modelled distance for the TRI facilities to the maximum distance of the HEM modeling domain (50,000 meters). This was done to remove the extrapolation of concentrations from 3,000 meters inherent in the HEM programming to have it run the model for all distances evaluated out to 50,000 meters (12 distances total). EPA downloaded the latitude, longitude, and elevation of each of the 226 AMTIC monitoring sites reported in the AMTIC archive to create the final alternate receptor input file needed by the HEM for the alternative receptor analysis. EPA ran the HEM for the alternate receptor analysis focusing on the evaluation of cancer effects.

5.2.5.3 Modeled Concentrations and Findings

Table 5-27 summarizes the aggregated results from the HEM alternate receptor analysis output files by AMTIC monitoring site. Since the real-time monitoring data from the AMTIC archive is a total aggregate concentration measured at a given time at each monitoring site, the aggregate modeled concentrations in Table 5-27 represents the sum of all individual facility's highest modeled concentration at each alternate receptor (AMTIC monitoring site) impacting that alternate receptor. Table 5-27 aligns the aggregated modeled concentrations with the maximum monitored mean and maximum monitored maximum at each alternate receptor based on the AMTIC archive data to allow direct comparison of modeled and monitored concentrations at the same alternate receptor location.

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Table 5-27. Alternate Receptor Analysis Using TRI Reported Releases by AMTIC Monitoring Site

Monitor ID	Monitor Latitude	Monitor Longitude	# Facilities Impacting Monitor	Modeled Aggregate	Maximum Monitored (Mean)	Maximum Monitored (Maximum)
ALTM180190009	38.27668	-85.7638	1	1.1E-06	0	0
ALTM211390004	37.07151	-88.3339	1	9.7E-03	3.8E-02	0.38
ALTM211570014	37.0452	-88.3309	1	2.3E-02	3.5E-02	0.38
ALTM211570018	37.02702	-88.3439	1	3.2E-03	3.0E-02	0.39
ALTM211570020	37.0412	-88.3519	1	6.2E-03	4.6E-02	0.59
ALTM211570021	37.04791	-88.3383	1	4.6E-02	0.58	11
ALTM220050004	30.22965	-90.9656	7	2.5E-03	1.0E-02	0.33
ALTM220190008	30.2626	-93.2851	2	0.11	0.30	6.3
ALTM22019SPE3	30.21561	-93.312	2	0.14	0.12	1.3
ALTM220330003	30.41981	-91.182	6	2.1E-03	1.1E-02	0.28
ALTM220330009	30.46198	-91.1792	6	4.8E-03	1.4E-02	0.23
ALTM220330013	30.7009	-91.0561	2	8.1E-05	5.0E-03	0.24
ALTM220332002	30.52565	-91.1863	6	4.8E-03	2.7E-02	0.27
ALTM220470009	30.22125	-91.3154	6	3.1E-03	1.8E-02	0.33
ALTM220470012	30.20422	-91.126	7	3.4E-03	1.4E-02	0.27
ALTM220770001	30.68172	-91.3662	3	2.6E-04	1.3E-02	0.22
ALTM220897000	29.95418	-90.3264	1	2.7E-06	5.5E-03	0.16
ALTM221210001	30.50064	-91.2136	6	9.3E-03	1.9E-02	0.16
ALTM360010013	42.64093	-73.7565	1	5.4E-05	1.0E-03	3.3E-02
ALTM390350038	41.47701	-81.6824	1	4.5E-09	0	0
ALTM390351002	41.39629	-81.8187	1	9.3E-09	0	0
ALTM390670005	40.33293	-80.9334	1	3.3E-08	0	0
ALTM390810017	40.36644	-80.6156	2	3.7E-07	0	0
ALTM420070008	40.69186	-80.2992	1	3.6E-07	0	0
ALTM421255200	40.26896	-80.244	1	5.0E-08	2.6E-03	0.12
ALTM480391003	29.01084	-95.3977	2	6.5E-03	1.7E-02	0.66

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Monitor ID	Monitor Latitude	Monitor Longitude	# Facilities Impacting Monitor	Modeled Aggregate	Maximum Monitored (Mean)	Maximum Monitored (Maximum)
ALTM481670005	29.38523	-94.9315	3	2.1E-05	9.1E-04	5.4E-02
ALTM482010036	29.7761	-95.1051	3	7.4E-04	1.8E-03	5.6E-02
ALTM482010055	29.69573	-95.4992	3	3.4E-05	3.1E-03	0.11
ALTM482010057	29.73423	-95.2385	3	1.7E-04	6.6E-03	0.38
ALTM482010058	29.7707	-95.0312	3	2.2E-04	5.5E-03	5.7E-02
ALTM482010061	29.615	-95.0181	3	9.5E-05	1.2E-02	0.55
ALTM482010307	29.7188	-95.2599	3	1.2E-04	2.0E-02	0.55
ALTM482010803	29.76479	-95.1785	3	4.0E-04	2.0E-02	0.65
ALTM482011015	29.76165	-95.0814	3	9.3E-04	2.1E-02	0.90
ALTM482011039	29.67002	-95.1285	3	2.4E-04	7.4E-03	0.38
ALTM482011049	29.71661	-95.2225	3	1.8E-04	2.9E-03	5.5E-02
ALTM482450009	30.03642	-94.0711	1	7.0E-05	4.7E-03	0.28
ALTM482450011	29.89752	-93.9911	1	1.2E-04	7.2E-03	0.22
ALTM482450014	29.96112	-93.8959	1	3.8E-05	5.5E-03	0.21
ALTM482450017	29.98253	-93.9529	1	5.2E-05	3.9E-03	0.18
ALTM482450018	29.9428	-94.0008	1	8.9E-05	3.0E-03	0.17
ALTM482450019	29.89385	-93.9793	1	1.2E-04	1.0E-03	5.5E-02
ALTM482451050	30.06712	-94.0909	1	5.5E-05	4.5E-03	0.27
ALTM483550029	27.80754	-97.4193	1	2.6E-05	1.9E-03	5.5E-02
ALTM483550032	27.8045	-97.4316	1	2.3E-05	1.5E-02	0.43
ALTM483550034	27.81182	-97.4657	1	2.2E-05	1.9E-03	0.11
AMTIC = Ambient Monitoring Technology Information Center; TRI = Toxics Release Inventory						

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A total of 47 AMTIC monitoring sites were located within the modeling domain around all 29 TRI facilities modeled with the HEM alternate receptor analysis. Based on the HEM results, none of the facility-specific modeled concentrations for 1,1,2-trichloroethane at any of the 47 AMTIC monitoring sites resulted in calculated risk estimates greater than the relative benchmark for cancer effects. Additionally, when one AMTIC site was impacted by two or more TRI facilities, none of the aggregated concentrations across all TRI facilities impacting that AMTIC monitoring site resulted in calculated risk estimates greater than the relative benchmark for cancer effects. These findings are consistent with the findings from the Tier 3 Analysis-TRI Release Dataset facility-specific census block and multi-facility aggregate census block analyses described in Section 5.2.3.1 where final temporally aligned releases modeled in the HEM did not lead to general population exposure concentrations which resulted in calculated risk estimates greater than the relative benchmark for cancer effects.

Direct comparison of the modeled aggregate concentrations to the monitored concentrations at alternate receptors (AMTIC monitoring sites) found nearly every maximum modeled aggregate concentration was less than the associated maximum mean monitored concentration at the respective AMTIC monitoring site impacted by those facilities. Similarly, modeled maximum aggregate concentrations from all contributing TRI facilities were less than the associated maximum monitored concentration at the respective AMTIC monitoring site impacted by those facilities. This is representative of the expectations when considering monitoring data because the monitored values represent all contributing sources to total concentration (including secondary formation, combustion by-products, etc.) which cannot be attributed to a single OES/COU.

Conclusions for the Alternate Receptor Analysis

Cancer effects: The alternate receptor analysis was an additional, refined analysis EPA conducted for 1,1,2-trichloroethane. This analysis was limited to evaluating the TRI release dataset for the purpose of ground-truthing EPA's modeling approaches and results used in this 1,1,2-trichloroethane ambient air pathway assessment. The alternate receptor analysis also provided an additional line of evidence to further support for EPA's use of the results from the Tier 3 Analysis-TRI Release Dataset for exposure/risk characterization and deriving risk estimates as well as informing risk determination and regulatory decision-making.

The alternate receptor analysis showed both facility-specific and multi-facility aggregate modeled concentrations aligned well with monitored concentrations at AMTIC monitoring sites impacted by one or more TRI facilities evaluated. All but one of the multi-facility aggregate modeled concentrations were less than the associated monitored concentrations at the respective impacted AMTIC monitoring site. The one multi-facility aggregate modeled concentration exception was not less than the associated monitoring concentration at the respective, impacted AMTIC monitoring site was equal to the associated maximum monitored (mean) concentration and a magnitude less than the maximum monitored (maximum) concentration.

5.2.5.4 Evidence Integration and Weight of Scientific Evidence

EPA acknowledges the inputs used and assumptions made for the modeling in the Tier 3 analysis-TRI Release Dataset result in conservative, upper bounding (95th percentile) estimates of concentrations to which the general population may be exposed. However, based on findings from the alternate receptor analysis, EPA determined while modeling approaches applied to this ambient air pathway assessment for 1,1,2-trichloroethane remain conservative, they are not overly conservative and can be relied upon for exposure/risk characterization and deriving risk estimates as well as informing risk determination, and regulatory decision-making. Through integration of the alternate receptor analysis, EPA has robust confidence the results from the Tier 3 Analysis-TRI Release Dataset are representative of actual general

population exposures. EPA's confidence in the results of this Tier 3 analysis remain robust as the analysis ensured high-end releases, exposures, and associated risks were not missed and remain health protective.

Overall, EPA has robust confidence in the conclusion reached from this Tier 3 analysis that additional, refined analysis is not necessary. Therefore, EPA determined the Tier 3 Analysis-TRI Release Dataset was the final tier of analysis needed or warranted for this 1,1,2-trichloroethane general population exposure assessment for the ambient air pathway. Results from the Tier 3 Analysis-TRI Release Dataset will be carried into the *Draft Risk Evaluation for 1,1,2-Trichloroethane* ([U.S. EPA, 2026r](#)) and relied upon to derive risk estimates, characterize risks, and inform risk determination and regulatory decision-making.

5.3 Approach and Estimates for General Population Exposures

As described in Section 5.2, part of the multi-step process implemented by EPA for this ambient air pathway assessment is converting modeled concentrations obtained as outputs from the various models to exposure concentrations for purposes of determining general population exposures to 1,1,2-trichloroethane. For the 1,1,2-trichloroethane general population assessment, modeled air concentrations are converted to exposure estimates used to assess acute and chronic non-cancer effects, as well as cancer effects. The equations for estimating exposure are provided in the respective supplemental files for each Tier of analysis conducted for 1,1,2-trichloroethane, but also summarized in Sections 5.3.1, 5.3.2, and 5.3.3.

This ambient air exposure assessment of 1,1,2-trichloroethane assumes the general population is continuously exposed via inhalation (*e.g.*, 24 hours per day, 365 days per year) to ambient concentrations of 1,1,2-trichloroethane. This assumption and the averaging periods across which modeled concentrations are obtained (daily and annual average concentrations) result in daily average modeled ambient air concentrations equal to acute exposure concentrations (per Equation 5-1). Similarly, the annual average modeled ambient air concentrations are equal to the chronic exposure concentration (ADC) and the lifetime exposure concentration (LADC) (per Equation 5-2 and Equation 5-3).

5.3.1 Acute Concentration (AC)

The AC is defined as the daily air concentration adjusted for exposure duration and averaging time. For purposes of this ambient air exposure assessment, EPA uses the daily-average air concentration output from the respective models used and adjusted that concentration for a 24-hour exposure duration and a 24-hour averaging time to calculate the AC using Equation 5-1.

Equation 5-1

$$AC = \frac{(C \times ED)}{AT}$$

Where:

AC	=	Acute concentration ($\mu\text{g}/\text{m}^3$)
C	=	Daily-average modeled air concentration ($\mu\text{g}/\text{m}^3$)
ED	=	Exposure duration (24 hours)
AT	=	Averaging time (24 hours)

The calculated AC is used to calculate the risk estimate (MOE) for acute non-cancer effects as described in the *Draft Risk Evaluation for 1,1,2-Trichloroethane* ([U.S. EPA, 2026r](#)). In Section 5.2, the calculated

risk estimate is compared to the relative benchmark for acute non-cancer effects to inform whether additional, refined analysis are necessary or warranted for acute non-cancer effects.

5.3.2 Average Daily Concentration (ADC)

The ADC is defined as the mean amount of an agent to which an individual is exposed daily, often averaged over a definitive period (1 year). For purposes of this ambient air exposure assessment, EPA uses the annual-average air concentration output from the respective models used and adjusted that concentration for exposure time, exposure frequency, exposure duration, and averaging time associated with the exposure scenario to calculate the ADC using Equation 5-2.

Equation 5-2

$$ADC = \frac{(C \times ET \times EF \times ED)}{AT}$$

Where:

<i>ADC</i>	=	Average daily concentration (µg/m ³)
<i>C</i>	=	Annual-average modeled air concentration (µg/m ³)
<i>ET</i>	=	Exposure time (24 h/day)
<i>EF</i>	=	Exposure frequency (365 days/yr)
<i>ED</i>	=	Exposure duration (1 yr)
<i>AT</i>	=	Averaging Time, 1 yr × 365 days/yr × 24 hr/day

The calculated AC is used to calculate the risk estimate (MOE) for chronic non-cancer effects as described in the *Draft Risk Evaluation for 1,1,2-Trichloroethane* (U.S. EPA, 2026r). In Section 5.2, the calculated risk estimate is compared to the relative benchmark for chronic non-cancer effects to inform whether additional, refined analysis are necessary or warranted for acute non-cancer effects.

5.3.3 Lifetime Average Daily Concentration (LADC)

The LADC is defined as the mean amount of an agent to which an individual is exposed across the individual's lifetime. For purposes of this ambient air exposure assessment, EPA uses the annual-average air concentration output from the respective models used and adjusted that concentration for exposure time, exposure frequency, exposure duration, and averaging time associated with the exposure scenario to calculate the LADC using Equation 5-3.

Equation 5-3

$$LADC = \frac{(C \times ET \times EF \times ED)}{AT}$$

Where

LADC:	Lifetime Average Daily Concentration (µg/m ³)
C:	Annual average modeled concentration (µg/m ³)
ET:	Exposure Time (24 hrs/day)
EF:	Exposure Frequency (365 days/year)
ED:	Exposure duration (78 yrs resident)
AT:	Averaging Time (78 yrs x 365 days/year x 24 hrs/day)
78 =	Number of years resident assumed to reside in a single residential location (years) [from Exposure Factors Handbook]
78 =	Number of years a receptor is assumed to live (years) [from Exposure Factors Handbook]

The calculated LADC is used to calculate the risk estimate (risk) for cancer effects as described in the *Draft Risk Evaluation for 1,1,2-Trichloroethane* (U.S. EPA, 2026r). In Section 5.2, the calculated risk estimate is compared to the relative benchmark for cancer effects to inform whether additional, refined analysis are necessary or warranted for acute non-cancer effects.

5.4 Approach and Estimates for Environmental Exposures

EPA considered inhalation exposures to terrestrial species via the ambient air pathway since they may encounter industrial facilities releasing 1,1,2-trichloroethane to the ambient air. EPA applied a tiered approach for estimating concentrations of 1,1,2-trichloroethane in ambient air. The highest modeled concentration from the highly conservative Tier 1 analysis described in Section F.2.1 was 33.7 µg/m³ (Section F.2.1). This concentration represents a high-end, upper bounding (95th percentile) exposure concentration and remains below any concentrations found to cause potential acute or chronic health effects in terrestrial species and is used in screening environmental risk to terrestrial animals in the *Draft Risk Evaluation for 1,1,2-Trichloroethane* (U.S. EPA, 2026r).

5.4.1 Risk Quotient (RQ)

The RQ is defined as the ratio of estimated environmental concentration to a toxicity endpoint. In Section 5.2, if the RQ is less than one for either acute or chronic non-cancer effects, EPA determined additional, refined analysis is not necessary or warranted.

Equation 5-4

$$RQ = \frac{C}{HT}$$

Where

RQ: Risk Quotient

C: Maximum modeled concentration (µg/m³)

HT: Hazard Threshold (µg/m³)

5.5 Evidence Integration and Weight of Scientific Evidence

The physical, chemical, fate, and transport properties of 1,1,2-trichloroethane described in Sections 2 and 3, demonstrate 1,1,2-trichloroethane is a volatile chemical expected to be present in, and persist in, ambient air. Monitoring data shows measured concentrations of 1,1,2-trichloroethane are detected in ambient air further supporting the presence of 1,1,2-trichloroethane in the ambient air on a continuous basis. The release datasets described in Section 4.1.2 demonstrate 1,1,2-trichloroethane is released from industrial processes to the ambient air on a continuous basis and can be attributed to one or more OES/COUs. Taken together, and considering the weight of scientific evidence, EPA has robust confidence these lines of evidence support the ambient air pathway as a likely exposure pathway for general population to 1,1,2-trichloroethane warranting a quantitative assessment.

The approaches used for these analyses are all previously peer reviewed and underwent public comment. Additionally, EPA integrated relevant recommendations and comments received from those reviews and public comments into the analyses applied for 1,1,2-trichloroethane. Furthermore, EPA's analyses include conservative assumptions to ensure high end exposures are not missed. Finally, EPA conducts a direct comparison of modeled air concentrations to measured (monitored) concentrations obtained using multiple EPA reference methods across EPA's ambient monitoring network to confirm the conservatism integrated into the HEM modeling does not overestimate ambient concentrations of 1,1,2-trichloroethane or associated exposures experienced by the general population. Taken together, these

factors give EPA robust confidence in the approaches used for the 1,1,2-trichloroethane ambient air exposure assessment.

To assess the ambient air exposure pathway for 1,1,2-trichloroethane, EPA relies on modeling and monitoring information to inform exposure characterization. For modeling, EPA applies the tiered approach described in Section F.2 (specifically, the Tier 1, Tier 2, and Tier 3 analyses) and presents findings for all Tiers of analysis in Section 5.2. The monitoring dataset relied upon by EPA for this 1,1,2-trichloroethane ambient air assessment is limited to the AMTIC archive dataset (2018 through 2022), since EPA's systematic review process did not identify any U.S. or Canadian studies which measured ambient concentrations of 1,1,2-trichloroethane that can be attributed to OES/COUs. Available monitoring data from the AMTIC archive is discussed and analyzed in Section 5.1 and compared to the modeled concentrations from the HEM in Section 5.2.5. Results from these analyses show general population exposures based on modeling (and monitoring) result in calculated risk estimates less than the relative benchmark for chronic non-cancer effects and calculated risk estimates greater than the relative benchmark for cancer effects. However, as additional, more refined analyses and detailed investigations into facilities were conducted, EPA found general population exposures were eliminated (through discontinued use of 1,1,2-trichloroethane) or no longer resulted in calculated risk estimates less than the relative benchmark for chronic non-cancer effects or greater than the relative benchmark for cancer effects. Therefore, EPA concluded general population exposures to 1,1,2-trichloroethane via the ambient air pathway which result in calculated risk estimates less than the relative benchmarks for acute or chronic non-cancer effects and calculated risk estimates greater than the relative benchmark for cancer effects are not expected under the OES/COUs evaluated.

5.6 Conclusions and Exposure Characterization

Overall, EPA has robust confidence that the calculated air concentrations and associated exposure estimates from these analyses are representative and protective of general population exposures to 1,1,2-trichloroethane from industrial releases which are associated with the OES/COUs evaluated. EPA has robust confidence the results from these analyses can be used to derive risk estimates, characterize risks for the general population exposure to 1,1,2-trichloroethane, and inform risk determination and regulatory decision-making. Therefore, results from the final tier of analysis for the ambient air pathway, inhalation route are carried into the *Draft Risk Evaluation for 1,1,2-Trichloroethane* ([U.S. EPA, 2026r](#)) and used to derive risk estimates, and inform risk determination and regulatory decision-making.

6 SURFACE WATER AND SEDIMENT PATHWAY ASSESSMENT

For the evaluation of surface water and aquatic sediment, EPA reviewed available monitoring data and modeling of facility-specific and generic scenario releases to surface water. EPA searched peer-review literature, gray literature and databases of environmental monitoring data to obtain concentrations of 1,1,2-trichloroethane in ambient surface water, aquatic sediments and drinking water (Section 6.1). These monitoring data are used to provide, where possible, contextual and supporting information to modeled releases which represents the bulk of analysis in the surface water and sediment pathways.

The Agency modeled 1,1,2-trichloroethane concentrations in surface water and aquatic sediment resulting from facility-specific and generic scenario releases from TSCA COUs (COUs presented in Table 4-2). Ten OESs supporting the TSCA COUs had facility-specific release information reported to TRI and DMR databases which were used for the facility-specific modeling, while 3 OESs had developed generic scenarios with potential water releases (See Section 4 for discussion of generic scenarios).

6.1 Measured Concentrations

1,1,2-Trichloroethane has been measured in surface water, aquatic sediment and drinking water and illustrate that these media are potential pathways of exposure to both environmental aquatic biota and the general human population. Below the approaches for reviewing, synthesizing and characterizing available data in these media are discussed.

6.1.1 Measured Concentrations in Surface Water

EPA reviewed data from available peer reviewed literature as well as available national and state databases to characterize concentrations of 1,1,2-trichloroethane in surface water. Data was prioritized for monitoring data from the past 10 years from the United States or Canada as they are most temporally and spatially relevant to this evaluation. Based on these search strategies, no available peer reviewed monitoring information was identified.

Surface water concentration results were acquired from the Water Quality Portal (Available at: www.waterqualitydata.us) which represents the largest repository by scope and duration with nationwide coverage for the years of 2015 to 2025 and houses publicly available water quality data from the U.S. Geological Survey (USGS), EPA, and state, federal, Tribal, and local agencies. Full details of retrieved surface water data are available at Draft Surface Water and Sediment Monitoring Data for 1,1,2-Trichloroethane (U.S. EPA, 2026s). Sampling programs were generally not designed to target specific chemical occurrences (timing, frequency, site selection) or TSCA COUs, and sampling frequency is typically sporadic in nature. A total of 1,051 samples were retrieved for the years 2015 – 2025 with the vast majority of those samples reporting non-detectable measurements with an overall low detection frequency of 1.6% (Table 6-1). Samples were reported from a total of 23 states with the highest number of samples reported in ND, UT, and CA (Figure 6-1; Figure 6-2). Of the overall 1,051 samples, 1,018 reported the detection limit which ranged from 0.0349 to 10 µg/L and a median value of 0.5 µg/L.

A total of 17 surface water samples were measured above the detection limit across 6 states (AL, CA, FL LA, MN, and PA) and were reported to the Water Quality Portal 2015 – 2025 (Table 6-1). Reported samples ranged from 0.25 to 10.8 µg/L with a median value of 1 µg/L and a 95th percentile value of 5.4 µg/L (Table 6-1; Figure 6-3). Caution should be used when interpreting this data due to the small number of samples, potential lack of geospatial and temporal resolution with areas of 1,1,2-trichloroethane release and lack of samples collected from the same sites over multiple years.

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Table 6-1. Measured Concentrations of 1,1,2-Trichloroethane in Surface Water from the Water Quality Portal (2015–2025) ^a

Year	Detection Frequency	Concentration in All Samples (µg/L) ^b			Concentration in Only Samples Above the Detection Limit (µg/L)		
		No. of Samples (No. of Unique Locations)	Range ^c	Median/95th Percentile	No. of Samples (No. Unique Locations) ^d	Range	Median/95th Percentile
2015 – 2025	1.6%	1,051 (247)	ND to 10.8	0.25 / 2.5	17 (14)	0.25 – 10.8	1 / 5.4

^a Data were downloaded from the WQP (www.waterqualitydata.us) on January 12, 2026 with full details available at *Draft Surface Water and Sediment Monitoring Data for 1,1,2-Trichloroethane* (U.S. EPA, 2026s).

^b A total of 1,054 samples were either blank (n=10) or reported as non-detects (n = 1,044). Of those samples recorded as non-detects, 1,038 had reported data at or below the level of detection.

^c ND = Not Detected. Reported detection limits in all samples ranged from 0.0349 – 10 µg/L

^d Detection limits of samples above detection limit ranged from 1 – 4 µg/L. Detectable samples were reported in AL, CA, FL, LA, MN, and PA

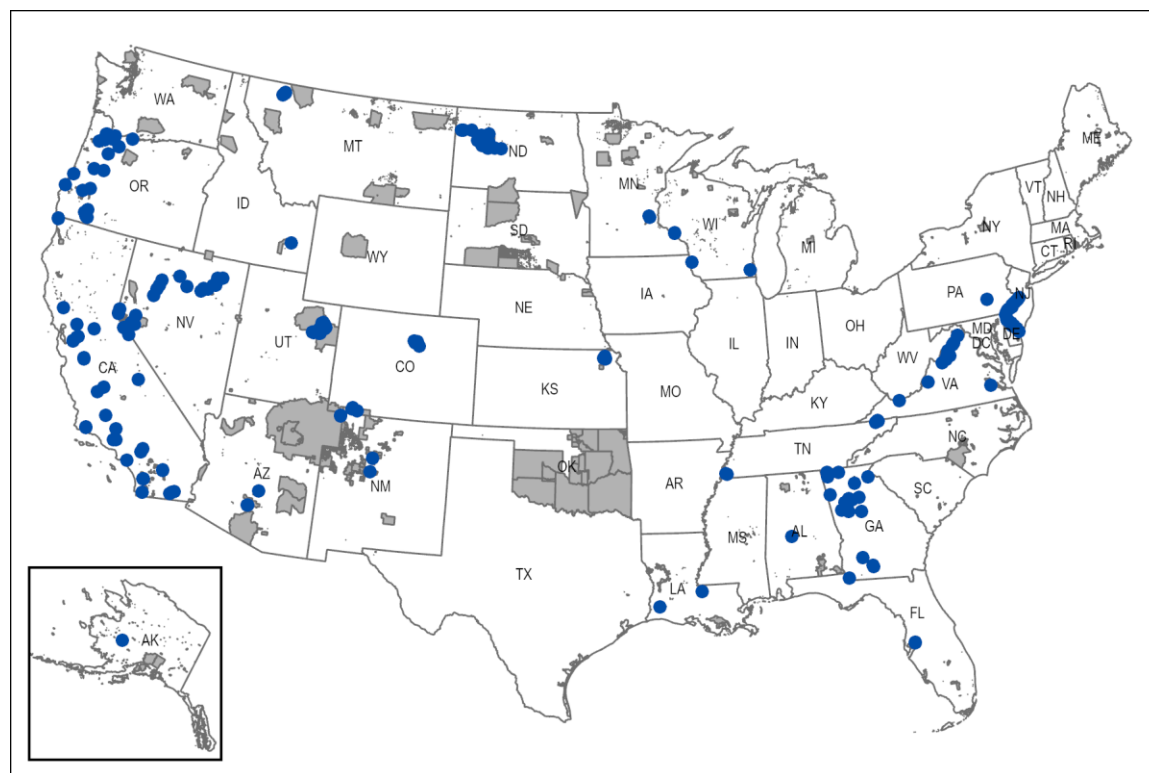


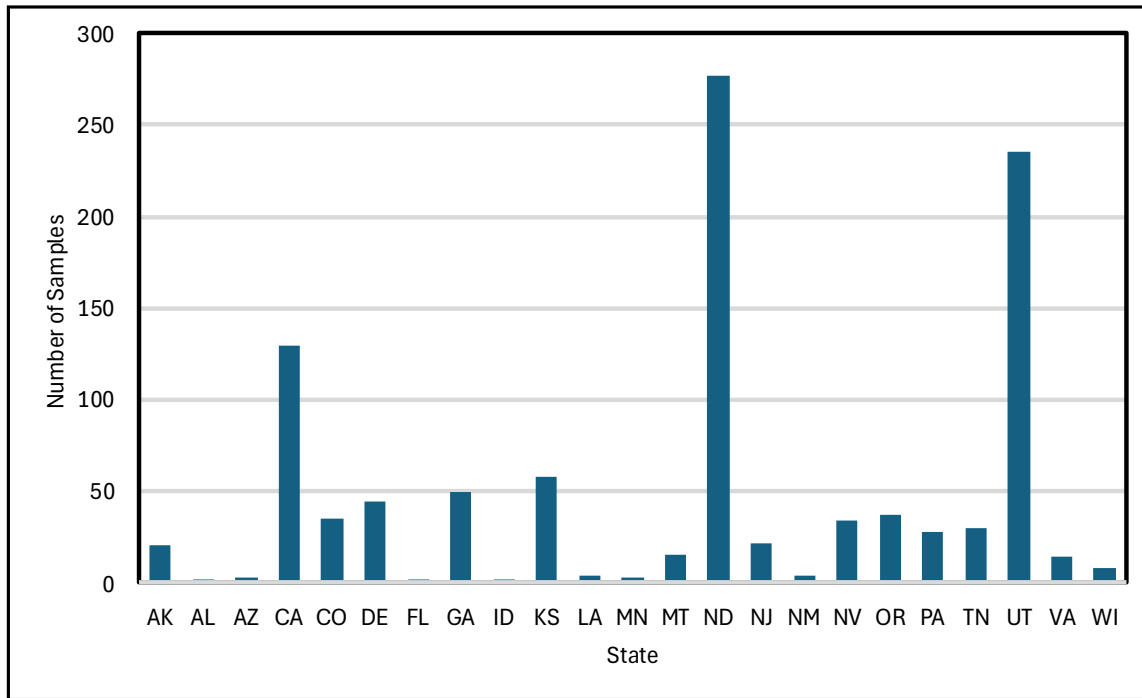
Figure 6-1. Surface Water Sampling Locations of 1,1,2-Trichloroethane Retrieved from the Water Quality Portal (2015–2025).

American Indian/Alaska Native/Native Hawaiian (AIANNH) tribal boundaries are shaded in gray as found at U.S. Census Bureau⁹.

Note: American Samoa, Guam, Hawaii, N. Mariana Islands, Puerto Rico, and the U.S. Virgin Islands are not shown because the WQP does not contain 1,1,2-trichloroethane surface water monitoring for these locations

⁹ Available at: <https://www.census.gov/cgi-bin/geo/shapefiles/index.php?year=2025&layergroup=American+Indian+Area+Geography>

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Figure 6-2. Reported Number of Surface Water Samples by State with Monitoring Data for 1,1,2-Trichloroethane Entered into the Water Quality Portal (2015-2025).

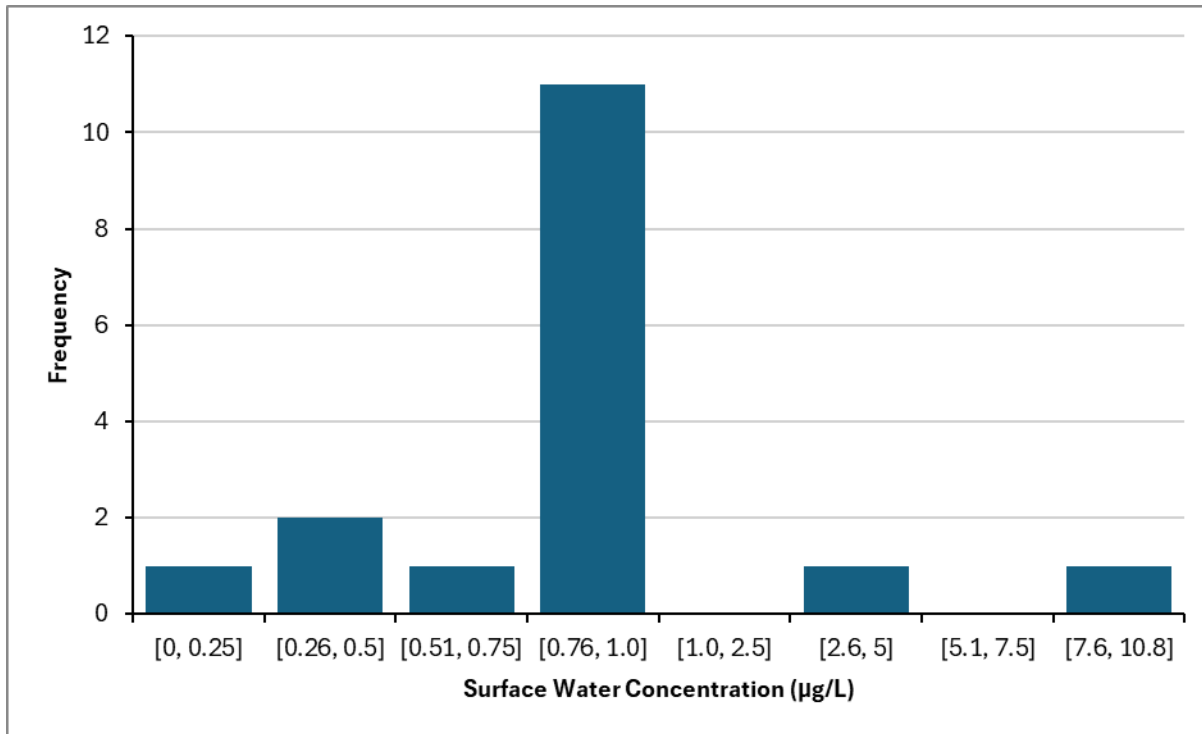


Figure 6-3. Distribution of 1,1,2-Trichloroethane Concentrations in Surface Water Monitoring Samples above Detection Limit as Reported to the Water Quality Portal (2015-2025).

6.1.2 Measured Concentrations in Sediment

EPA reviewed data from available peer reviewed literature as well as available national and state databases to characterize concentrations of 1,1,2-trichloroethane in sediment. Data was prioritized for looking at monitoring data from the past 10 years from the United States or Canada as these data are most temporally and spatially proximate to evaluated known and modeled releases within this 1,1,2-trichloroethane risk evaluation. Based on these search strategies, no available peer reviewed monitoring information was identified. Sediment concentration results were acquired from the Water Quality Portal (WQP) (Available at: www.waterqualitydata.us) which represents the largest repository by scope and duration with nationwide coverage for the years of 2015 to 2025 and houses publicly available water quality data from the U.S. Geological Survey (USGS), EPA, and state, federal, Tribal, and local agencies. Full details of retrieved sediment data are available at *Draft Surface Water and Sediment Monitoring Data for 1,1,2-Trichloroethane* supplemental file ([U.S. EPA, 2026s](#)). Sampling programs were generally not designed to target specific chemical occurrences (timing, frequency, site selection) or TSCA COUs and sampling frequency is typically sporadic in nature. A total of 351 samples were retrieved from the WQP between the years of 2015 to 2025 (Table 6-2). Greater than 90% of the samples were collected as part of the EPA Great Lakes National Program (n = 321) from a variety of sampling locations throughout the Great Lakes region. Detection limits varied widely across reporting organization, location and event, but for all retrieved samples, values were recorded as at or below the reported detection limit indicating that monitored concentrations are uniformly low.

Table 6-2. Measured Concentrations of 1,1,2-Trichloroethane in Sediment Samples Obtained from the Water Quality Portal (WQP): 2015-2025 ^a

Year	Reporting Organization	Samples	Reported Values
2015, 2020	EPA Great Lakes National Program, Great Lakes, USA (2 locations)	2	Estimated value and/or under reported DL of 0.21 – 300 µg/kg depending on sample
2021	Palermo Wellfield Superfund Site, WA, USA (5 locations)	5	All listed as less than reported DL of 9.6 – 48 µg/kg depending on sample
2020	EPA Great Lakes National Program, Great Lakes, USA (4 locations)	8	All listed as estimated or less than under reported DL of 1 µg/L ^b
2015, 2020, 2021	EPA Great Lakes National Program, Great Lakes, USA (130 locations)	308	All listed as estimated value and/or less than DL or QL of 33 – 110,000 µg/kg depending on sample ^c
2019	USGS TX Water Center, TX, USA (9 locations)	28	All listed as less than reported DL of 89 – 410 µg/kg depending on sample
DL = Detection Limit; QL = Quantification Limit			
^a Data were downloaded from the WQP (www.waterqualitydata.us) on January 12, 2026 with full details available at <i>Draft Surface Water and Sediment Monitoring Data for 1,1,2-Trichloroethane</i> (U.S. EPA, 2026s).			
^b Concentrations reported as µg/L are more consistent with saturation or unconsolidated sediments			
^c Not all samples reported a detection limit			

6.1.3 Measured Concentrations in Drinking Water

The 1996 Amendments to the Safe Drinking Water Act (SDWA) require that the Environmental Protection Agency (EPA) “shall, not less often than every 6 years, review and revise, as appropriate, each national primary drinking water regulation.” Called the Six-Year Review (SYR), its purpose is to evaluate current information for regulated contaminants to determine if there is new information on health effects, treatment technologies, analytical methods, occurrence and exposure, implementation, and/or other factors that provide a health or technical basis to support a regulatory revision that will improve or strengthen public health protection ([U.S. EPA, 2024a](#)).

1,1,2-Trichloroethane is a regulated drinking water contaminant and included in the periodic SYR monitoring efforts under the SDWA. The most recent data is available from 2024, the fourth iteration of the review (SYR 4) and presents 1,1,2-trichloroethane detection frequency ([U.S. EPA, 2024a](#)). Monitoring data was collected between the years 2012 – 2019 from 52,200 public water systems (PWS) for a total of 482,294 total samples. These samples indicated that 113 systems (0.22% of all systems) representing a potential of 2,517,275 people (0.92% of all population served) had at least a single detection of 1,1,2-trichloroethane, with detected concentrations ranging from 0.25 – 4.9 µg/L (5th – 95th percentile). This detection frequency is similar to previous six-year review cycles which showed PWS

detection frequencies of 0.62% (SYR 1, 1993 – 1997); 0.18% (SYR 2, 1998 – 2005); and 0.21% (SYR 3, 2006 – 2011). Of those systems with a detection in the SYR 4 cycle, 5 systems (0.010% of all systems) had a detection greater than the maximum contaminant level (MCL) of 5 µg/L serving a potential population of 392,172 people (0.143% of all population served). This is again similar to previous reporting cycles showing percentage of systems with a detection greater than the MCL of 0.04% (SYR 1); 0.01% (SYR 2); and 0.01% (SYR 3). These measures of detection represent a conservative approach based on if even one monitoring sample is above the concentration threshold for a given chemical. Follow on analysis evaluating longer term average concentrations for 1,1,2-trichloroethane between 2012 – 2019 showed that no PWS nationwide had an estimated mean concentration greater than the MCL of 5 µg/L. Two PWS in Virginia, serving 50 people, had estimated mean concentrations greater than the maximum contaminant level goal (MCLG) of 3 µg/L with both PWS having groundwater as their source water. Nationwide, no PWS with surface water as the source of drinking water had mean concentrations greater than the MCLG.

6.2 Modeling Approach and Estimates for Surface Water and Drinking Water Concentrations

6.2.1 Surface Water Concentrations

1,1,2-Trichloroethane is known to be released to surface waters from direct discharge of wastewater from industrial operations and wastewater treatment plant facilities as covered under TSCA COUs. EPA modeled facility-specific identified releases and potential generic scenario releases associated with relevant OESs of 1,1,2-trichloroethane to surface water.

EPA modeled concentrations of 1,1,2-trichloroethane in surface water based on both reported facility-specific releases reported to the TRI and DMR databases between 2019 – 2023 as well as estimated generic scenario releases based on OES. These modeled surface water concentrations are used to evaluate different exposure scenarios for both the general population (incidental dermal and oral exposures, and drinking water; Sections 6.4.1, 6.4.2, and 6.4.3) and to environmental biota (Section 6.5). Differences in modeling approaches between facility-specific and generic scenario releases are described below for facility-specific releases in Section 6.2.1.1 and generic scenarios in Section 6.2.1.2 , but begins with common elements across both approaches.

Estimated concentrations within surface water, drinking water and sediment followed a tiered approach, whereby the specific needs of estimating exposures to the general population and environmental biota and the corresponding development of the draft risk evaluation for 1,1,2-trichloroethane dictate which tiers are applied. These tiers are described in more detail for both facility-specific and generic scenarios below but generally rely on calculated risk estimates to inform whether additional, more refined analyses are necessary or warranted for each tier of analysis. For the general population, EPA relies on calculated risk estimates (MOEs or risks) which are based on the points of departure (PODs) and benchmarks presented in the *Draft Human Health and Environmental Hazard Assessment for 1,1,2-Trichloroethane* ([U.S. EPA, 2026l](#)) and associated risk equations and calculations presented in the *Draft Risk Evaluation for 1,1,2-Trichloroethane* ([U.S. EPA, 2026r](#)). General population non-cancer endpoints are informed by the calculated MOEs and their relationship to human health hazard values and defined benchmark MOEs. Exposure scenarios resulting in MOEs less than benchmark for non-cancer endpoints and greater than benchmark for cancer endpoints were identified for further review and potential higher tier analysis and refinement. For environmental populations, preliminary risk estimates are informed by calculated risk quotients (RQs) that are derived from identified concentrations of concern (COCs) to

exposed environmental populations. A risk quotient is defined as the predicted environmental concentration divided by the hazard threshold or COC. RQs>1 are identified as scenarios that result in review and potential higher tier analysis and refinement. More discussion on these approaches and human health and environmental hazard values is found in *Draft Human Health and Environmental Hazard Assessment for 1,1,2-Trichloroethane* ([U.S. EPA, 2026l](#)) and *Draft Risk Evaluation for 1,1,2-Trichloroethane* ([U.S. EPA, 2026r](#)). Ultimately, any refinement or higher tiering of analysis is designed to ensure potential exposures (and associated risks) are not missed and are representative of the environmental or general populations.

For an initial evaluation of surface water concentrations for both facility-specific and generic scenario approaches, generation of modeled surface water concentrations employed the equations within the E-FAST 2014 model ([U.S. EPA, 2007b](#)), but were conducted in an excel workbook format. Advantages in using the E-FAST approach include that it requires minimal input parameters and has undergone extensive peer review by experts outside of EPA. E-FAST 2014 is a model that estimates chemical concentrations in water to which aquatic life may be exposed using upper percentile and/or mean exposure parametric values, resulting in possible conservative exposure estimates. Other assumptions and uncertainties in the model and input data, including ways it may be underestimating or overestimating exposure are discussed below. Benefits of employing these approaches outside of the E-FAST tool include increased flexibility, efficiency and repeatability. Importantly, using the excel format allows for incorporation of newer and more relevant hydrologic flow information than was included in the older, underlying, E-FAST software (the EPA original Reach File 1 dating back to 1984) which is described in detail below. With this improved approach, facility-specific and generic scenario modeling can be conducted using a similar methodology and logic to the E-FAST 2014 tool, but with updated hydrologic flow information that improves confidence in the accuracy of the estimated surface water concentrations, and for facility-specific modelling, better linkages between the facility releases and their true receiving water body.

Inputs necessary to estimate surface water concentrations across both approaches include the amount of chemical released to wastewater, the number of release days, removal of the chemical due to wastewater treatment, and receiving water body streamflow. For the purposes of this initial assessment, estimated surface water concentrations represent conservative, higher-end concentrations at the point of discharge and do not incorporate physical, chemical, and environmental fate properties or hydrologic transport that may impact actual concentrations downstream.

A key input when modeling surface water concentrations for these different exposure scenarios is the flow of the receiving waterbody, with different hydrologic flow rates used for different exposure scenarios. The 30Q5 flows (*i.e.*, the lowest 30-day average flow that occurs in a 5-year period) are used to estimate acute, incidental human exposure through swimming or recreational contact and acute exposure via drinking water. The annual average flow represents long-term flow rates, but a harmonic mean provides a more conservative estimate and is preferred for assessing potential chronic human exposure via drinking water. The harmonic mean is also used for estimating human exposure through fish ingestion because it takes time for chemical concentrations to accumulate in fish. Lastly, for aquatic or ecological exposure, a 7Q10 flow (*i.e.*, the lowest 7-day average flow that occurs in a 10-year period) is used to estimate exceedances of concentrations of concern for aquatic life ([U.S. EPA, 2007b](#)). Different approaches are used to estimate these flows dependent on whether the releasing facility is identified from the TRI and DMR databases or estimated as a generic scenario and described below.

6.2.1.1 Facility-Specific Releases

6.2.1.1.1 Tier 1 – Approach and Estimates of Surface Water Concentration

Annual releases of 1,1,2-trichloroethane to surface waters from regulated facility discharges were retrieved from the TRI and DMR public data records for the 2019 – 2023 reporting period. Annual releases generated for facility-specific releases were converted to daily releases based on two release patterns with different numbers of operating days. One release pattern used estimated facility operating days for each OES as described in Section 4.1.4 and the second release pattern used a 21-day operating day scenario. The former scenario assumes releases occur during all facility operating days and provides a refined analysis and more realistic surface water concentrations for estimating drinking water exposure, incidental oral and dermal exposure estimates. The latter scenario provides a more conservative facility release pattern based on the best available information that could lead to risk from chronic exposure for aquatic species. For generic scenarios, annual releases were converted to daily releases based on an estimated central tendency and high-end number of operating days as described in Section 4.2.

To the extent possible, modeled hydrologic flow data (*i.e.*, stream flow) associated with a facility's receiving water body via NPDES permit information was retrieved from the NHDPlus V2.1 dataset ([U.S. EPA and U.S.G.S., 2016](#)). In instances where a representative receiving waterbody was either not identified in the NPDES permit, not found in the NHDPlus dataset, or unable to be identified through professional judgement, use of available facility effluent rate or effluent monitoring information was used from the EPA Enforcement and Compliance History Online (ECHO) database.

The ECHO database was accessed December 2025 and queried for the facilities reporting releases of 1,1,2-trichloroethane.¹⁰ All available NPDES permit IDs were retrieved from the facilities returned by the query. An additional query of the DMR REST service was conducted via the ECHO API to return NHDPlus reach code associated with the receiving water body for each available facility. Modeled flow metrics were then extracted for the retrieved reach codes from the National Hydrography Dataset (NHD) Plus V2.1 Flowline Network Enhanced Unit Runoff Method (EROM) Flow database. EROM is used to estimate mean annual flow and incremental flow for NHDFlowline Features in the NHDPlus HR network. The EROM Flow database provides modeled monthly average flows for each month of the year and mean annual flows. While the EROM Flow database represents averages across a 30-year period, the lowest of the monthly average flows for a receiving waterbody was selected as a substitute for the 30Q5 flow used in modeling, as both approximate the lowest observed monthly flow at a given location. The substitute 30Q5 flow was then plugged into the regression equation used by E-FAST General Population and Ecological Exposure From Industrial Releases Module to convert between these flow metrics and solved for the 7Q10 flow using Equation 6-1 ([U.S. EPA, 2007b](#)). As in previous EPA TSCA assessments, EPA has selected the 7Q10 flow as a representative low flow scenario for biological impacts due to effluent in streams, while the harmonic mean represents a more average flow for assessing chronic drinking water exposure and fish ingestion exposure.

Equation 6-1. Calculation of 7Q10 Flow

$$7Q10 = \frac{(0.409 \frac{cfs}{MLD} \times \frac{30Q5}{1.782})^{1.0352}}{0.409 \frac{cfs}{MLD}}$$

¹⁰ The EPA Enforcement and Compliance History Online (ECHO) Database is available at: <https://echo.epa.gov/>

Where:

$7Q10$ = Modeled 7Q10 flow, in MLD (million liters per day)
 $30Q5$ = Lowest monthly average flow from NHD, in MLD
 cfs = cubic feet per second

Furthermore, the harmonic mean (HM) flow was calculated using Equation 6-2, derived from the relevant E-FAST regression.

Equation 6-2. Calculation of Harmonic Mean Flow

$$HM = \frac{(0.409 \frac{cfs}{MLD} \times AM)^{0.473} \times (0.409 \frac{cfs}{MLD} \times 7Q10)^{0.552}}{0.409 \frac{cfs}{MLD}}$$

Where:

HM = Modeled harmonic mean flow, in MLD (million liters per day)
 AM = Annual average flow from NHD, in MLD
 $7Q10$ = Modeled 7Q10 flow from the previous equation, in MLD
 cfs = cubic feet per second

In addition to the hydrologic flow data retrieved from the NHDPlus database, information about the facility effluent rate was collected, as available, from the ECHO API. Where the facility effluent rate exceeded the hydrologic flow, the facility plant effluent flow rate was applied as the flow in the receiving water body. If neither the NHDPlus nor plant effluent flow were available, the measured 1,1,2-trichloroethane effluent concentration was substituted for the modeled concentration.

EPA used the equation for free-flowing water bodies within E-FAST 2014 to estimate site-specific surface water concentrations for documented releases. Surface water concentrations are calculated using the following equation:

Equation 6-3. Calculation of Surface Water Concentrations

$$SWC = \frac{WWR \times CF1 \times \left(1 - \frac{WWT}{100}\right)}{SF \times CF2}$$

Where:

SWC = Surface water concentration (parts per billion (ppb) or $\mu g/L$)
 WWR = Chemical release to wastewater (kg/day)
 WWT = Removal from wastewater treatment (%)
 SF = Estimated flow of the receiving stream (million liters/day (MLD))
 $CF1$ = Conversion factor ($10^9 \mu g/kg$)
 $CF2$ = Conversion factor ($10^6 L/day/MLD$)

Reported facility releases to DMR represent facilities that directly discharge to surface water (*i.e.* “direct releasers”) that have already undergone potential wastewater treatment and therefore a WWT value of 0 was applied when estimating surface water concentrations for these releases. TRI reported releases may represent either indirect (*i.e.* undergo WWT prior to discharge to surface water) or direct releases. Direct releases reported in TRI similarly have already undergone potential WWT and a value of zero was

applied. 1,1,2-trichloroethane had one reported indirect release and this release was assumed to undergo wastewater treatment prior to discharge to surface waters with a removal rate of 73% based on information presented in Section 3.5.2.

Surface water concentrations were modelled for each facility for all years of available data between 2019 – 2023 for both release day scenarios (operating days vs. 21 days) and for all relevant flow metrics for evaluation of exposure pathways (7Q10, 30Q5, and HM). Individual facilities were grouped into their respective OESs. To characterize the surface water impacts of facility-specific discharges, EPA selected each facility's highest release across the 2019-2023 five-year time period and compiled those releases according to OES as an initial evaluation step. Table_Apx G-1 presents the highest 7Q10 flow surface water concentration across all facilities and reporting years for each OES which is used to evaluate environmental exposures. Table_Apx G-2 presents the highest 30Q5 and HM flow surface water concentrations across all facilities and reporting years for each OES which is used to evaluate general population exposures. Note that the highest facility representing a given OES may differ between these two tables due to differences in the source of flow information used to estimate surface water concentrations. Complete modeling of all facility release data across all years are available in *Draft Surface Water Concentration Modeling and Environmental Exposure for 1,1,2-Trichloroethane* supplemental file ([U.S. EPA, 2026t](#)).

Using these initially E-FAST modeled surface water concentrations, exposures and risk estimates for environmental and general populations were calculated as described in Section 6.4 for the general population and in Section 6.5 for environmental populations. For the environmental populations, OESs with calculated acute and/or chronic risk quotients greater than 1 were flagged for additional tiers of analysis. For the general population, incidental oral and dermal exposures scenarios and acute and chronic non-cancer drinking water scenarios resulting in risk estimates (MOEs) less than the relative benchmark were identified for additional tiers of analysis (Acute MOE = 30 and Chronic MOE = 300). Chronic cancer effects greater than the relative benchmark of 1.0×10^{-6} were identified for potential additional tiers of analysis. The estimation of these doses and potential risks are shown as follows: Environmental Aquatic Species Exposure to Surface Water: Surface water concentrations in Table_Apx G-1 and preliminary risks in Table_Apx G-3.

- Incidental Dermal Exposure via Surface Water to the General Population: Doses in Table_Apx G-4 and potential preliminary risks in Table_Apx G-5
- Incidental Oral Exposure via Surface Water to the General Population: Doses in Table_Apx G-6 and potential preliminary risks in Table_Apx G-7
- Drinking Water Exposure to the General Population: Doses in Table_Apx G-8 and potential preliminary risks in Table_Apx G-9

Table 6-3 gives the results for each of the evaluated OES and potential identification of risk for 1,1,2-trichloroethane Tier 1 analysis. Full description and quantification of these exposure and risk estimates is available in Appendix G, *Draft Surface Water Concentration Modeling and Environmental Exposure for 1,1,2-Trichloroethane* supplemental file ([U.S. EPA, 2026t](#)), *Draft General Population Surface Water Pathway Exposure Estimates for 1,1,2-Trichloroethane* supplemental file ([U.S. EPA, 2026k](#)), and the *Draft Risk Evaluation for 1,1,2-Trichloroethane* ([U.S. EPA, 2026r](#)).

Table 6-3. Identified Preliminary Risk for Tier 1 Environmental and General Population Exposure Scenarios by Occupational Exposure Scenario

OES	Environmental Exposure				General Population Exposure					
	Acute Aquatic Vertebrates and Invertebrates	Chronic Aquatic Vertebrates	Algae	Further Refinement Needed?	Incidental Dermal	Incidental Oral	Drinking Water Acute Non-cancer	Drinking Water Chronic Non-cancer	Drinking Water Cancer	Further Refinement Needed?
Manufacturing as a Byproduct	No	No	No	No	No	No	No	No	Yes	Yes
Not Mapped to an OES	No	No	No	No	No	No	No	No	Yes	Yes
Processing as a Reactant	No	Yes	Yes	Yes	No	No	No	Yes	Yes	Yes
Repackaging	No	No	No	No	No	No	No	No	No	No
Use of laboratory chemicals	No	No	No	No	No	No	No	No	No	No
Waste Handling, Disposal and Treatment (Incineration)	No	No	No	No	No	No	No	No	No	No
Waste Handling, Disposal and Treatment (Landfill)	No	No	No	No	No	No	No	No	No	No
Waste Handling, Disposal and Treatment (non-POTW WWT)	No	No	No	No	No	No	No	No	Yes	Yes
Waste Handling, Disposal and Treatment (POTW)	No	No	No	No	No	No	No	No	Yes	Yes
Waste Handling, Disposal and Treatment (Remediation)	No	No	No	No	No	No	No	No	No	No
OES = occupational exposure scenario; POTW = publicly owned treatment works; WWT = wastewater treatment										

6.2.1.1.2 Tier 2 – Approach and Estimates of Surface Water Concentration

Tier 1 exposure estimates to both the human general population and environmental populations identified scenarios where preliminary risk was identified and additional tiers of refinement to initial modeled surface water concentration estimates were warranted. Based on the Tier 1 facility-specific surface water concentration estimates, 13 facilities across five OES identified preliminary risk for either or both general population and environmental pathways. Following identification of scenarios indicating preliminary risk, initial Tier 1 inputs and results were reviewed for potential refinement of estimated surface water concentrations. In particular, facilities were reviewed for availability of effluent monitoring information of 1,1,2-trichloroethane as reported within the ECHO database. Where appropriate, these reported effluent concentrations were used as more representative maximum estimates of potential concentrations entering surface waterbodies. These monitored concentrations were used across all evaluated flow metrics, followed by reassessment of exposures to relevant populations. A total of four facilities identified with exposure concentrations indicating Tier 1 analysis preliminary risk were able to be refined and are given in Table_Apx G-10.

The refinement of these facilities resulted in a revised highest representative facility 7Q10 surface water concentration and 30Q5/HM flow surface water concentration as compared to those shown in Tier 1 analyses for the Processing as a Reactant OES and the Waste Handling, Disposal and Treatment (POTW) OES (Tier 1: Table_Apx G-1; Table_Apx G-2). Refined Tier 2 7Q10 flow surface water concentrations are shown in Table 6-4 for evaluation of environmental exposure and Tier 2 30Q5/HM flow surface water concentrations in Table 6-5 for evaluation of general population exposures. Other identified OESs remained the same between Tier 1 and Tier 2 modeled concentration estimates. Overall, after Tier 2 evaluation, modeled surface water concentrations were highest for the Manufacturing as a Byproduct OES with a maximum estimated 7Q10 flow concentration of 2,415 µg/L and 145 µg/L for the 21 operating day and maximum operating day release scenarios respectively (Table 6-4). Manufacturing as a Byproduct also had the highest 30Q5 flow and HM flow concentrations at 78 µg/L and 43 µg/L respectively across all modeled OES (Table 6-5).

Following generation of Tier 2 surface water concentration estimates, preliminary risk was re-evaluated for both environmental and general populations to determine whether additional tiers of refinement were warranted (Table 6-6). Preliminary risk remained for general population drinking water exposure and refinement of these concentrations is described in Section 6.2.2. No further refinement of surface water concentrations was necessary for evaluation of environmental population exposures or incidental dermal and incidental oral exposures to the general population. These exposures are further described for incidental dermal and oral exposures to the general population in Sections 6.4.1 and 6.4.2 and for environmental populations in Section 6.5

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Table 6-4. Facilities with Highest Modeled 7Q10 Surface Water Concentrations per Occupational Exposure Scenario (OES) for TRI and DMR Releases 2019 – 2023 for Tier 2 Surface Water Evaluation.

OES (NPDES) ^a	Annual Release (kg/yr)	Operating Days	Daily Release Estimate (kg/d)	7Q10 Flow (mld)	7Q10 Conc. (µg/L)
Manufacturing as a Byproduct (LAJ660151) ^b	38	21	1.8	0.75	2,415
		350	0.11		145
Not Mapped to an OES (NV0022888 ^b ; NV0024239 ^c) ^e	0.76	21	3.6E-02	3.3	11
	4.0E-02	250	1.6E-04	NA	7.9
Processing as a Reactant (IL0002917) ^d	11	21	0.54	2.7	196
		350	3.2E-02		12
Repackaging (IL0005126) ^b	428	21	20	438	46
		250	1.7		3.9
Use of Laboratory Chemicals (CO0001511) ^d	5.9E-02	21	2.8E-03	0.15	18
		260	2.3E-04		1.5
Waste Handling, Disposal and Treatment (Incineration) (CA0030210) ^c	2.3E-02	21	1.1E-03	0.16	6.6
		250	9.0E-05		0.56
Waste Handling, Disposal and Treatment (Landfill) (KY0099660) ^b	0.64	21	3.0E-02	3.1	9.7
		250	2.6E-03		0.81
Waste Handling, Disposal and Treatment (non-POTW WWT) (CA0057827) ^b	1.1	21	5.3E-02	0.33	161
		250	4.4E-03		13
Waste Handling, Disposal and Treatment (POTW) (KY0107107) ^b	34	21	1.6	19	88
		365	9.4E-02		5.1
Waste Handling, Disposal and Treatment (Remediation) (RI0022942 ^b ; VAG830596 ^c) ^e	0.23	21	1.1E-02	0.52	21
	5.4E-03	250	2.1E-05	NA	5
7Q10 = the modeled 7Q10 flow, in MLD (million liters per day); 30Q5 = the lowest monthly average flow from NHD, in MLD; NPDES = National Pollutant Discharge Elimination System facility permit number ^a See Table 4-2 for crosswalk between Occupational Exposures Scenarios OES) and Conditions of Use (COU) ^b Concentrations based on flows from NHDPlus EROM dataset ^c Concentrations based on effluent flow concentrations for representative facility extracted from Enforcement and Compliance History Online Dataset (ECHO) ^d Concentrations based on plant flow for representative facility extracted from Enforcement and Compliance History Online Dataset (ECHO) ^e Not Mapped to an OES and Waste Handling, Disposal and Treatment (Remediation) OES had different facilities representing the highest 7Q10 flow surface water concentrations for the 21 and 250 operating day scenarios.					

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Table 6-5. Facilities with Highest Modeled 30Q5 and HM Surface Water Concentrations per Occupational Exposure Scenario (OES) for TRI and DMR Releases 2019 – 2023 for Tier 2 Surface Water Evaluation.

OES (NPDES) ^a	Annual Release (kg/yr)	Operating Days	Daily Release Estimate (kg/d)	30Q5 Flow (mld)	HM Flow (mld)	30Q5 Conc. (µg/L)	HM Conc. (µg/L)
Manufacturing as a Byproduct (LAJ660151) ^b	38	350	0.11	1.4	2.5	78	43
Not Mapped to an OES (NV0024239) ^c	4.0E-02	250	1.6E-04	NA	NA	7.9	7.9
Processing as a Reactant (IL0002917) ^d	11	350	3.2E-02	2.7	2.7	12	12
Repackaging (IL0005126) ^b	428	250	1.7	654	949	2.6	1.8
Use of Laboratory Chemicals (CO0001511) ^d	5.9E-02	260	2.3E-04	0.15	0.15	1.5	1.5
Waste Handling, Disposal and Treatment (Incineration) (CA0030210) ^b	2.3E-02	250	9.0E-05	0.32	0.92	0.28	9.8E-02
Waste Handling, Disposal and Treatment (Landfill) (KY0099660) ^b	0.64	250	2.6E-03	5.6	9	0.46	0.28
Waste Handling, Disposal and Treatment (non-POTW WWT) (NN0030343) ^d	0.11	250	4.5E-04	5.0E-02	5.0E-02	9.1	9.1
Waste Handling, Disposal and Treatment (POTW) (KY0020974) ^{b d}	3.3	365	9.0E-03	1.8	2.2	4.9	4.1
Waste Handling, Disposal and Treatment (Remediation) (VAG830596) ^c	5.4E-03	250	2.1E-05	NA	NA	5	5
7Q10 = the modeled 7Q10 flow, in MLD (million liters per day); 30Q5 = the lowest monthly average flow from NHD, in MLD; DMR = Discharge Monitoring Report; HM = harmonic mean; NPDES = National Pollutant Discharge Elimination System facility permit number; TRI = Toxics Release Inventory ^a See Table 4-2 for crosswalk between Occupational Exposures Scenarios OES) and Conditions of Use (COU) ^b Concentrations based on flows from NHDPlus EROM dataset ^c Concentrations based on effluent flow concentrations for representative facility extracted from Enforcement and Compliance History Online Dataset (ECHO) ^d Concentrations based on plant flow for representative facility extracted from Enforcement and Compliance History Online Dataset (ECHO)							

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Table 6-6. Identified Preliminary Risk for Tier 2 Environmental and General Population Exposure Scenarios by Occupational Exposure Scenario

OES	Environmental Exposure				General Population Exposure					
	Acute Animals	Chronic Vertebrates	Algae	Further Refinement Needed?	Incidental Dermal	Incidental Oral	Drinking Water Acute Non-cancer	Drinking Water Chronic Non-cancer	Drinking Water Cancer	Further Refinement Needed?
Manufacturing as a Byproduct	No	No	No	No	No	No	No	No	Yes	Yes
Not Mapped to an OES	No	No	No	No	No	No	No	No	Yes	Yes
Processing as a Reactant	No	No	No	No	No	No	No	No	Yes	Yes
Repackaging	No	No	No	No	No	No	No	No	No	No
Use of Laboratory Chemicals	No	No	No	No	No	No	No	No	No	No
Waste Handling, Disposal and Treatment (Incineration)	No	No	No	No	No	No	No	No	No	No
Waste Handling, Disposal and Treatment (Landfill)	No	No	No	No	No	No	No	No	No	No
Waste Handling, Disposal and Treatment (non-POTW WWT)	No	No	No	No	No	No	No	No	Yes	Yes
Waste Handling, Disposal and Treatment (POTW)	No	No	No	No	No	No	No	No	Yes	Yes
Waste Handling, Disposal and Treatment (Remediation)	No	No	No	No	No	No	No	No	No	No
OES = occupational exposure scenario; POTW = publicly owned treatment works; WWT = wastewater treatment										

6.2.1.2 Generic Scenario Releases

In addition to facility reported releases to DMR or TRI, when releases are expected from OES activities but do not have specific facility reported release data in DMR or TRI or when collected release data may underrepresent the release potential, EPA will model potential generic scenario releases to environmental media for various OES (Section 4.1.3). Three of the OES with generated generic scenarios for 1,1,2-trichloroethane had identified potential releases to surface water with details on the development and estimation of those scenarios given above:

- Formulation of adhesives and sealants (Section 4.2.5; Table 4-10)
- Use of Adhesives and Sealants (Section 4.2.6; Table 4-13)
- Use of Cleaning and Degreasing Solvents (Section 4.2.7; Table 4-16)

For each of the generic scenarios a central tendency and high-end scenario was developed with varying daily release volumes developed based on Monte Carlo modeling of annual releases and days of release. These release volumes are modeled to incorporate an assumption of treatment before release (73% for 1,1,2-trichloroethane). Summary information for the three generic scenarios is given in Table 6-7.

Table 6-7. Modeled Generic Scenario Releases with Potential Releases to Surface Water

OES	Scenario	Annual Release Before Treatment (kg/site-yr)	Annual Release After Treatment ^{a b} (kg/site-yr)	Release Days ^a (days/yr)	Daily Release After Treatment (kg/site-day)
Formulation of Adhesives and Sealants ^c	CT	668	180	145	1.3
	HE	829	224	365	5
Use of Adhesives and Sealants ^d	CT	2.7	0.73	260	2.7E-03
	HE	5.9	1.6		6.2E-03
Use of Cleaning and Degreasing Solvents ^e	CT	63	17	296	5.2E-02
	HE	117	32		9.0E-02
CT = central tendency; HE = high-end; OES = occupational exposure scenario					
^a Details on operating days and daily releases are provided in Section 4.1.3					
^b Treatment Efficiency Applied: 73%					
^c See Table 4-10. Summary of Modeled Environmental Releases During the Formulation of Adhesives and Sealants					
^d See Table 4-13. Summary of Modeled Environmental Releases During the Use of Adhesives and Sealants					
^e See Table 4-16. Summary of Modeled Environmental Releases During the Use of Cleaning and Degreasing Solvents					

Since these estimated releases for a given OES are not site-specific, EPA is unable to identify the receiving water bodies and their location-specific hydrological flow data as described for facility-specific releases in Section 6.2.1.1. For these OES generic scenarios, the Agency generated a distribution of flow metrics by collecting flow data for facilities across North American Industry Classification System (NAICS) codes relevant to 1,1,2-trichloroethane releases to surface water (Table 6-8). The same databases described in Section 6.2.1.1 were queried for facility-specific data including permit and receiving waterbody information within the NAICS code to develop a modeled distribution of hydrological flow data. This process develops a distribution specific to an industry sector rather than individual facilities and provides a reasonable estimate of the distribution of location-specific values.

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Processing and generation of relevant flow metrics then followed the same process as described in Section 6.2.1.1 including the use of Equation 6-1 and Equation 6-2 for calculation of 7Q10 and harmonic mean flows respectively. The 10th, 50th, 75th, and 95th percentile (P10, P50, P75, and P90, respectively) of each flow metric were extracted and used for hydrological modeling. A minimum effluent flow rate was applied that was derived from the average reported effluent flow rate across facilities representing an OES.

For 1,1,2-trichloroethane, the supporting NAICS codes for the three modeled generic scenarios with potential releases to surface water are given in Table 6-8 and the resulting 7Q10, 30Q5, and harmonic mean flow values generated from the distribution of flows for each OES is given in Table 6-9.

Table 6-8. Generic Scenario Supporting NAICS Used for Development of Waterbody Flow Distributions

OES	Supporting NAICS Codes
Formulation of Adhesives and Sealants (n=1)	32552
Use of Adhesives and Sealants (n=68)	334111, 334112, 334113, 334119, 334210, 334220, 334290, 334310, 334411, 334412, 334413, 334414, 334415, 334416, 334417, 334418, 334419, 334510, 334511, 334512, 334513, 334514, 334515, 334516, 334517, 334518, 334519, 334611, 334612, 334613, 335110, 335121, 335122, 335129, 335211, 335212, 335221, 335222, 335224, 335228, 335311, 335312, 335313, 335314, 335911, 335912, 335921, 335929, 335931, 335932, 335991, 335999, 336111, 336112, 336120, 336211, 336212, 336213, 336214, 336311, 336312, 336321, 336322, 336330, 336340, 336350, 336360, 336370, 336391, 336399, 326211, 322222
Use of Cleaning and Degreasing Solvents (n=70)	314999, 321113, 323111, 325180, 325998, 326299, 331110, 331210, 331410, 331420, 332111, 332112, 332119, 332117, 332215, 332216, 332311, 332313, 332431, 332510, 332618, 332721, 332722, 332811, 332812, 332813, 332912, 332913, 332919, 332994, 332996, 332999, 333132, 333249, 333318, 333415, 333921, 333994, 333999, 334220, 334413, 334416, 334417, 334419, 334513, 334515, 335120, 335121, 335210, 335312, 335313, 335911, 335921, 335929, 335999, 336320, 336340, 336411, 336413, 336414, 336510, 337125, 337127, 339114, 339990, 339992, 339995, 339999, 488111, 493110, 811310

Table 6-9. Distribution of Hydrologic 7Q10, 30Q5, and Harmonic Mean (HM) Flows for OES Generic Scenarios

OES	Unique Facilities	Flow Percentile ^a	7Q10 Flow (mld)	30Q5 Flow (mld)	HM Flow (mld)
Formulation of Adhesives and Sealants	32	P10	1,793	2,116	2,459
		P50	5,934	9,252	17,062

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OES	Unique Facilities	Flow Percentile ^a	7Q10 Flow (mld)	30Q5 Flow (mld)	HM Flow (mld)
		P75	95,944	150,038	311,313
		P90	294,592	445,373	849,790
Use of Adhesives and Sealants	698	P10	1,684	1,868	2,041
		P50	2,709	3,721	4,954
		P75	8,011	11,849	18,308
		P90	71,700	113,112	227,922
Use of Cleaning and Degreasing Solvents	2,516	P10	25,928	26,073	26,244
		P50	27,364	28,648	29,954
		P75	38,338	46,892	58,654
		P90	330,013	485,910	879,645
7Q10 = the modeled 7Q10 flow, in MLD (million liters per day); 30Q5 = the lowest monthly average flow from NHD, in MLD; HM = the modeled harmonic mean flow, in MLD (million liters per day); OES = occupational exposure scenario					
^a The P10, P50, P75, and P90 flows refer to the 10th, 50th, 75th, and 90th percentiles of the distribution of water body flow rates in generic release scenarios					

Surface water concentrations were modelled for each OES central tendency and high-end generic scenario across all relevant flow metrics (7Q10, 30Q5, and HM) for evaluation of environmental exposure (Table 6-10; See Section 6.5) and general population exposure pathways (Table 6-11 See Section 6.4). Modeled 7Q10 flow concentrations ranged from 3.8×10^{-5} to $6.1 \mu\text{g/L}$ with the highest estimated concentrations modeled for the high-end P10 Formulation of Adhesives and Sealants OES (Table 6-10). Formulation of Adhesives and Sealants OES also had the highest modeled concentrations for the 30Q5 and HM flow metrics with ranges for 30Q5 modeled flows across all evaluated scenarios of 2.4×10^{-5} to $5.2 \mu\text{g/L}$ and 1.2×10^{-5} to $4.5 \mu\text{g/L}$ for harmonic mean flow scenarios (Table 6-11).

6512 **Table 6-10. OES Generic Scenario Modeled 7Q10 Surface Water Concentrations**

OES	Scenario	Annual Release after Treatment (kg/site-yr)	Release Days (days/yr)	Daily Release after Treatment (kg/site-day)	Flow Percentile	7Q10 Flow (mld)	7Q10 Water Column Concentration (µg/L)
Formulation of Adhesives and Sealants	CT	180	145	1.3	P10	1,793	0.73
					P50	5,934	0.22
					P75	9.6E04	1.4E−02
					P90	2.9E05	4.4E−03
	HE	224	365	5	P10	1,793	2.8
					P50	5,934	0.84
					P75	9.6E04	5.2E−02
					P90	2.9E05	1.7E−02
Use of Adhesives and Sealants	CT	0.73	260	2.7E−03	P10	1,684	1.6E−03
					P50	2,709	1.0E−03
					P75	8,011	3.4E−04
					P90	7.2E04	3.8E−05
	HE	1.6	6.2E−03	P10	1,684	3.7E−03	
				P50	2,709	2.3E−03	
				P75	8,011	7.7E−04	
				P90	7.2E04	8.6E−05	
Use of Cleaning and Degreasing Solvents	CT	17	296	5.2E−02	P10	2.6E04	2.0E−03
					P50	2.7E04	1.9E−03
					P75	3.8E04	1.4E−03
					P90	3.3E05	1.6E−04
	HE	32	9.2E−02	P10	2.6E04	3.5E−03	
				P50	2.7E04	3.4E−03	
				P75	3.8E04	2.4E−03	
				P90	3.3E05	2.8E−04	

OES	Scenario	Annual Release after Treatment (kg/site-yr)	Release Days (days/yr)	Daily Release after Treatment (kg/site-day)	Flow Percentile	7Q10 Flow (mld)	7Q10 Water Column Concentration (µg/L)
7Q10 = the modeled 7Q10 flow, in MLD (million liters per day); CT = Central Tendency; HE = High End; OES = occupational exposure scenario Release day calculated by Engineering; Treatment Efficiency Applied = 73%;							

Table 6-11. OES Generic Scenario Modeled 30Q5 and Harmonic Mean (HM) Surface Water Concentrations

OES	Scenario	Annual Release after Treatment (kg/site-yr)	Release Days (days/yr)	Daily Release after Treatment (kg/site-day)	Flow Percentile	30Q5 Flow (mld)	HM Flow (mld)	30Q5 Water Column Conc. (µg/L)	HM Water Column Conc. (µg/L)
Formulation of Adhesives and Sealants	CT	180	145	1.3	P10	2,116	2,459	0.61	0.53
					P50	9,252	1.7E04	0.14	7.6E−02
					P75	1.5E05	3.1E05	8.7E−03	4.2E−03
					P90	4.5E05	8.5E05	2.9E−03	1.5E−03
	HE	224	365	5	P10	2,116	2,459	2.4	2
					P50	9,252	1.7E04	0.54	0.29
					P75	1.5E05	3.1E05	3.3E−02	1.6E−02
					P90	4.5E05	8.5E05	1.1E−02	5.9E−03
Use of Adhesives and Sealants	CT	0.73	260	2.7E−03	P10	1,868	2,041	1.4E−03	1.3E−03
					P50	3,721	4,954	7.3E−04	5.5E−04
					P75	1.2E04	1.8E04	2.3E−04	1.5E−04
					P90	1.1E05	2.3E05	2.4E−05	1.2E−05
	HE	1.6	6.2E−03	P10	1,868	2,041	3.3E−03	3.0E−03	
				P50	3,721	4,954	1.7E−03	1.3E−03	
				P75	1.2E04	1.8E04	5.2E−04	3.4E−04	
				P90	1.1E05	2.3E05	5.5E−05	2.7E−05	
Use of Cleaning and Degreasing Solvents	CT	17	296	5.2E−02	P10	2.6E04	2.6E04	2.0E−03	2.0E−03
					P50	2.9E04	3.0E04	1.8E−03	1.7E−03
					P75	4.7E04	5.9E04	1.1E−03	8.9E−04
					P90	4.9E05	8.8E05	1.1E−04	5.9E−05

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OES	Scenario	Annual Release after Treatment (kg/site-yr)	Release Days (days/yr)	Daily Release after Treatment (kg/site-day)	Flow Percentile	30Q5 Flow (mld)	HM Flow (mld)	30Q5 Water Column Conc. (µg/L)	HM Water Column Conc. (µg/L)
	HE	32		9.2E-02	P10	2.6E04	2.6E04	3.5E-03	3.5E-03
					P50	2.9E04	3.0E04	3.2E-03	3.1E-03
					P75	4.7E04	5.9E04	2.0E-03	1.6E-03
					P90	4.9E05	8.8E05	1.9E-04	1.0E-04
30Q5 = modeled lowest monthly average, in MLD (million liters per day); CT = Central Tendency; HE = High End; HM = modeled harmonic mean, in MLD (million liters per day); OES = occupational exposure scenario Release day calculated by Engineering; Treatment Efficiency Applied = 73%									

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6.2.2 Drinking Water Concentrations

For the evaluation of drinking water, EPA considers the modeling of facility-specific and generic scenario releases to surface water and review of available monitoring data. As discussed previously in Section 6.1.3, EPA searched peer-review literature, gray literature and databases of monitoring data to obtain concentrations of 1,1,2 trichloroethane in drinking water. These measured monitoring data are used to provide, where possible, contextual and supporting information to the modeled releases. The Agency modeled 1,1,2 trichloroethane concentrations in surface water as described for Tier 1 and Tier 2 analysis in Section 6.2.1. In this section, EPA describes the translation of those surface water concentrations to drinking water concentration estimates and explains additional Tier 3 surface water concentration modeling refinements for further evaluation of drinking water exposures below.

6.2.2.1 Drinking Water Concentration Estimates via modeled Surface Water Concentrations

Estimates of drinking water concentrations via surface water were estimated for both facility-specific releases and for generic release scenarios and are based off those concentrations estimated using the E-FAST modeling equations described in Section 6.2.1. For both modeling scenarios, the estimated 30Q5 surface water concentrations were used for calculation of drinking water doses and initial identification of preliminary acute risk, while the harmonic mean flow surface water concentrations were used for identification of preliminary chronic non-cancer and chronic cancer risk. Initial tiering of these drinking water concentration estimates do not incorporate further removal from drinking water treatment, fate or physical chemical considerations, or additional dilution beyond the point of discharge, and it is assumed that a presumptive drinking water intake is located at the same location or in very close proximity to the surface water outfall for the releasing facility. These assumptions result in higher-end estimates of potential drinking water exposure. Drinking water concentrations, resulting doses, and identification of preliminary risk for facility-specific releases were estimated following both Tier 1 and Tier 2 evaluation as follows:

- Tier 1 Drinking Water Exposures to the General Population: Concentrations in Table_Apx G-2; Doses in Table_Apx G-8; and potential preliminary risks in Table_Apx G-9
- Tier 2 Drinking Water Exposures to the General Population: Concentrations in Table 6-5; Doses in Table_Apx G-11; and potential preliminary risks in Table_Apx G-12
- Generic Scenario Drinking Water Exposures to the General Population: Concentrations in Table 6-11 with doses and risk discussed further in Section 6.4.3.3

Following Tier 2 analysis for facility-specific releases, estimated concentrations may be further refined to incorporate their proximity to known drinking water intakes and possible downstream dilution due to the known physical location and receiving waterbody for these locations (Tier 3; Section 6.2.2.2). In contrast, generic scenarios are not location specific and unable to be refined further to incorporate consideration of downstream drinking water intake information. Therefore, considered drinking water concentrations for generic scenario drinking water exposure are given in Table 6-11 with exposures discussed in Section 6.4.3.3.

6.2.2.2 Tier 3 Facility-Specific Releases Approach and Estimates of Surface Water Concentration

If preliminary risks relative to their benchmark were identified through this initial analysis for facility-specific releases, facility releases were mapped to drinking water sources using public water systems (PWS) data stored in EPA's Safe Drinking Water Information System Federal Data Warehouse (SDWIS) ([U.S. EPA, 2022e](#)). This dataset is updated quarterly and the second quarter 2022 version was used for this analysis. Following the mapping, the colocation of and proximity of facility release sites to

downstream PWS drinking water intake locations were evaluated. These drinking water data are considered sensitive by EPA's Office of Water and are protected from public release. Geospatial analysis using the NHDPlus V2.1 flowline network was used to determine PWS intake locations within 250 km downstream of 1,1,2-trichloroethane releasing facilities with identified exposures indicating risk relative to their benchmark identified after Tier 2 evaluation described above. A total of 10 facilities across 5 OESs were identified with preliminary risk (Table 6-12) based on calculation of drinking water doses associated with modeled Tier 2 surface water concentrations as described in Section 6.2.1.1.2 and Appendix G.2. A diluted 1,1,2-trichloroethane surface water concentration was subsequently calculated based on the change in hydrologic flow between the facility release location and the receiving waterbody associated with the identified PWS intake location. Provided a PWS may have multiple intake locations, concentrations of 1,1,2-trichloroethane were estimated at the most upstream intake for a given PWS; therefore, reflecting a more conservative estimate. If there were no downstream drinking water intake locations within the 250 km distance, EPA considered there were no drinking water exposures resulting from the facility releases. Therefore, the Agency focused the analysis on those facilities and corresponding COUs with potential drinking water exposures.

Of the 10 facilities evaluated for downstream drinking water intake analysis, 4 had identified downstream drinking water intakes while 6 had no downstream drinking water intakes within 250 km. For those facilities with drinking water intakes downstream, no intakes were less than 70 km downstream and all releases were diluted to less than 0.1% of their initial concentration. Discussion of these estimates of distance to drinking water intakes and percent dilution on potential drinking water exposure is in Section 6.4.3.

Table 6-12. Downstream Trace Analysis Identifying Distance to Drinking Water Intake and Percent Downstream Dilution for Facility-Specific Releases Indicating Preliminary Risk After Tier 2 Analysis

FRS ID	Facility	State	OES	Nearest DW Intake ^a (km)	Dilution ^b (%)
110000597328	Occidental Chemical Corp – Convent Facility	LA	Manufacturing as a Byproduct	NA	>99.9
110000494894	Westlake US 2 LLC ^c	LA	Manufacturing as a Byproduct	NA	>99.9
110070948151	Allegiant Stadium	NV	Not Mapped to an OES	>150	>99.9
110060340162	Enterprise Pasadena Plant	TX	Processing as a Reactant	NA	>99.9
110000746211	Equistar Chemicals LP – Tuscola Plant	IL	Processing as a Reactant	>120	>99.9
110000433013	Equistar Chemicals LP – Morris Plant	IL	Processing as a Reactant	NA	>99.9
110000741608	ISP Chemicals LLC	KY	Processing as a Reactant	>90	>99.9
110064631457	Northern Edge Casino	NM	Waste Handling, Disposal and Treatment (non-POTW WWT)	NA	>99.9
110039705049	Lancaster STP	KY	Waste Handling,	>70	>99.9

FRS ID	Facility	State	OES	Nearest DW Intake ^a (km)	Dilution ^b (%)
			Disposal and Treatment (POTW)		
110000732253	Radcliff STP	KY	Waste Handling, Disposal and Treatment (POTW)	NA	>99.9

DW = drinking water; OES = occupational exposure scenario; POTW = publicly owned treatment works; WWT = wastewater treatment

^a Distances to nearest DW intakes are rounded values to protect sensitive data. If reported as NA, no intakes were identified within 250 km.

^b Percent dilution is the decrease in estimated concentration from initially estimated surface water concentration following Tier 2 evaluation.

^c Westlake US 2 LLC had two identified releases under different NPDES permits to differing receiving waterbodies evaluated separately.

6.3 Modeling Approach and Estimates for Aquatic Sediment Concentrations

1,1,2-Trichloroethane is released to surface waters from direct discharge of wastewater from industrial operations and wastewater treatment plant facilities as covered under TSCA COUs (Section 6.2.1). While 1,1,2-trichloroethane released into surface waters is expected to mostly remain in the water column, there is potential for it to partition to sediment and also be present in the benthic pore water based on its solubility. Therefore, there is potential for exposure to benthic aquatic organisms. Below EPA describes the modeling of identified and potential concentrations of 1,1,2-trichloroethane within sediments resulting from both facility-specific releases (Section 6.3.1) and generic scenario releases to surface water (Section 6.3.2). Available measured concentrations were discussed in Section 6.1.2.

EPA utilized Point Source Calculator (PSC) to estimate the concentration of 1,1,2-trichloroethane in sediment and sediment pore water from the release of 1,1,2-trichloroethane to surface water ([U.S. EPA, 2019d](#)). As an initial screening evaluation of potential sediment and pore water concentrations, EPA selected the facility releases for each OES resulting in the highest facility-specific estimated 7Q10 flow water concentrations from the E-FAST surface water analysis following Tier 2 analysis conducted in Section 6.2.1.1.2 (Table 6-4). Similarly, to evaluate potential sediment exposures resulting from generic scenario surface water releases, the generic scenario with the highest estimated 7Q10 flow surface water concentration as conducted in Section 6.2.1.2 was selected as a screening level evaluation (Table 6-10). These scenarios were chosen for initial evaluation because if no exposure concentrations resulted in a risk quotient >1, all other potential releases would result in lower estimated concentrations and exposures.

Physical, chemical, and environmental fate properties selected by EPA for this assessment were applied as inputs to the PSC model (Table 6-13). Selected values are described in detail in Section 3. The PSC model relies on the Heat of Henry parameter, which was estimated from temperature variation of the Henry's Law constant calculated by HENRYWINTM in EPI SuiteTM ([U.S. EPA, 2017b](#))

Table 6-13. PSC Model Inputs (Chemical Parameters)

Parameter ^a	Value
K _{OC}	114
Water Column Half-Life	378 days
Photolysis Half-Life	54.6 days
Hydrolysis Half-Life	13,505 days
Molecular Weight	133.41 g/mol
Vapor Pressure	23 mmHg at 25 °C
Water Solubility	4,580 mg/L at 25 °C
Henry's Law Constant	8.24E-4 atm·m ³ /mol
Heat of Henry	30,678 J/mol
Reference Temperature	25 °C
K _{OC} = carbon:water partition coefficient; PSC = Point Source Calculator	
^a For more details on selected values, see Section 3	

A consistent setup for the modeling environment and media parameters was applied across all PSC scenarios using default waterbody characteristics for parameterization of the water column and sediment parameters (Table 6-14) as a conservative screening scenario (U.S. EPA, 2019d). A watershed geometry of width of 5m, length of 40m and depth of 1m also applied. Only the release parameters (daily release amount and days of release) and the hydrologic flow rate were changed between model runs to reflect both facility-specific and generic scenario conditions. The 7Q10 hydrologic flow associated with each scenario was chosen as the representative flow metric to evaluate potential exposures to environmental populations. The maximum operating day scenarios for the Not Mapped to an OES and Waste Handling, Disposal and Treatment (Remediation) OESs relied on monitored effluent concentrations for estimation of Tier 2 surface water concentrations (Table 6-4) and lacked receiving waterbody flow information. This lack of flow information precluded modeling in PSC for porewater and sediment concentrations. For these two scenarios, porewater concentrations were assumed to equal surface water concentrations as a high-end conservative estimate and sediment concentrations calculated via benthic conversion factors for porewater to sediment as done in other scenarios conducted in PSC.

Table 6-14. Waterbody Characteristics for Point Source Calculator Model Inputs

Parameter	Value ^a
DFAC (represents the ration of vertical path lengths to depth as defined in the EPA's exposure analysis modeling system [EXAMS] ((U.S. EPA, 2019d))	1.19
Water column suspended sediment	30 mg/L
Chlorophyll	5.0E-03 mg/L
Water column f_{oc} (fraction of organic carbon associated with suspended sediment	4.0E-02
Water column dissolved organic carbon (DOC)	5.0 mg/L
Water column biomass	0.4 mg/L

Parameter	Value ^a
Benthic depth	0.05 m
Benthic porosity	0.50
Benthic bulk density	1.35 g/cm ³
Benthic f_{oc}	4.0E-02
Benthic DOC	5.0 mg/L
Benthic biomass	6.0E-03 g/m ²
Mass transfer coefficient	1.0E-08 m/s
^a Waterbody characteristic parameters align with those of the standard EPA “farm pond” (U.S. EPA, 2019d)	

6.3.1 Facility-Specific Releases

To screen for environmental exposures, facility releases within each OES with the highest estimated 7Q10 flow surface water concentration was used to model potential sediment and pore-water concentrations as described in Section 6.2.1.1 and shown in Table 6-4. Modeled sediment concentrations ranged from 2 – 2,520 µg/kg and pore-water concentrations ranged from 0.4 – 512 µg/L with maximum concentrations in both media modeled as part of the Media as a Byproduct OES (Table 6-15). These concentrations resulted in no environmental exposures with risk quotients >1 and are carried into the *Draft Risk Evaluation for 1,1,2-Trichloroethane* ([U.S. EPA, 2026r](#)) to inform risk determination and regulatory decision-making.

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Table 6-15. Modeled Sediment Concentrations per Occupational Exposure Scenario (OES) for Evaluated Facility-Specific Releases Reporting to TRI and DMR 2019 – 2023

OES ^a	Days of Release	Pollutant Load (kg/day)	7Q10 Sediment Concentration (µg/kg)	Pore Water Concentration (µg/L)
Manufacturing as a Byproduct	21	1.8	2,520	512
	350	0.11	628	127
Not Mapped to an OES ^b	21	3.6E-02	12	2.4
	250	1.6E-04	39 ^c	7.9 ^c
Processing as a Reactant	21	0.54	208	42
	350	3.2E-02	53	11
Repackaging	21	20	48.4	9.82
	250	1.7	17.5	3.56
Use of Laboratory Chemicals	21	2.8E-03	17	3.5
	260	2.3E-04	6.5	1.3
Waste Handling, Disposal and Treatment (Incineration)	21	1.1E-03	6.2	1.3
	250	9.0E-05	2	0.4
Waste Handling, Disposal and Treatment (Landfill)	21	3.0E-02	10	2.1
	250	2.6E-03	3.4	0.68
Waste Handling, Disposal and Treatment (non-POTW WWT)	21	5.3E-02	163	33
	250	4.4E-03	51	10
Waste Handling, Disposal and Treatment (POTW)	21	1.6	92	19
	365	9.4E-02	24	4.9
Waste Handling, Disposal and Treatment (Remediation) ^b	21	1.1E-02	22	4.5
	250	9.3E-04	25 ^c	5 ^c

7Q10 = lowest 7-day average flow that occurs (on average) once every 10 years; POTW = publicly owned treatment works; WWT = wastewater treatment

^a Each OES is represented by the facility-specific release resulting in the highest estimated surface water concentration as presented in Table 6-4.

^b Not Mapped to an OES and Waste Handling, Disposal and Treatment (Remediation) OES had different facilities representing the highest 7Q10 flow surface water concentrations for the 21 and 250 operating day scenarios.

^c Relied on effluent flow concentrations which precluded modeling in Point Source Calculator. Estimated pore water concentrations are assumed to equal effluent flow concentrations with sediment concentrations calculated via conversion factors.

6.3.2 Generic Scenario Releases

To screen for environmental exposures, the generic scenario with the highest estimated 7Q10 surface water concentration was used to model potential sediment and pore-water concentrations. As described in Section 6.2.1.2 and shown in Table 6-10, the generic scenario resulting in the highest modeled surface water concentration of 6.1 µg/L is the high-end Formulation of Adhesives and Sealants OES under a

P10 7Q10 flow scenario. This high-end release scenario (Daily release = 11 kg/site-day and Release Days = 365) was input into PSC for modeling of sediment and pore water concentrations. Modeled sediment concentrations of 29.5 µg/kg and pore-water concentrations of 5.98 µg/L resulted in no exposures with risk quotients >1 for environmental populations (Table 6-16). Therefore, other flow scenarios within the Formulation of Adhesives and Sealants OES or other OES generic scenarios were not evaluated further since those scenarios would result in lower estimated concentrations and these results are carried into the *Draft Risk Evaluation for 1,1,2-Trichloroethane* (U.S. EPA, 2026r) to derive risk estimates and inform risk determination and regulatory decision-making.

Table 6-16. Point Source Calculator (PSC) Modeled Sediment and Pore Water concentrations for the Formulation of Adhesives and Sealants OES

OES	Days of Release	Pollutant Load (kg/day)	P10 7Q10 Flow (mld)	7Q10 Sediment Conc. (µg/kg)	Pore Water Conc. (µg/L)
Formulation of Adhesives and Sealants	365	5	1,793	13.4	2.72
7Q10 = lowest 7-day average flow that occurs (on average) once every 10 years; OES = occupational exposure scenario					

6.4 Approach and Estimates of General Population Exposures

6.4.1 Incidental Dermal Exposure via Surface Water

EPA considers both modeling and measured monitoring information in its assessment of incidental dermal exposures to the general population while swimming in surface waters containing 1,1,2-trichloroethane resulting from TSCA COU activities. This section describes incidental dermal exposure to the general population using previously described surface water concentrations to calculate age-group specific doses. The estimation of these exposures were used to identify potential risks to the general population and aid in determining which evaluation tiers are warranted.

6.4.1.1 Approach

The general population may swim in surface waters (streams and lakes) that are affected by 1,1,2-trichloroethane contamination. Modeled 30Q5 flow surface water concentrations estimated in Section 6.2.1.1 and presented in Table 6-5 for facility-specific releases and Section 6.2.1.2 and presented in Table 6-11 for generic scenario releases were used to estimate acute doses (ADR) from dermal exposure while swimming.

The following equation was used to calculate incidental dermal (swimming) doses for adults, youth and children:

Equation 6-4. Incidental Dermal (swimming) Calculations.

$$ADR = \frac{SWC \times K_p \times SA \times ET \times CF1 \times CF2}{BW}$$

Where:

ADR = Acute dose rate (mg/kg/day)

SWC = Surface water concentration in receiving waterbody (ppb or µg/L; 30Q5)

			concentration for ADR)
K_p	=		Permeability coefficient (cm/h)
SA	=		Skin surface area exposed (cm ²)
ET	=		Exposure time (h/day)
$CF1$	=		Conversion factor (1.0×10^{-3} mg/ μ g)
$CF2$	=		Conversion factor (1.0×10^{-3} L/cm ³)
BW	=		Body weight (kg)

A summary of inputs used for these exposure estimates are provided in Appendix G.4 and *Draft General Population Surface Water Pathway Exposure Estimates for 1,1,2-Trichloroethane* supplemental file ([U.S. EPA, 2026k](#)). A permeability value (K_p) of 5.68×10^{-3} cm/hr was used for evaluation of incidental dermal exposure ([Labcorp Early Development, 2023](#)).

6.4.1.2 Results

Facility-Specific Releases

Table 6-17 shows a summary of estimated ADRs due to dermal exposure while swimming for adult (21+ years); youth (11-15 years); and children (6-10 years) for the facility in each OES resulting in the highest modeled surface water concentration. Acute doses associated with facility-specific releases ranged from 5.5×10^{-7} to 3.2×10^{-4} mg/kg-day across age groups with the highest doses modeled for Manufacturing as a Byproduct OES.

Generic Scenario Releases

Table 6-18 shows a summary of estimates of ADRs due to dermal exposure while swimming for adult (21+ years); youth (11-15 years); and children (6-10 years) for the high-end release scenario combined with the lowest flow scenario (P10 flow) which results in the highest potential modeled surface water concentrations per OES. Across the three modeled generic scenario OESs, acute doses ranged from 6.4×10^{-9} to 2.2×10^{-5} mg/kg-day with highest doses modeled for the Formulation of Adhesives and Sealants OES.

Summary

EPA presents these higher-end scenarios for evaluation of possible dermal exposures from both facility-specific and generic scenario releases as no evaluated scenarios resulted in preliminary risks to the general population and all other scenarios for other facilities or generic scenario releases would result in lower expected doses. Full results of incidental dermal exposure due to swimming are available in *Draft General Population Surface Water Pathway Exposure Estimates for 1,1,2-Trichloroethane* supplemental file ([U.S. EPA, 2026k](#)) and these results for acute non-cancer effects are carried into the *Draft Risk Evaluation for 1,1,2-Trichloroethane* ([U.S. EPA, 2026r](#)) to derive risk estimates and inform risk determination and regulatory decision-making.

Table 6-17. Facility-Specific Incidental Dermal (Swimming) Acute Doses Across Adult, Youth, and Child Lifestages by OES

OES ^a	Modeled Surface Water Concentrations		Adult (21+ years)	Youth (11-15 years)	Child (6-10 years)
	30Q5 Conc. (μ g/L)	HM Conc. (μ g/L)	ADR _{POT} (mg/kg-day)	ADR _{POT} (mg/kg-day)	ADR _{POT} (mg/kg-day)
Manufacturing as a Byproduct	78	43	3.2E-04	2.5E-04	1.5E-04

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OES ^a	Modeled Surface Water Concentrations		Adult (21+ years)	Youth (11-15 years)	Child (6-10 years)
	30Q5 Conc. (µg/L)	HM Conc. (µg/L)	ADR _{POT} (mg/kg-day)	ADR _{POT} (mg/kg-day)	ADR _{POT} (mg/kg-day)
Not Mapped to an OES	7.9	7.9	3.3E-05	2.5E-05	1.5E-05
Processing as a Reactant	12	12	4.9E-05	3.7E-05	2.3E-05
Repackaging	2.6	1.8	1.1E-05	8.3E-06	5.0E-06
Use of Laboratory Chemicals	1.5	1.5	6.2E-06	4.7E-06	2.9E-06
Waste Handling, Disposal and Treatment (Incineration)	0.28	9.8E-02	1.2E-06	9.0E-07	5.5E-07
Waste Handling, Disposal and Treatment (Landfill)	0.46	0.28	1.9E-06	1.5E-06	8.9E-07
Waste Handling, Disposal and Treatment (non-POTW WWT)	9.1	9.1	3.8E-05	2.9E-05	1.7E-05
Waste Handling, Disposal and Treatment (POTW)	4.9	4.1	2.0E-05	1.5E-05	9.4E-06
Waste Handling, Disposal and Treatment (Remediation)	5	5	2.1E-05	1.6E-05	9.6E-06
30Q5 = 30 consecutive days of lowest flow over a 5-year period; HM = Harmonic mean; ADR = Acute dose rate; POT = Potential; OES = occupational exposure scenario; POTW = publicly owned treatment works; WWT = wastewater treatment					
^a Each OES is represented by the facility within that OES with the highest estimated surface water concentration for that OES as described in Section 6.2.1.1					

Table 6-18. Generic Scenario Incidental Dermal (Swimming) Acute Doses Across Adult, Youth, and Child Lifestages by OES

OES ^a	Flow Percentile	Modeled Surface Water Concentrations		Adult (21+ years)	Youth (11-15 years)	Child (6-10 years)
		30Q5 Conc. (µg/L)	HM Conc. (µg/L)	ADR _{POT} (mg/kg-day)	ADR _{POT} (mg/kg-day)	ADR _{POT} (mg/kg-day)
Formulation of Adhesives and Sealants	P10	2.4	2	9.8E-06	7.5E-06	4.6E-06
Use of Cleaning and Degreasing Solvents	P10	3.5E-03	3.5E-03	1.5E-08	1.1E-08	6.8E-09
Use of Adhesives and Sealants	P10	3.3E-03	3.0E-03	1.4E-08	1.1E-08	6.4E-09
30Q5 = 30 consecutive days of lowest flow over a 5-year period; ADR = acute dose rate; HM = harmonic mean; HE = high-end; OES = occupational exposure scenario; POT = potential						
^a Each OES represented in table by the high-end release scenario for that OES as described in Section 6.2.1.2						

6.4.2 Incidental Oral Exposure via Surface Water

EPA considers both modeling and measured monitoring information in its assessment of incidental oral exposure to 1,1,2-trichloroethane while swimming in surface waters containing 1,1,2-trichloro ethane resulting from TSCA COU activities. This section describes incidental oral exposure to the general population using previously described modeled surface water concentrations to calculate age-group specific doses. The estimation of these exposures were used to identify potential risks to the general population and aid in determining which evaluation tiers are warranted.

6.4.2.1 Approach

The general population may swim in surface waters (streams and lakes) that are affected by 1,1,2-trichloroethane contamination. Modeled surface water concentrations estimated in Section 6.2.1.1 and presented in for Table 6-5 facility-specific releases and Section 6.2.1.2 and presented in Table 6-11 for generic scenario releases were used to estimate acute doses (ADR) due to ingestion while swimming.

The following equations were used to calculate incidental oral (swimming) doses for adults, youth and children:

Equation 6-5. Acute Incidental Ingestion Calculation.

$$ADR = \frac{SWC \times IR \times CF1}{BW}$$

Where:

<i>ADR</i>	=	Acute dose rate (mg/kg/day)
<i>SWC</i>	=	Surface water concentration in receiving waterbody (ppb or µg/L; 30Q5 concentration for ADR)
<i>IR</i>	=	Daily ingestion rate (L/day)
<i>CF1</i>	=	Conversion factor (1.0×10^{-3} mg/µg)
<i>BW</i>	=	Body weight (kg)

A summary of inputs used for these exposure estimates are provided in Appendix G.4 and *Draft General Population Surface Water Pathway Exposure Estimates for 1,1,2-Trichloroethane* supplemental file ([U.S. EPA, 2026k](#)).

6.4.2.2 Results

Facility-Specific Releases

Table 6-19 shows a summary of estimates of ADRs due to incidental oral exposure while swimming for adult (21+ years); youth (11-15 years); and children (6-10 years) for the facility in each OES resulting in the highest modeled surface water concentration. Acute doses associated with facility-specific releases ranged from 8.6×10^{-7} to 4.2×10^{-4} mg/kg-day across age groups with the highest doses modeled for Manufacturing as a Byproduct OES from a 30Q5 flow surface water concentration of 78 µg/L.

Generic Scenario Releases

Table 6-20 shows a summary of estimates of ADRs due to incidental oral exposure while swimming for adult (21+ years); youth (11-15 years); and children (6-10 years) for the high-end release scenario combined with the lowest flow scenario (P10 flow) which results in the highest potential modeled surface water concentrations per OES. Across the three modeled generic scenario OESs, acute doses ranged from 1.0×10^{-8} to 1.3×10^{-5} mg/kg-day across age groups with highest doses modeled for the Formulation of Adhesives and Sealants OES from a 30Q5 flow surface water concentration of 2.4 µg/L.

Summary

EPA presents these higher-end scenarios for evaluation of possible incidental oral exposures from both facility-specific and generic scenario releases as no evaluated scenarios resulted in preliminary risks to the general population and all other scenarios for other facilities or generic scenario releases would result in lower expected doses. Full results of incidental oral exposure due to swimming are available in *Draft General Population Surface Water Pathway Exposure Estimates for 1,1,2-Trichloroethane*

supplemental file ([U.S. EPA, 2026k](#)) and these results for acute non-cancer effects are carried into the *Draft Risk Evaluation for 1,1,2-Trichloroethane* ([U.S. EPA, 2026r](#)) to derive risk estimates and inform risk determination and regulatory decision-making.

Table 6-19. Facility-Specific Incidental Oral (Swimming) Acute Doses Across Adult, Youth, and Child Lifestages by OES

OES ^a	Modeled Surface Water Concentrations		Adult (21+ years)	Youth (11-15 years)	Child (6-10 years)
	30Q5 Conc. (µg/L)	HM Conc. (µg/L)	ADR _{POT} (mg/kg-day)	ADR _{POT} (mg/kg-day)	ADR _{POT} (mg/kg-day)
Manufacturing as a Byproduct	78	43	2.7E-04	4.2E-04	2.4E-04
Not Mapped to an OES	7.9	7.9	2.7E-05	4.2E-05	2.4E-05
Processing as a Reactant	12	12	4.1E-05	6.3E-05	3.6E-05
Repackaging	2.6	1.8	9.0E-06	1.4E-05	7.9E-06
Use of Laboratory Chemicals	1.5	1.5	5.1E-06	8.0E-06	4.5E-06
Waste Handling, Disposal and Treatment (Incineration)	0.28	9.8E-02	9.8E-07	1.5E-06	8.6E-07
Waste Handling, Disposal and Treatment (Landfill)	0.46	0.28	1.6E-06	2.5E-06	1.4E-06
Waste Handling, Disposal and Treatment (non-POTW WWT)	9.1	9.1	3.1E-05	4.9E-05	2.7E-05
Waste Handling, Disposal and Treatment (POTW)	4.9	4.1	1.7E-05	2.6E-05	1.5E-05
Waste Handling, Disposal and Treatment (Remediation)	5	5	1.7E-05	2.7E-05	1.5E-05
30Q5 = 30 consecutive days of lowest flow over a 5-year period; ADR = acute dose rate; HM = harmonic mean; OES = occupational exposure scenario; POT = potential					
^a Each OES is represented by the facility within that OES with the highest estimated surface water concentration for that OES as described in Section 6.2.1.1					

Table 6-20. Generic Scenario Incidental Oral (Swimming) Acute Doses Across Adult, Youth, and Child Lifestages by OES

OES ^a	Flow Percentile	Modeled Surface Water Concentrations		Adult (21+ years)	Youth (11-15 years)	Child (6-10 years)
		30Q5 Conc. (µg/L)	HM Conc. (µg/L)	ADR _{POT} (mg/kg-day)	ADR _{POT} (mg/kg-day)	ADR _{POT} (mg/kg-day)
Formulation of Adhesives and Sealants	P10	2.4	2	8.2E-06	1.3E-05	7.1E-06
Use of Cleaning and Degreasing Solvents	P10	3.5E-03	3.5E-03	1.2E-08	1.9E-08	1.1E-08
Use of Adhesives and Sealants	P10	3.3E-03	3.0E-03	1.1E-08	1.8E-08	1.0E-08
30Q5 = 30 consecutive days of lowest flow over a 5-year period; HM = Harmonic mean; ADR = Acute dose rate; OES						

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OES ^a	Flow Percentile	Modeled Surface Water Concentrations		Adult (21+ years)	Youth (11-15 years)	Child (6-10 years)
		30Q5 Conc. (µg/L)	HM Conc. (µg/L)	ADR _{POT} (mg/kg-day)	ADR _{POT} (mg/kg-day)	ADR _{POT} (mg/kg-day)

= occupational exposure scenario; POT = Potential

^a Each OES represented in table by the high-end release scenario for that OES as described in Section 6.2.1.2

6.4.3 Drinking Water Exposure

EPA considers both modeling and measured monitoring in its assessment of drinking water exposure from 1,1,2-trichloroethane to the general population. The modeling approach is described in Section 6.4.3.1 with estimated doses to the general population shown in Section 6.4.3.2 for facility-specific releases and Section 6.4.3.3 for generic scenario releases. Description of available measured data in drinking water was explained in 6.1.3. This section estimates the drinking water exposure to the general population through the conversion of previously described surface water concentrations to age-group specific doses as described below. The estimation of these exposures were used to identify potential risks to the general population and aid in determining which evaluation tiers are warranted.

6.4.3.1 Approach

Drinking water exposures were calculated for a variety of lifestages ranging from infants to adults for both facility-specific and generic scenario releases. Drinking water exposures for bottle-fed infants (<1 year), toddlers (1-5 years) and adults (21+ years) are presented below but full explanation of all age groups is available in *Draft General Population Surface Water Pathway Exposure Estimates for 1,1,2-Trichloroethane* supplemental file ([U.S. EPA, 2026k](#)). In including infant exposure estimates, the Agency is considering PESS and protecting this sensitive subpopulation. The potential acute dose rate (ADR_{POT}; Equation 6-6) and potential average daily dose (ADD_{POT}; Equation 6-7) are used for evaluating acute and chronic non-cancer drinking water exposures respectively, while the potential lifetime average daily dose (LADD_{POT}; Equation 6-8) and potential lifetime average daily concentration (LADC_{POT}; Equation 6-9) are used for estimating cancer exposures from drinking water.

Equation 6-6. Drinking Water Acute Dose Calculation

$$ADR_{POT} = \frac{(SWC \times (1 - \frac{DWT}{100}) \times IR_{dw} \times RD \times CF1}{(BW \times AT)}$$

Equation 6-7. Drinking Water Average Daily Dose Calculation

$$ADD_{POT} = \frac{(SWC \times (1 - \frac{DWT}{100}) \times IR_{dw} \times ED \times RD \times CF1}{(BW \times AT \times CF2)}$$

Equation 6-8. Drinking Water Lifetime Average Daily Dose Calculation

$$LADD_{POT} = \frac{(SWC \times (1 - \frac{DWT}{100}) \times IR_{dw} \times ED \times RD \times CF1}{(BW \times AT \times CF2)}$$

Equation 6-9. Drinking Water Lifetime Average Daily Concentration Calculation

$$LADC_{POT} = \frac{(SWC \times (1 - \frac{DWT}{100}) \times ED \times RD \times CF1}{(AT \times CF2)}$$

Where:

ADD_{POT}	=	Potential average daily dose (mg/kg/day)
SWC	=	Surface water concentration in receiving waterbody (ppb or µg/L; 30Q5 concentration for ADR; harmonic mean concentration for ADD, LADD, LADC)
DWT	=	Removal during drinking water treatment (%) (not applied for this analysis)
IR_{dw}	=	Drinking water intake rate (L/day)
ED	=	Exposure duration (years for ADD, LADD, and LADC; 1 day for ADR)
RD	=	Release days (days/hr for ADD, LADD, and LADC; 1 day for ADR)
BW	=	Body weight (kg)
AT	=	Averaging time (years for ADD, LADD, and LADC; 1 day for ADR)
$CF1$	=	Conversion factor (1.0×10^{-3} mg/µg)
$CF2$	=	Conversion factor (365 days/year)

A summary of inputs used for these exposure estimates is provided in Appendix G.3 and *Draft General Population Surface Water Pathway Exposure Estimates for 1,1,2-Trichloroethane* supplemental file (U.S. EPA, 2026k). Drinking water doses were calculated for both facility-specific and generic scenario releases to identify potential exposures and preliminary risks relative to their non-cancer and cancer benchmarks. Calculated doses were used to inform whether additional tiers of analysis including evaluation of proximity to drinking water sources and potential degree of dilution were warranted as explained Sections 6.2.1 and 6.2.2, and Appendices G.1.5 and G.2.2. Complete description and explanation of results is given for facility-specific releases in Section 6.4.3.2 and for generic scenario releases in Section 6.4.3.3.

6.4.3.2 Results for Facility-Specific Releases

As described in Section 6.2.1.1 and Section 6.2.2 the evaluation of drinking water exposures and doses for facility releases followed a tiered analysis where if preliminary risks relative to the non-cancer and cancer benchmarks are identified using Tier 2 surface water concentrations which estimate concentrations near the point of discharge, the evaluation of proceeds to a Tier 3 evaluation and consideration of proximity to downstream drinking water intake information (Section 6.2.2). Table 6-21 shows the calculated doses to adults, infants and toddlers following the Tier 2 modeling evaluation of 30Q5 and HM flow surface water concentrations shown in Table 6-5. Each OES in Table 6-21 is represented by the facility with the highest estimated surface water concentration near the point of discharge after Tier 2 refinement. If preliminary risks relative to the non-cancer or cancer benchmarks are identified for this highest representative facility, additional facilities within the OES with lower

concentrations were evaluated for potential preliminary risk and determination of whether Tier 3 refinement is warranted. Full results are available in Appendix G.2.2 and *Draft General Population Surface Water Pathway Exposure Estimates for 1,1,2-Trichloroethane* supplemental file ([U.S. EPA, 2026k](#)).

Acute doses associated with represented facility-specific releases in Table 6-21 ranged from 1.1×10^{-5} to 1.1×10^{-2} mg/kg-day across age groups, average daily doses ranged from 7.4×10^{-7} to 1.2×10^{-3} across age groups, and lifetime average daily doses ranged from 2.4×10^{-8} to 3.3×10^{-4} across age groups with the highest doses modeled for Manufacturing as a Byproduct OES from a 30Q5 flow surface water concentration of 78 µg/L and harmonic mean flow concentration of 43 µg/L. Preliminary risks were not identified (*i.e.*, estimated MOEs were greater than the benchmark MOEs of 30 or 300) for acute or chronic non-cancer drinking water exposures, while preliminary risks were identified (*i.e.*, estimated risks greater than the benchmark of 1.0×10^{-6}) for 10 facilities across 5 OES for chronic cancer drinking water exposures (Table 6-6, Appendix G.2.2):

- Manufacturing as a Byproduct
- OES Unable to be Mapped
- Processing as a Reactant,
- Waste Handling, Disposal and Treatment (POTW)
- Waste Handling, Disposal and Treatment (non-POTW WWT)

The identification of these preliminary risks relative to the benchmark led to further potential refinement of drinking water concentrations and doses (Tier 3) by evaluating these releases and their proximity to potential downstream drinking water intake information (Section 6.2.2). After evaluation of these 10 facilities, 4 had drinking water intakes located within 250 km downstream, while 6 had no identified drinking water intakes (Table 6-12). For those that did have identified downstream drinking water intakes, none were closer than 70 km downstream and all resulting instream concentrations were greater than 99.9% diluted from initial surface water concentrations estimated after Tier 2 analysis. Therefore, facilities either did not have drinking water intakes downstream or those that did were far downstream resulting in significant reductions of estimated 1,1,2-trichloroethane concentrations. While specific doses are not presented here to protect sensitive information, based on this degree of dilution from initial surface water concentrations (>99.9% in all evaluated cases), no drinking water exposures with risks greater than the cancer benchmark of 1.0×10^{-6} are identified for facility-specific releases following Tier 3 evaluation. These results are carried into the *Draft Risk Evaluation for 1,1,2-Trichloroethane* ([U.S. EPA, 2026r](#)) to derive risk estimates and inform risk determination and regulatory decision-making. Full characterization of facility releases and calculation of doses across all age groups is available in *Draft General Population Surface Water Pathway Exposure Estimates for 1,1,2-Trichloroethane* supplemental file ([U.S. EPA, 2026k](#)).

6.4.3.3 Results for Generic Scenario Releases

Drinking water exposures from estimated Generic Scenario releases described in Section 6.2.1.2 and Section 6.2.2 were evaluated from estimated 30Q5 and HM flow surface water concentrations as shown in Table 6-11. Table 6-22 shows the calculated drinking water doses to adults, infants and toddlers based on estimated surface water concentrations. Acute doses associated with high-end release scenarios modeled using the P10 flow percentile ranged from 1.3×10^{-7} to 3.3×10^{-4} mg/kg-day across age groups, average daily doses ranged from 2.4×10^{-8} to 5.7×10^{-5} across age groups, and lifetime average daily doses ranged from 7.8×10^{-10} to 1.6×10^{-5} across age groups with the highest doses modeled for Formulation of Adhesives and Sealants OES from a 30Q5 flow surface water concentration of 2.4 µg/L and harmonic mean flow concentration of 2 µg/L. No exposures indicating preliminary risk relative to

6928 their benchmarks were identified for acute and chronic non-cancer or chronic cancer endpoints for any
6929 scenario of the evaluated OESs (Table_Apx G-13). These results are carried into the *Draft Risk*
6930 *Evaluation for 1,1,2-Trichloroethane* ([U.S. EPA, 2026r](#)) to derive risk estimates and inform risk
6931 determination and regulatory decision-making.

Table 6-21. Facility-Specific Drinking Water Doses Across Adult, Infant, and Toddler Lifestages by Occupational Exposure Scenario (OES) Based on Tier 2 Modeled Surface Water Concentrations

OES ^a	Modeled Surface Water Concentrations		Adult (21+ years)			Infant (birth to < 1 year)			Toddler (1-5 years)		
	30Q5 Conc. (µg/L)	HM Conc. (µg/L)	ADR _{POT} (mg/kg-day)	ADD (mg/kg-day)	LADD _{POT} (mg/kg-day)	ADR _{POT} (mg/kg-day)	ADD (mg/kg-day)	LADD _{POT} (mg/kg-day)	ADR _{POT} (mg/kg-day)	ADD (mg/kg-day)	LADD _{POT} (mg/kg-day)
Manufacturing as a Byproduct	78	43	3.1E-03	4.6E-04	3.3E-04	1.1E-02	1.2E-03	1.5E-05	3.9E-03	5.0E-04	3.2E-05
Not Mapped to an OES	7.9	7.9	3.2E-04	5.9E-05	4.3E-05	1.1E-03	1.5E-04	1.9E-06	4.0E-04	6.5E-05	4.2E-06
Processing as a Reactant	12	12	4.7E-04	1.2E-04	9.1E-05	1.7E-03	3.2E-04	4.1E-06	5.9E-04	1.4E-04	8.7E-06
Repackaging	2.6	1.8	1.1E-04	1.4E-05	9.9E-06	3.7E-04	3.5E-05	4.4E-07	1.3E-04	1.5E-05	9.5E-07
Use of Laboratory Chemicals	1.5	1.5	6.0E-05	1.2E-05	8.5E-06	2.1E-04	3.0E-05	3.8E-07	7.5E-05	1.3E-05	8.2E-07
Waste Handling, Disposal and Treatment (Incineration)	0.28	9.8E-02	1.1E-05	7.4E-07	5.4E-07	4.0E-05	1.9E-06	2.4E-08	1.4E-05	8.1E-07	5.2E-08
Waste Handling, Disposal and Treatment (Landfill)	0.46	0.28	1.9E-05	2.1E-06	1.6E-06	6.5E-05	5.4E-06	7.0E-08	2.3E-05	2.3E-06	1.5E-07
Waste Handling, Disposal and Treatment (non-POTW WWT)	9.1	9.1	3.6E-04	6.8E-05	5.0E-05	1.3E-03	1.7E-04	2.2E-06	4.6E-04	7.5E-05	4.8E-06
Waste Handling, Disposal and Treatment (POTW)	4.9	4.1	2.0E-04	4.5E-05	3.3E-05	6.9E-04	1.1E-04	1.5E-06	2.4E-04	4.9E-05	3.1E-06
Waste Handling, Disposal and Treatment (Remediation)	5	5	2.0E-04	3.8E-05	2.8E-05	7.1E-04	9.6E-05	1.2E-06	2.5E-04	4.1E-05	2.6E-06
30Q5 = 30 consecutive days of lowest flow over a 5-year period; ADR = acute dose rate; ADD = average daily dose; HM = harmonic mean; LADD = lifetime average daily dose; OES = occupational exposure scenario; POT = potential											
^a Each OES is represented by the facility within that OES with the highest estimated surface water concentration for that OES as described in Section 6.2.1.1 and shown in Table 6-5											

Table 6-22. Generic Scenario Drinking Water Doses across Adult, Infant, and Toddler Lifestages by Occupational Exposure Scenario (OES)

OES ^a	Flow Percentile	Modeled Surface Water Concentrations		Adult (21+ years)			Infant (Birth to < 1 year)			Toddler (1-5 years)		
		30Q5 Conc. (µg/L)	HM Conc. (µg/L)	ADR _{POT} (mg/kg-day)	ADD (mg/kg-day)	LADD _{POT} (mg/kg-day)	ADR _{POT} (mg/kg-day)	ADD (mg/kg-day)	LADD _{POT} (mg/kg-day)	ADR _{POT} (mg/kg-day)	ADD (mg/kg-day)	LADD _{POT} (mg/kg-day)
Formulation of Adhesives and Sealants	P10	2.4	2	9.5E-05	2.2E-05	1.6E-05	3.3E-04	5.7E-05	7.3E-07	1.2E-04	2.4E-05	1.6E-06
Use of Cleaning and Degreasing Solvents	P10	3.5E-03	3.5E-03	1.4E-07	3.1E-08	2.3E-08	5.0E-07	8.0E-08	1.0E-09	1.8E-07	3.4E-08	2.2E-09
Use of Adhesives and Sealants	P10	3.3E-03	3.0E-03	1.3E-07	2.4E-08	1.7E-08	4.7E-07	6.1E-08	7.8E-10	1.7E-07	2.6E-08	1.7E-09
30Q5 = 30 consecutive days of lowest flow over a 5-year period; ADR = acute dose rate; ADD = average daily dose; HM = harmonic mean; LADD = lifetime average daily dose; POT = potential												
^a Each OES represented in table by the high-end release scenario for that OES as described in Section 6.2.1.2												

6.4.4 Fish Ingestion

As described in Section 9, exposure to 1,1,2-trichloroethane via fish ingestion is not expected to be a pathway of concern for either human or wildlife receptors. Bioaccumulation estimates indicate a low bioaccumulation factor (BAF) of 6.59 (Section 3.5.4), that is consistent with its physical and chemical properties ($\log K_{ow} = 2.05$; Section 2.2.1.8). Consistent with this expectation, EPA identified no studies that report evidence of 1,1,2-trichloroethane in tissues of wild-caught fish or other organisms. In addition, no evidence of dietary or oral toxicity to wild mammals or birds has been reported ([U.S. EPA, 2026l](#)).

Based on the above factors, considerations, and investigations, a quantitative screening-level fish ingestion assessment was not conducted for 1,1,2-trichloroethane. Should future monitoring data or toxicity information become available, indicating measurable bioaccumulation of 1,1,2-trichloroethane in aquatic organisms or dietary hazard to wildlife, the need for a quantitative fish ingestion assessment would be reconsidered.

6.5 Environmental Exposures for Surface Water and Sediment

6.5.1 Surface Water

EPA modeled concentrations of 1,1,2-trichloroethane in surface water based on a tiered approach for both reported facility-specific releases reported to the TRI and DMR databases between 2019 – 2023 as well as estimated generic scenario releases based on relevant OESs (Section 6.2.1). Following Tier 2 analysis of surface water concentrations, the highest modeled 7Q10 flow surface water concentrations using TRI and DMR facility release data and maximum days of release was 145 $\mu\text{g/L}$ 1,1,2-trichloroethane for the Manufacturing as a Byproduct OES (Table 6-4). The highest surface water concentration from generic scenarios was 2.8 $\mu\text{g/L}$ 1,1,2-trichloroethane modeled using the 7Q10 P10 flow (1,793,000 m^3/day) for the Formulation of Adhesives and Sealants OES (Table 6-10). These surface water concentrations represent high-end exposure concentrations used in screening environmental risk to aquatic organisms in the *Draft Risk Evaluation for 1,1,2-Trichloroethane* ([U.S. EPA, 2026r](#)). Full details of modeled facility-specific surface water concentrations are given in *Draft Surface Water Concentration Modeling and Environmental Exposure for 1,1,2-Trichloroethane* supplemental file ([U.S. EPA, 2026t](#)).

6.5.2 Sediment

EPA modeled concentrations of 1,1,2-trichloroethane in sediment based on both reported facility-specific releases reported to the TRI and DMR databases between 2019 – 2023 as well as estimated generic scenario releases based on OES. After all refinements, the highest modeled sediment concentrations using TRI and DMR facility release data and maximum days of release was 628 $\mu\text{g/kg}$ 1,1,2-trichloroethane from the Manufacturing as a Byproduct OES (Table 6-15). The highest sediment concentration from generic scenarios was 13.4 $\mu\text{g/kg}$ modeled using the 7Q10 P10 flow (1,793,000 m^3/day) for the Formulation of Adhesives and Sealants OES (Table 6-16). These sediment concentrations represent high-end exposure concentrations used in screening environmental risk to aquatic organisms in the *Draft Risk Evaluation for 1,1,2-Trichloroethane* ([U.S. EPA, 2026r](#)).

6.6 Strengths, Limitations, Assumptions and Key Sources of Uncertainty for Surface Water and Sediment Pathway

Surface Water Concentrations

EPA primarily relied on modeling for estimation of surface water, sediment and drinking water concentrations of 1,1,2-trichloroethane as well as associated default and user-selected inputs for these models which can affect the overall strength in evaluating surface water concentrations. EPA used E-FAST as part of a tiered approach to estimate concentrations of 1,1,2-trichloroethane within surface water which does not consider fate or hydrologic transport characteristics and is intended to give a representative estimate of surface water concentrations at the point of discharge, but more conservative compared to potential downstream concentrations. For facility releases, EPA relied on the use of TRI and DMR data which can either underestimate or overestimate potential releases. Reporting to TRI is based on annual reported loadings and does not include facilities with fewer than 10 full time employees, nor does it consider certain sections, which may lead to underestimates in total 1,1,2-trichloroethane releases to the environment. The EPA Pollutant Loading Tool compiles and makes public discharges as reported to DMRs required in NPDES permits and provides data on the amount and monitored concentration of 1,1,2-trichloroethane in discharged effluent to the receiving water body. In compilation of this information, DMR monitoring data is often over shorter time periods of months to quarters, which are then extrapolated to estimate annual total releases that may under or overestimate releases.

In instances where EPA identified preliminary risks relative to the benchmark for the evaluated routes, the use of the higher tier evaluation scenarios to review and potentially refine release and release monitoring information at individual facilities in this assessment acts as a check on estimated releases and provides additional strength on the validity of potential estimated surface water concentrations. Adding additional strength to this evaluation, EPA incorporated an updated hydrologic flow network and flow data into this assessment that allowed a more site-specific consideration of release location and associated receiving water body flows.

As mentioned previously, the evaluation of generic scenarios is unable to identify a specific known release or evaluate those releases at a specific location or associated receiving waterbody. This leads to uncertainty about release volumes or potential receiving waterbody flows. However, the generation of distributions of both release volumes and days of release through Monte Carlo modeling as well as the potential distributions of flows derived based on generic facility data for these OES is intended to give the range of possible exposures encountered at these facilities.

Sediment Concentrations

EPA used PSC to estimate concentrations of 1,1,2-trichloroethane within sediment using both known facility and generic scenario releases. PSC considers model inputs of physical and chemical properties of 1,1,2-trichloroethane and allows EPA to model predicted sediment concentrations. The use of physical and chemical properties of 1,1,2-trichloroethane refined through the systematic review process and supplemented by EPA models increases confidence in the application of the PSC model for evaluation of sediment concentrations. A standard EPA water body was used to represent a consistent and conservative receiving water body scenario. As with the surface water concentrations above, there is greater uncertainty in the sediment concentrations at the evaluated generic scenarios as compared to the facility-specific releases due to lack of specific receiving waterbody flow information or releases, but the generated distribution of flows and releases for these generic scenarios is expected to characterize the range exposures occurring across an OES.

Drinking Water Concentrations

Drinking water concentrations relied on the same modeling tools as used to evaluate surface water concentrations with similar strengths, weaknesses and assumptions described above. Initial tiers of drinking water exposure evaluation consider concentrations near the point of discharge without the consideration of drinking water treatment. Higher tier modeling of facility-specific drinking water concentrations and estimation of doses and potential risks to the general population incorporate the consideration of proximity to drinking water intakes as well as the potential for downstream dilution. Through this refinement there is increased confidence in estimation of potential drinking water concentration at the point of intake from facility-specific releases. While generic scenarios do not allow for this level of refinement there is strong confidence that the evaluated scenarios and inputs to those scenarios are effective in estimating the range of drinking water concentrations across the range of release and flow inputs for an OES. Lending support to the drinking water modeling evaluation for both facility-specific and generic scenarios is that modeling scenarios are generally in agreement with measured information with low concentrations for both modeled and measured concentrations. Therefore, these concentrations and resultant exposures would be expected to represent higher-end, conservative estimates of potential drinking water exposure.

6.7 Evidence Integration and Weight of Scientific Evidence

6.7.1 Evidence Integration and Weight of Scientific Evidence for Surface Water

6.7.1.1 Measured and Modeled Information

EPA quantitatively modeled estimated concentrations of 1,1,2-trichloroethane in surface water from known facility releases as reported to DMR and TRI as well as developed generic release scenarios through the use of the E-FAST modeling tool. Additionally, the use of tiering by identifying initial potential exposures of concern to both environmental and human populations provided greater confidence and better characterization of the facility releases and representation of surface water concentrations. Comparing between modeled surface water concentrations using the maximum operating days scenario for the highest facility reported releases per OES and the modeled generic scenarios show that modeled concentrations are broadly similar (*e.g.*, within the same order of magnitude) offering increased confidence of estimated surface water concentrations.

Although there is limited available measured data of 1,1,2-trichloroethane in surface waters, these monitored values provide a point of reference and comparison with the modeled releases estimates. While it is difficult to directly compare monitored values to potential modeled releases due to measured concentrations oftentimes not being temporally or geographically close to known releases of 1,1,2-trichloroethane, most measured concentrations are low and similar in magnitude to modeled facility and generic scenario estimates. The high-end modeled concentrations, based on industrial releases data released over a limited number of days exceeded the highest values available from monitoring by 1-2 orders of magnitude, thereby supporting EPA's approach in using these more conservative inputs and scenarios as a screening exercise for environmental and general population exposure.

6.7.1.2 General Population Incidental Dermal and Oral Exposure while Swimming

As mentioned in the previous section, there is high confidence that the modeled surface water concentrations presented for both the facility-specific releases and generic scenario releases represent higher-end estimated concentrations, and that these concentrations are reasonably applied for estimation of potential incidental dermal and oral exposure across the evaluated age groups and OESs. EPA's Swimmer Exposure Assessment Model provided detailed information on the skin surface areas for

dermal exposure and potential swimming exposure times for the evaluated age groups given as high-end default durations for the evaluated age groups ([U.S. EPA, 2015b](#)). For estimation of incidental oral exposures, age group specific ingestion rates are selected from EPA's Exposure Factors Handbook as upper percentile values while swimming ([U.S. EPA, 2019c](#)). Further, estimated concentrations are representative of those expected near the point of discharge to receiving waterbodies and a more conservative estimate of expected exposures. Concentrations would be expected to dilute and/or degrade with time and movement downstream. Therefore, EPA has robust confidence that estimates of exposure are representative of higher end exposure estimates for incidental dermal exposure per OES.

6.7.1.3 Environmental Exposure to Surface Water

Environmental exposures to surface water were effectively modeled using the E-FAST modeling tool. Exposures to aquatic biota followed a tiered structure whereby if preliminary risk was identified at a lower tier using more conservative inputs and higher-end release information, those scenarios were evaluated for potential refinement. The refinement process resulted in revised estimations of potential environmental exposure where appropriate that resulted in risk quotients <1 across the range of evaluated OES.

6.7.2 Evidence Integration and Weight of Scientific Evidence for Drinking Water

6.7.2.1 Measured and Modeled Information

EPA effectively quantitatively modeled estimated concentrations of 1,1,2-trichloroethane in surface water from known facility releases as reported to DMR and TRI as well as developed generic release scenarios using the E-FAST modeling tool for evaluation of the drinking water pathway. Additionally, the use of tiering for identifying preliminary risk and areas of potential refinement for the drinking water pathway provided greater confidence and better characterization of the facility releases and representation of surface water concentrations and drinking water exposures. Subsequent further evaluation of proximity to drinking water intakes and magnitude of potential dilution of 1,1,2-trichloroethane facility-specific releases as the chemical is transported downstream for those releases still showing preliminary risk following Tier 2 evaluation offers additional support for evaluating drinking water exposure. Downstream trace analysis showed that for facilities with downstream intakes, those distances were at least 70 km downstream and had high levels of dilution. There is lesser confidence in the precision of estimated concentrations resulting from evaluation of generic scenario releases, but robust confidence that evaluated scenarios represent the range of potential concentrations for evaluated OES.

There was also ample monitoring data of 1,1,2-trichloroethane in drinking water across multiple reporting cycles due to it being a regulated water contaminant. EPA has robust confidence based on the available data that 1,1,2-trichloroethane is infrequently detected, and when detected is below the MCL of 5 µg/L. While it is difficult to directly compare monitored values to potential modeled releases due to measured concentrations oftentimes not being temporally or geographically close to known releases of 1,1,2-trichloroethane, most measured concentrations are low and similar in magnitude to modeled facility and generic scenario estimates.

6.7.2.2 General Population Drinking Water Exposure

As mentioned above, there is high confidence that the modeled surface water concentrations presented for both the facility-specific releases and generic scenario releases represent higher-end concentrations, and that these concentrations are reasonably applied for initial identification of drinking water exposure across the evaluated age groups. The use of a tiering structure to evaluate and where possible, refine

these, offered increasing confidence and robustness in predicted drinking water exposures. For example, higher tier evaluation and refinement of those facility-specific releases showing potential risks to the general population following Tier 2 evaluation incorporate proximity to drinking water intakes and magnitude of potential dilution of 1,1,2-trichloroethane as described in Section 6.4.3. These refinements provided additional support and confidence in actual potential exposures encountered by the general population from facility-specific releases. While it is difficult to directly compare monitored values to potential modeled releases due to measured concentrations oftentimes not being temporally or geographically close to known releases of 1,1,2-trichloroethane, the ample monitoring data of 1,1,2-trichloroethane in drinking water across multiple reporting cycles due to it being a regulated drinking water contaminant broadly confirmed modeled results. Available data showed that 1,1,2-trichloroethane is infrequently detected in drinking water and when measured, most measured concentrations are low and similar in magnitude to the modeled facility and generic scenario estimates.

6.7.3 Evidence Integration and Weight of Scientific Evidence for Sediment

6.7.3.1 Measured and Modeled Information

Concentrations of 1,1,2-trichloroethane within the sediment were estimated for both facility-specific releases as well as general scenario releases using PSC which considers model inputs of physical and chemical properties of 1,1,2-trichloroethane. The use of reviewed physical and chemical properties of 1,1,2-trichloroethane increases confidence in the application of the PSC model to estimate sediment concentrations of the chemical.

Evaluation of facility releases used the highest facility release for each OES, while generic scenario releases were evaluated using the high-end scenario of release volume and days of release with resultant estimated concentrations indicative of concentrations near the point of discharge. Sediment concentrations were estimated using the calculated 7Q10 flow for each waterbody which represents the lowest 7-day flow in a 10-year period and represents a more conservative metric of potential instream flows encountered by environmental populations. There is greater uncertainty around the 7Q10 flows and release volumes associated with generic scenarios as compared to facility-specific releases since the specific location of releases and amount released is not known for these generic scenarios. However, the developed distribution of flows and releases is inclusive of the range of potential flows and releases for facilities in a given OES. Additionally, the use of the high-end release volume and P10 flow for this initial evaluation of potential sediment concentrations would represent more conservative conditions within that OES and therefore greater confidence that potential exposures of concern would not be missed. Overall confidence in the sediment concentrations associated with both facility-specific and generic scenarios is moderate to robust.

As with the surface water monitoring data discussed in Section 6.1.1, there is limited available measured data of 1,1,2-trichloroethane in sediments as discussed in 6.1.2. While it is difficult to directly compare monitored values to potential modeled concentrations due to measured concentrations oftentimes not being temporally or geographically close to known releases of 1,1,2-trichloroethane, available measured concentrations were always below detection limit for the given sampling efforts and indicate generally low concentrations that are similar in magnitude to modeled facility and generic scenario estimates.

6.7.3.2 Environmental Exposure to Sediment

There is high confidence that the modeled sediment concentrations presented for both the facility-specific releases and generic scenario releases represent higher-end concentrations, and that these concentrations are reasonably applied. The use of the PSC model effectively models sediment concentrations using physical and chemical properties of 1,1,2-trichloroethane that provide additional

confidence in the modeled results. And while monitoring information was limited in geographic scope, measured values are generally consistent with modeled results indicating that sediment exposures to 1,1,2-trichloroethane are expected to be low across evaluated OES.

6.8 Conclusions and Exposure Characterization

Based on available measured monitoring information and release information from TRI/DMR databases, 1,1,2-trichloroethane is known to be released to surface water from TSCA COUs and has been measured in surface water, sediment and drinking water leading to expected exposures to both environmental and human populations. Exposures to both these populations have been estimated here using modeled concentrations and exposures in surface water, sediment and drinking water. Environmental populations were evaluated for both acute and chronic exposures, while the general population was evaluated for acute incidental oral and dermal exposures from surface water, acute and chronic non-cancer drinking water exposure, and chronic cancer drinking water exposure. Using various described modeling tools and approaches that incorporate a series of tiering steps, exposures have been quantified with refinements and higher tier analyses intended to bolster confidence and precision for both facility-specific and generic scenario releases of 1,1,2-trichloroethane. Results from these analyses will be used to estimate exposure, characterize risk, and inform risk determination and regulatory decision making in the *Draft Risk Evaluation for 1,1,2-Trichloroethane* ([U.S. EPA, 2026r](#)).

7 GROUNDWATER PATHWAY ASSESSMENT

7.1 Groundwater Pathway

For the evaluation of groundwater, EPA reviewed available monitoring data to make its decision not to pursue this pathway quantitatively. EPA searched peer-review literature, gray literature and databases of environmental monitoring data to obtain concentrations of 1,1,2-trichloroethane in groundwater. These monitoring data are used to provide, where possible, context for the Agency's decision not to pursue this pathway quantitatively. A summary presentation of monitoring concentrations for groundwater is in Section 7.1.1.

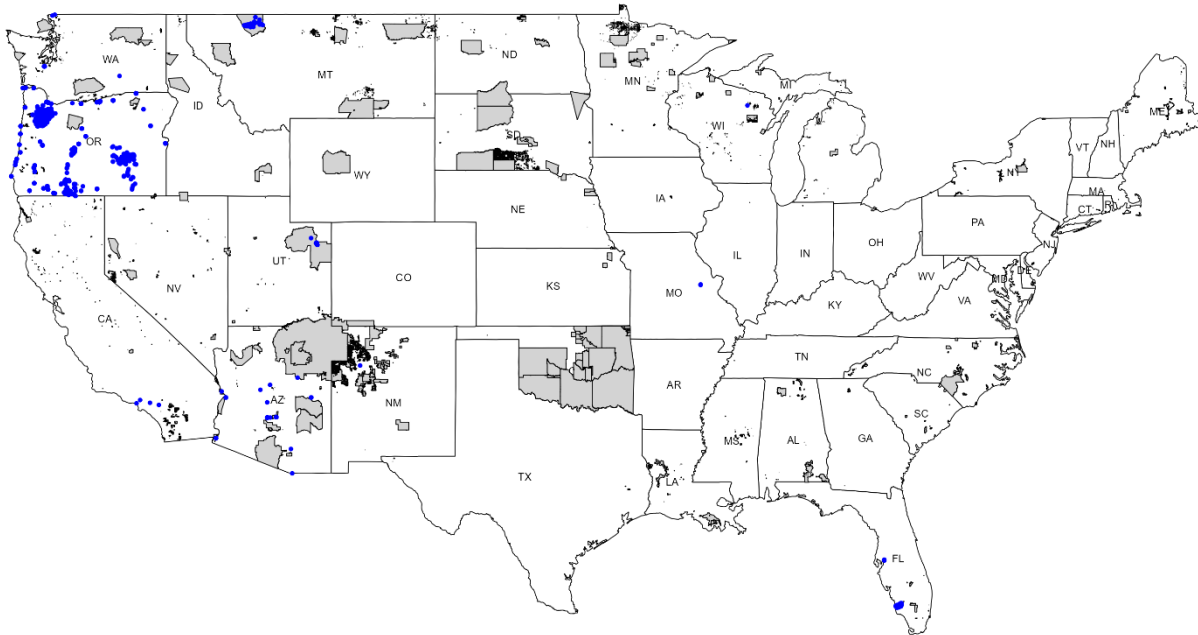
7.1.1 Measured Concentrations in Groundwater

EPA used data from national and state databases to characterize concentrations of 1,1,2-trichloroethane in groundwater. EPA did not identify any peer-reviewed literature with groundwater monitoring data in the U.S. conducted more recently than 2015. A discussion of studies identified during Systematic Review that were conducted before 2015 and contain groundwater monitoring data is in Section 3.4.3.4; however, given the age of those studies, EPA has determined that sources of 1,1,2-trichloroethane in those studies are likely not due to current uses (Section 7.1.1.2). Therefore, EPA is not considering those studies as part of the exposure assessment in this evaluation.

7.1.1.1 Water Quality Portal

Concentrations of 1,1,2-trichloroethane measured from groundwater monitoring wells are collated by the National Water Quality Monitoring Council and stored in the WQP (Available at: www.waterqualitydata.us). Figure 7-1 shows the spatial distribution of 1,1,2-trichloroethane groundwater monitoring locations across the contiguous U.S. reported in the WQP. There were monitoring data available for ten states, with approximately 75% of the monitoring occurring in Oregon. A total of 1,202 groundwater monitoring concentration results were acquired from the WQP for the years of 2015 to 2025, with 34 having a concentration above the detection limit, resulting in an overall detection frequency of approximately 2.8%. Concentrations of 1,1,2-trichloroethane in groundwater ranged from below detection to 110 µg/L (Figure 7-2) and detection limits ranged from 0.0349 to 20 µg/L.

1,1,2 Trichloroethane Groundwater Sampling



Source: Water Quality Portal, 2015-2025

Figure 7-1. Locations of 1,1,2-Trichloroethane Groundwater Monitoring Wells Acquired from the WQP for the Years of 2015–2020

AIANNH tribal boundaries are shaded in gray.

Note: Alaska, American Samoa, Guam, Hawaii, N. Mariana Islands, Puerto Rico, and the U.S. Virgin Islands are not shown because the WQP does not contain groundwater monitoring for these locations.

June 2026

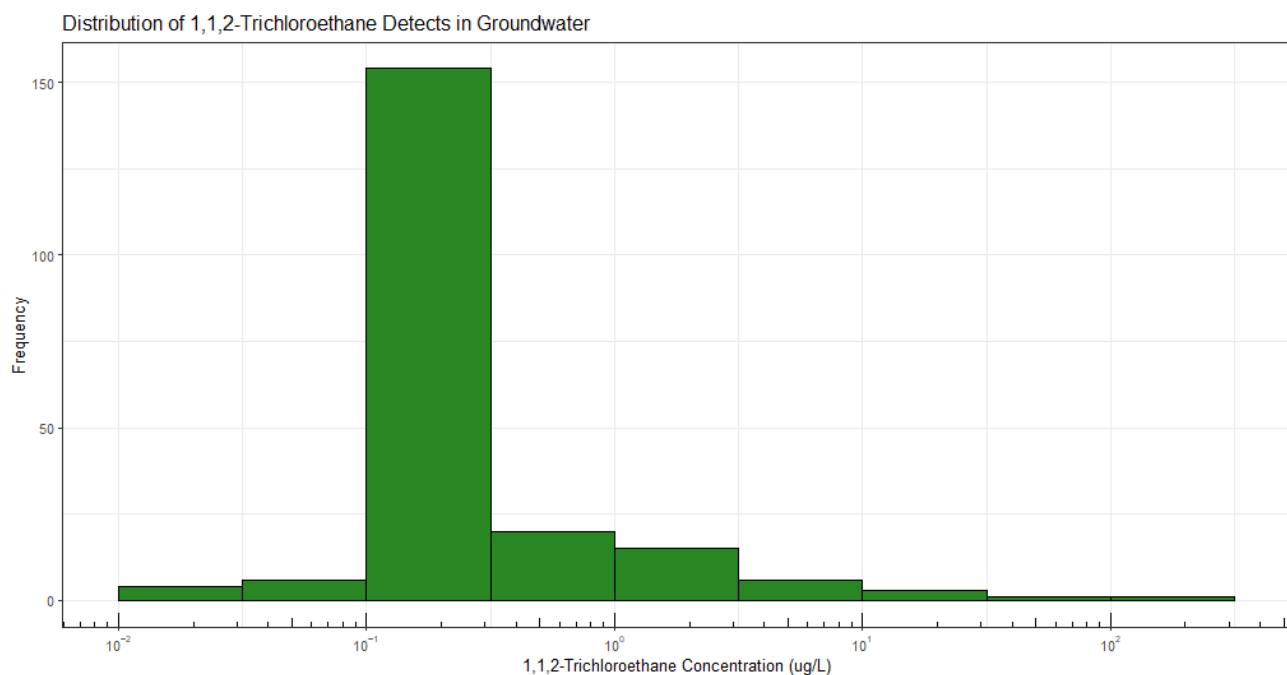


Figure 7-2. Distribution of 1,1,2-Trichloroethane Concentrations from Groundwater Monitoring Wells with Concentrations Above the Detection Limit as Reported to the Water Quality Portal for the Years of 2015–2025

7.1.1.2 State Groundwater Databases

In addition to the WQP, EPA also queried state groundwater monitoring databases for the States of California and Washington.

For the data from the State of Washington, EPA queried data from the Department of Ecology's Environmental Information Management database for the years of 2015 to 2025¹¹. EPA extracted 36,297 entries and 398 were determined to have a concentration above the detection limit, resulting in a detection frequency of 1.18%. The reported detectable concentrations range 0.0353 to 24,100 µg/L, with detection limits ranging from 0.00013 to 70 µg/L. Figure 7-3 shows the distribution of the detectable concentrations. The monitoring data were associated with seven monitoring types, as described by the database: Contaminated site investigation (characterization, includes RI/FS and remedial design); Landfills – routine monitoring and Solid Waste Management program (SWM) cleanups; Post-cleanup, long-term confirmation monitoring or remediated contaminate site (periodic review, operation & maintenance); Voluntary Cleanup Program (VCP) – awaiting Application Approval; Voluntary Cleanup Program (VCP); Performance monitoring for emergency or interim cleanup action at contaminated site; and General environmental study. Monitoring data that include legacy contamination or emergency clean up action were not considered to be within the scope of this evaluation. The remaining monitoring types, as defined by the database, are General environmental study and Landfills – routine monitoring and Solid Waste Management program (SWM) cleanups. The range of monitored concentrations above the detection limit was 0.092 to 34 µg/L, with detection limits ranging from 0.07 to 6.4 µg/L.

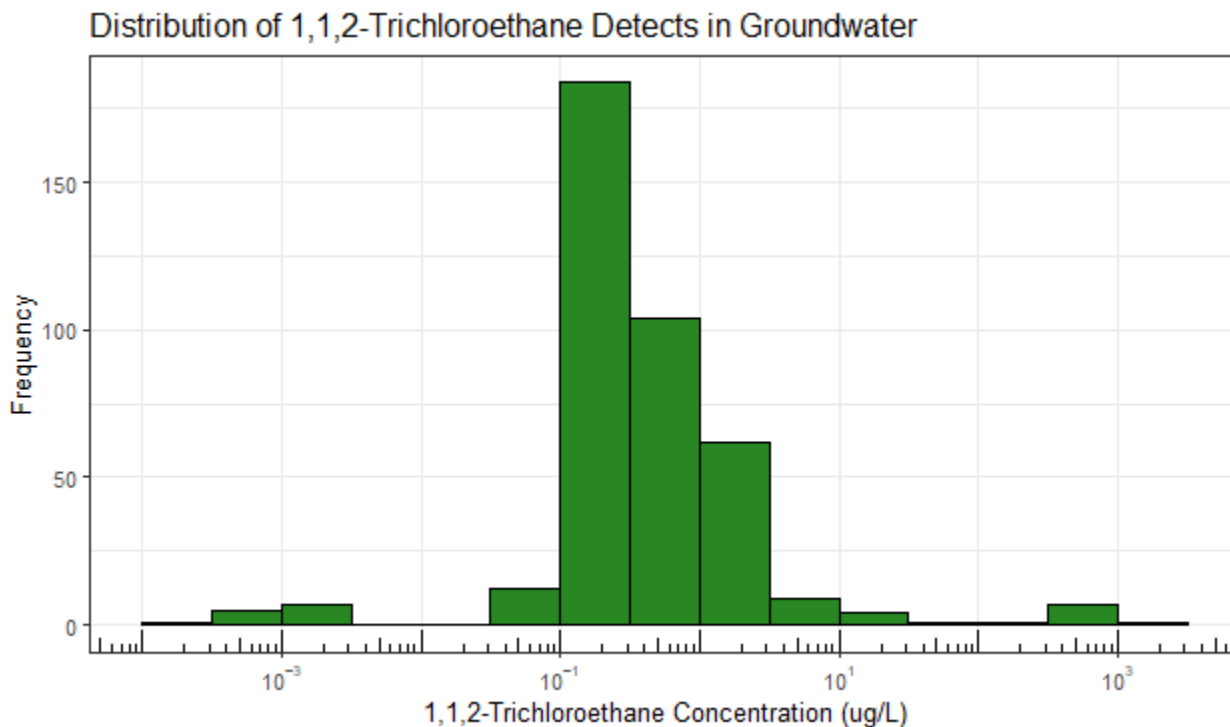
For the data from the State of California, EPA queried data from the Water Resources Control Board's Ground Ambient Monitoring and Assessment Program for the years of 2015 to 2025¹². EPA extracted

¹¹ Data from the online portal (<https://apps.ecology.wa.gov/eim/search/default.aspx>) were queried in May 2026.

¹² Data were queried in May of 2026 (<https://www.waterboards.ca.gov/gama/>)

June 2026

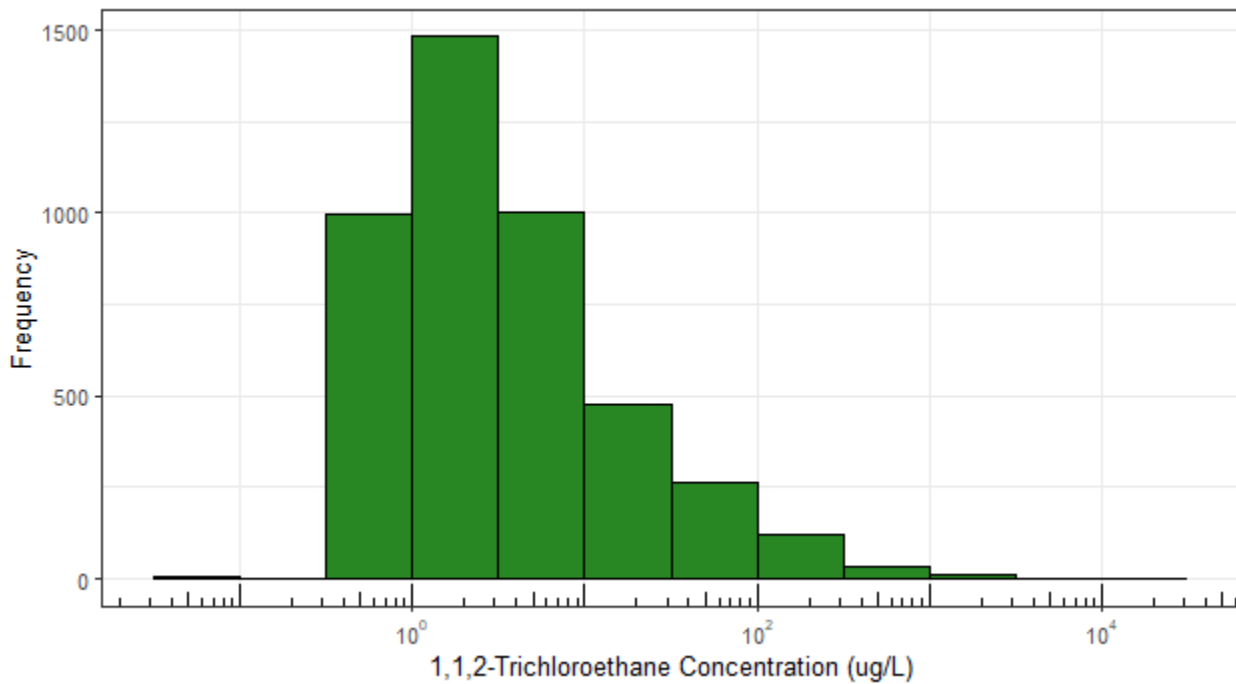
503,550 entries and 4,391 were determined to have a concentration above the detection limit, resulting in a detection frequency of 0.87%. The reported detectable concentrations range from 0.071 to 19,000 µg/L, with detection limits ranging from 0.001 to 1,250 µg/L. Figure 7-4 shows a distribution of the detectable concentrations. Of the detectable values, 4,243 of the entries were a part of the Water Board Cleanup and Permitted Sites data set. This data set represents environmental and regulatory data from sites contaminated by underground storage tanks, oil and gas activities, confined animal/concentrated animal and feed lots, among others. When considering data that were not part of the Water Board Cleanup and Permitted Sites data set, the monitored concentrations above the detection limit ranged from 0.071 to 33.1 µg/L, with detection limits ranging from 0.04 to 0.5 µg/L.



Source: Environmental Information Management Database, Department of Ecology, State of Washington, 2015-2025

Figure 7-3. Distribution of 1,1,2-Trichloroethane Concentrations from Groundwater Monitoring Wells with Concentrations Above the Detection Limit as Reported to the State of Washington's Environmental Information Management Database for the Years of 2015–2025

Distribution of 1,1,2-Trichloroethane Detects in Groundwater



Source: Groundwater Ambient Monitoring and Assessment Program, Water Resources Control Board, State of California

Figure 7-4. Distribution of 1,1,2-Trichloroethane Concentrations from Groundwater Monitoring Wells with Concentrations Above the Detection Limit as Reported to the State of California’s Groundwater Ambient Monitoring and Assessment Program for the Years of 2015–2025

7.1.2 Evidence Integration and Weight of Scientific Evidence for Groundwater for the General Population

Monitoring data show that 1,1,2-trichloroethane is a commonly detected groundwater pollutant across the U.S. The highest monitored concentrations from the States of Washington and California show that the highest concentrations are likely associated with legacy contamination, which is outside the scope of this evaluation. Additionally, 1,1,2-trichloroethane is the degradation product of other chlorinated ethanes, such as 1,1,1,2-tetrachloroethane (Section 3.3.1); therefore, some of the 1,1,2-trichloroethane present in groundwater is likely to be due to the uses and disposal of other chlorinated compounds. EPA also acknowledges that there are other state databases that were not queried as a part of this evaluation; however, the data that have been collected provide strong evidence that the highest levels of groundwater contamination are not due to ongoing uses of 1,1,2-trichloroethane. Therefore, EPA determined that querying of other state databases was not necessary for this evaluation. Overall, EPA has moderate confidence that exposure to 1,1,2-trichloroethane via groundwater is not likely to occur due to ongoing uses. Based on the overall weight of evidence, EPA is not performing a quantitative groundwater exposure assessment to the general population as part of this evaluation.

8 LAND PATHWAY ASSESSMENT

8.1 Land (Soil) Pathway

EPA searched peer-reviewed literature, gray literature, and databases of environmental monitoring data for concentrations of 1,1,2-trichloroethane in media that encompass the land pathways (e.g., biosolids, wastewater sludge, agricultural soils, landfills, and landfill leachate).

8.1.1 Landfills

EPA did not identify any data on concentrations of 1,1,2-trichloroethane in landfills during systematic review. EPA did identify one study conducted in 1984 reporting groundwater concentrations of 7.7 to 31 µg/L at sites located near municipal solid waste landfills in Minnesota, indicating that 1,1,2-trichloroethane can migrate to groundwater from landfills (NCBI, 2020b; Sabel and Clark, 1984). However, given that EPA identified limited consumer uses in adhesives (Section 11), 1,1,2-trichloroethane is unlikely to be present in municipal landfills based on its current uses. 1,1,2-Trichloroethane could be present in municipal landfills due to the biodegradation of other chlorinated ethanes, such as 1,1,1,2-tetrachloroethane (Section 3.3.1). EPA is therefore assuming that exposure of 1,1,2-trichloroethane to the general population from municipal solid waste landfills will be low.

For the reporting years of 2019 to 2023, TRI land releases ranged from 6 to 25,040 kg/year. The two highest annual releases (5,279 kg in 2022 and 25,033 kg 2023) were categorized in TRI as “off-site–other landfills.” These releases were transfers to a waste handling facility that also reports to TRI. In 2022 and 2023, the waste handling facility reported that greater than 99% of the total 1,1,2-trichloroethane received was incinerated, with only up to 2 pounds being categorized in TRI as “total off-site disposal to Class I underground Injection Wells, RCRA Subtitle C landfills, and other landfills.”

8.1.2 Measured Concentrations in Soils

EPA did not identify any reported concentrations of 1,1,2-trichloroethane in peer-reviewed literature conducted in the U.S. during systematic review or in the WQP from 2015 to 2025. EPA did identify 36 entries for soil in the State of Washington’s Environmental Information Management database for the years of 2015 to 2025 (Available at: <https://ecology.wa.gov/research-data/data-resources/environmental-information-management-database>) Of those, 5 were determined to have a reported concentration above the reporting limit. The maximum reported detectable soil concentrations was to 52,700 mg/kg. The four highest entries for detectable concentrations in soil in this database (ranging 47.9 to 52,700 mg/kg) occurred at a remediation site for an underground petroleum storage tank. There was only one other entry for soil with a concentration above the reported detection limit, at a reported concentration of 0.022 mg/kg. EPA did not identify any other soils concentrations above detection after 2014 in either peer reviewed literature conducted in the U.S. or the WQP.

8.1.3 Measured Concentrations in Biosolids

EPA did not identify any concentrations above detection of 1,1,2-trichloroethane in biosolids during its systematic review process. In addition to peer reviewed literature, EPA also searched for biosolids concentrations in the National Sewage Sludge Surveys (U.S. EPA, 1996) and the report did not identify any concentrations above the detection limit.

8.1.3.1 Air Deposition to Soil

Given its Henry’s Law constant (8.42×10^{-4} atm·m³/mol) and low to moderate affinity for organic carbon (log K_{oc} = 2.06), flux of 1,1,2-trichloroethane from air to soil is expected to be low; therefore, air deposition to soil is not expected to be an exposure pathway for 1,1,2-trichloroethane that would

contribute significantly to dermal or ingestion exposure for the general population or terrestrial organisms. Additionally, partitioning analyses and fugacity modeling show that when releases are at steady state and primarily to air, 1,1,2-trichloroethane is expected to partition primarily to air (Section 3.2). Additional fugacity modeling done using the OECD LRTP Screening Tool shows that 1,1,2-trichloroethane has an estimated transport efficiency of 21% (Section 3.4.1). The transport efficiency is the percentage of emission flux that is deposited to the soil and water of a hypothetical region adjacent to the region receiving emissions. Overall, the evidence suggests that deposition of 1,1,2-trichloroethane to soil is likely to be low; therefore, EPA did not estimate soil concentrations due to deposition.

8.1.4 Evidence Integration for General Population Exposure via Land Pathways

EPA identified limited data on concentrations of 1,1,2-trichloroethane in soils. EPA searched for soil concentrations in studies conducted in the U.S. and state and national environmental monitoring databases from 2015 to 2025. The only identified soils concentrations above the detection limit were from the State of Washington's Environmental Information Management database. These detectable concentrations were mostly associated with historic contamination from underground petroleum storage tanks. EPA does acknowledge that other states have environmental monitoring databases; however, for this chemical, it was determined that the data presented is sufficient to characterize exposures via soil. Overall, the monitoring data suggest that for its current uses of 1,1,2-trichloroethane are not likely to be present in soils from landfills, biosolids, or air deposition. These monitoring data results agree with the expectations based on the physical and chemical properties of the chemical. The K_{ow} and K_{oc} suggest that 1,1,2-trichloroethane will have moderate to high mobility in soils and will migrate to groundwater. The Henry's Law constant suggests that 1,1,2-trichloroethane can volatilize from surface soil. Additionally, the fugacity modeling suggests that air deposition is not likely to be a significant pathway for exposure. 1,1,2-Trichloroethane is not expected to sorb to biosolids based on its K_{oc} and K_{ow} , with volatilization expected to be the major removal mechanism in WWTPs. Further, based on its current uses and the TRI release data, 1,1,2-trichloroethane is not expected to be disposed of in non-hazardous landfills; however, it can be present in landfills due to biodegradation of other chlorinated ethanes, such as 1,1,1,2-tetrachloroethane. Overall, EPA has moderate confidence that 1,1,2-trichloroethane will be present at low concentrations in soils based on the monitoring data, physical and chemical properties, and release data. EPA therefore will not be conducting a quantitative exposure assessment for land pathways for either humans or the environment.

8.1.5 Trophic Transfer for Terrestrial Species

1,1,2-Trichloroethane is a volatile organic compound for which bioaccumulation and trophic transfer in aquatic and terrestrial food webs are expected to be limited. Low modeled bioaccumulation potential (Section 3.5.4), lack of empirical evidence for accumulation in fish or terrestrial organisms (Section 3.5.4), and absence of dietary hazard information for wildlife ([U.S. EPA, 2026](#)) indicate that exposure and risk to piscivorous receptors via fish ingestion are not anticipated. Accordingly, a quantitative screening-level fish ingestion assessment was not conducted.

1,1,2-Trichloroethane is not expected to undergo appreciable trophic transfer in aquatic or terrestrial food webs due to its physical, chemical, and environmental fate properties. Collectively, its volatility, low bioaccumulation potential, and lack of observed accumulation at lower trophic levels (Section 3.5.4) indicate that 1,1,2-trichloroethane does not biomagnify and is unlikely to undergo trophic transfer.

8.1.6 Evidence Integration for Terrestrial Species Exposure via Land Pathways

EPA identified limited data on concentrations of 1,1,2-trichloroethane in landfills, (Section 8.1.1), soils (Section 8.1.2), and biosolids (Section 8.1.3). Given its Henry's Law constant (8.42×10^{-4} atm·m³/mol), low to moderate affinity for organic carbon ($\log K_{ow} = 2.06$), and fate and transport modeling results

7375 (Section 3), flux of 1,1,2-trichloroethane from air to soil is expected to be low; therefore, air deposition
7376 to soil is not expected to be a significant exposure pathway for 1,1,2-trichloroethane. Overall, the
7377 evidence suggests that 1,1,2-trichloroethane in soil is likely to be low; therefore, EPA did not estimate
7378 soil exposure concentrations.
7379

9 BIOACCUMULATION AND TROPHIC TRANSFER

1,1,2-Trichloroethane has low to moderate hydrophobicity ($\log K_{ow} = 2.05$; Section 2.2.1.8), indicating limited partitioning to lipids and organic matter and a tendency to predominantly remain in the aqueous phase, resulting in limited uptake into aquatic animal tissues. EPA identified no studies that report evidence of 1,1,2-trichloroethane in tissues of wild-caught fish or field derived BAFs. In addition, no evidence of dietary or oral toxicity to wild mammals or birds has been reported ([U.S. EPA, 2026](#)). Measured bioconcentration factors (BCF) in carp (*Cyprinus carpio*) that range from 0.7 to 4.0 (Section 3.5.4) ([OECD, 2000](#)) and the maximum modeled BAF (6.59 for fish at high trophic levels; Section 3.5.4) indicate limited uptake coupled with rapid elimination relative to bioaccumulative substances ([Arnot and Gobas, 2006](#)). The similarity between BCF values (determined through gill uptake only) and BAF values (determined through dietary uptake plus gill uptake) also suggest that most 1,1,2-trichloroethane exchange is through diffusion across respiratory surfaces (*e.g.*, fish gills) with little uptake through the diet.

In water with 1,1,2-trichloroethane, based on its moderate lipophilicity, the chemical may rapidly equilibrate between fish and the surrounding water, with steady state occurring within 1 to 2 days of constant exposure ([OECD, 2000](#)). However, minimal accumulation or sequestration into lipid-rich tissues like muscles, liver, or brain likely occurs because the $\log K_{ow}$ of 2.05 also favors partitioning into the more aqueous blood within the body. Thus, most 1,1,2-trichloroethane remains in blood and rapidly eliminated across the gills when the fish is exposed to lower environmental water concentrations, which is also aided by high partial pressure differences across gill membranes due its moderate volatility (Henry's law constant = $8.24 \times 10^{-4} \text{ atm} \cdot \text{m}^3/\text{mol}$; Section 2.2.1.9) ([Fitzsimmons et al., 2001](#)). In other words, 1,1,2-trichloroethane, as a moderately lipophilic chemical, is likely to be taken up by fish, preferentially partitioned in aqueous tissue, and rapidly eliminated from blood, resulting in minimal net accumulation.

Aquatic animals generally experience no or low 1,1,2-trichloroethane in surface water (1.5% detection frequency, 10.8 $\mu\text{g/L}$ highest measured; Section 5.2.1). When present, exposure concentrations fluctuate due to its physical and chemical properties, variable release volumes, discharge and flow rates, turbulence, and animal behavior (*e.g.*, fish movement into and out of high concentration habitats). 1,1,2-trichloroethane in fish is expected to closely mirror these fluctuations in environmental concentrations due to rapid elimination from blood across gills, with minimal bioaccumulation over time. Together, limited uptake due to $\log K_{ow} = 2.05$, rapid elimination driven by the $\log K_{ow}$ and moderate volatility (Henry's law constant of $8.24 \times 10^{-4} \text{ atm} \cdot \text{m}^3/\text{mol}$), empirical BCFs, and modeled BAF support a weight of evidence conclusion that 1,1,2-trichloroethane has low bioaccumulation potential.

EPA has robust confidence that low bioaccumulation potential, lack of empirical evidence for accumulation in wild-caught fish, and absence of dietary hazard information for wildlife ([U.S. EPA, 2026](#)) indicate that exposure and risk to piscivorous receptors via fish ingestion are not anticipated.

Screening-level assessments of wildlife and human fish ingestion were not conducted because model outputs based on compounding conservative parameters and inputs add uncertainty in the form of predicted values, but not in the overall assessment. For example, screening with constant fish exposure to the highest modeled water concentration and the highest BCF while assuming steady-state, constant exposure to the maximum water concentration, no metabolic transformation, and no variation in fish habitat use adds uncertainty to whether the resulting values are plausible or representative of TSCA COUs given the weight of evidence. Accordingly, a quantitative screening-level human fish ingestion assessment was not conducted. These data also indicate that biomagnification and trophic transfer of 1,1,2-trichloroethane in food webs is unlikely.

10 OCCUPATIONAL EXPOSURE ASSESSMENT

10.1 Approach and Methodology

For workplace exposures, EPA considered exposures to both workers who directly handle 1,1,2-trichloroethane and ONUs who do not directly handle 1,1,2-trichloroethane but may be exposed to vapors, particulates, or mists that enter their breathing zone while working in locations in close proximity to where 1,1,2-trichloroethane is being used. EPA evaluated inhalation exposures to both workers and ONUs and dermal exposures to workers. An occupational exposure assessment was conducted for each OES, where possible, as specified in Table 4-2 of Section 4.

For occupational exposure assessment, EPA used measured (personal or area) and modeled air concentrations to assess inhalation exposure. Dermal monitoring data were not available; therefore, EPA estimated dermal exposure levels using a modeling approach. EPA applied the following hierarchy in selecting data and approaches for assessing occupational exposures ([CEB, 1991](#)):

Table 10-1. Hierarchy of Data and Approaches for Assessing Occupational Exposures to 1,1,2-Trichloroethane

Type of Approach	Description
1. Monitoring data	a) Personal and directly applicable
	b) Area and directly applicable
	c) Personal and potentially applicable or similar (analogous data)
	d) Area and potentially applicable or similar (analogous data)
2. Modeling approaches	a) Surrogate monitoring data
	b) Fundamental modeling approaches (near-field/far-field exposure models)

EPA utilized the estimated central tendency and high-end full-shift TWA inhalation exposure concentrations and estimated dermal concentrations to calculate exposure metrics required for risk evaluation. Additionally, EPA estimated the number of workers potentially exposed for each OES. The amount and the strength of the evidence available for inhalation and dermal exposure estimates vary widely among the OES, and as such EPA evaluated the evidence including strengths, limitations, uncertainties and assumptions made to arrive at an overall confidence rating for the assessment of each OES. See individual subsections in Section 10.2 for details on specific data utilized for each OES. Additionally, the *Draft 1,1,2-Trichloroethane Occupational Risk Calculator* ([U.S. EPA, 2026o](#)) includes the data and calculations used to determine occupational risk for workers and occupational non-users to 1,1,2-trichloroethane. The Agency's estimates of occupational exposure presented in this document do not assume the use of personal protective equipment (PPE); however, the effect of respiratory and dermal protection factors on EPA's occupational exposure estimates can be explored in the "Risk Reduction" tab in the *Draft Risk Calculator for 1,1,2-Trichloroethane* ([U.S. EPA, 2026o](#)). For more discussion on respiratory protection and glove protection, refer to Section 10.1.6.

10.1.1 Identifying Exposure Groups and Worker Activities

EPA recognizes that exposure potential can vary by facility or setting in an OES where 1,1,2-trichloroethane is manufactured, processed, or used. Exposure group refers to a group of potentially

exposed persons with a similar exposure profile to a chemical substance or mixture based on the substantial similarity of tasks performed, the manner in which the tasks are performed, and the materials and processes with which they work (40 CFR 751.5). For each OES assessed, EPA identified exposure groups (also referred to as similar exposure groups (SEGs)) and worker activities. EPA then estimated exposures by exposure group and utilized these to calculate risk estimates.

EPA performed a literature search and reviewed data from systematic review to identify worker activities that could potentially result in occupational exposures. Where worker activities were unclear or not available, the Agency referenced relevant generic scenarios (GSs) and emission scenario documents (ESDs). Additionally, for manufacturing and processing, EPA utilized information from industry submitted test orders to identify and describe exposure groups. In this scenario, EPA received detailed information on the exposure groups (also referred to as similar exposure groups), including worker activities and exposure levels, through the submission of the test order summary report. Where sufficient information to define specific worker exposure groups was not available, EPA assessed exposures to the general categories of workers and ONUs. EPA distinguished workers as those who worked in close proximity to 1,1,2-trichloroethane, having direct contact and/or handling of the chemical. ONUs do not directly handle 1,1,2-trichloroethane but may be indirectly exposed to it as part of their employment.

When modeling exposures, EPA utilized near-field/far-field exposure models which estimate the exposure concentration in two different zones in the workplace but do not further specify exposures by exposure group. EPA also used probabilistic mass balance modeling approaches, which estimate exposures to a worker performing a certain activity such as sampling or drumming but do not further specify exposures by exposure group.

10.1.2 Estimating Inhalation Exposures – Monitoring Data

EPA reviewed workplace inhalation monitoring data collected by government agencies such as OSHA and NIOSH, monitoring data found in published literature (*i.e.*, personal exposure monitoring data and area monitoring data), and monitoring data submitted as part of test orders. Studies were evaluated using the evaluation strategies laid out in the *Draft Systematic Review Protocol Supporting TSCA Risk Evaluations for Chemical Substances, Version 1.0: A Generic TSCA Systematic Review Protocol with Chemical-Specific Methodologies* ([U.S. EPA, 2021b](#)). Data and studies considered in this assessment can be found in the *Draft Systematic Review Protocol for 1,1,2-Trichloroethane* ([U.S. EPA, 2026u](#)) and in the “Inhalation Exposure” tab of the *Draft Occupational Risk Calculator for 1,1,2-Trichloroethane* ([U.S. EPA, 2026o](#)).

As previously described, EPA utilized the hierarchy of data and approaches for assessing occupational exposure as described in Table 10-1. In the absence of chemical and OES specific personal breathing zone data, EPA considers area monitoring data, which is collected at a stationary location as opposed to on a person. Generally, there is more uncertainty in use of this data, and more information is needed on the worker activity pattern to estimate the amount of time the worker is at the monitored location. Where directly applicable data was not available, EPA then considered analogous exposure monitoring data, which is monitoring data for the same chemical but for a different (but similar) OES.

In some cases, monitoring sample durations were shorter or longer than eight hours. Eight-hour TWAs were estimated by normalizing the measured inhalation concentration to an eight-hour period based on the actual sample duration. EPA estimated occupational exposures representative of the central tendency and high-end exposure conditions. Central tendency exposures are assumed to represent occupational exposures in the center of the distribution for a given COU. The high-end exposure is assumed to be

representative of occupational exposures that occur at probabilities greater than or equal to the 90th percentile, but below the exposure of the individual with the highest exposure (U.S. EPA, 1992b). Exposures are calculated from the monitoring datasets provided in the sources depending on the size of the dataset. For datasets with six or more data points, central tendency and high-end exposures were estimated using the 50th and 95th percentiles. For datasets with three data points, central tendency exposure was calculated using the median and the maximum was presented as the high-end exposure estimate. For datasets with two data points, the midpoint was presented as a midpoint value and the higher of the two values was presented as a higher value. Finally, datasets with only one data point presented the single exposure value.

For datasets including exposure data that were reported as below the limit of detection (LOD), EPA estimated the exposure concentrations for these data, following EPA's *Guidelines for Statistical Analysis of Occupational Exposure Data* (U.S. EPA, 1994), which recommends using the $\frac{LOD}{\sqrt{2}}$ if the geometric standard deviation of the data is less than 3.0 and $\frac{LOD}{2}$ if the geometric standard deviation is 3.0 or greater.

10.1.3 Estimating Inhalation Exposure - Modeling

Use of Surrogate Monitoring Data

As specified in the data hierarchy (Table 10-1), in some cases where inhalation exposures were expected for an OES but monitoring data specific to 1,1,2-trichloroethane was not available, monitoring data of the same OES but from a different chemical were utilized in the inhalation exposure assessment. In these cases, EPA compared the physical properties of possible surrogate chemicals to find the most appropriate surrogate and correction factors were applied to adjust for differences in chemical properties such as vapor pressure. For the assessment of 1,1,2-trichloroethane, EPA utilized surrogate monitoring data for other chlorinated solvents from previous published risk evaluations.

When using this approach, EPA corrected for differences in physical chemical properties between 1,1,2-trichloroethane and the surrogate chemical. EPA utilized Equation 10-1 to correct vapor monitoring data from a surrogate chemical to the chemical of interest:

Equation 10-2.

$$C_{v2} = C_{v1} \times \frac{VP_2 \times X_2}{VP_1 \times X_1}$$

Where:

C_{v2}	=	Estimated volumetric concentration of the chemical of interest (ppm)
C_{v1}	=	Measured volumetric concentration of surrogate chemical in air (ppm)
VP_1	=	Vapor pressure of surrogate chemical (torr)
X_1	=	Mole fraction of surrogate chemical in mixture (unitless)
VP_2	=	Vapor pressure of chemical of interest (torr)
X_2	=	Mole fraction of chemical of interest in mixture (unitless)

Fundamental Exposure Modeling Approaches

When surrogate monitoring data were unavailable or did not sufficiently capture the OES, EPA utilized exposure modeling to estimate inhalation exposures. These models apply deterministic calculations, stochastic calculations, or a combination of both deterministic and stochastic calculations to estimate inhalation exposures. EPA modeled inhalation exposures for 1,1,2-trichloroethane for the OES of import/repackaging.

EPA utilized generic scenarios (GSs) and emission scenario documents (ESDs) to provide detailed process descriptions that identify sources of exposure during the process. These sources also provide estimation methods and values for key parameters to estimate the amount of exposure during a particular worker activity. If a worker performs multiple activities during a workday, the exposures for each activity are combined in estimating the worker's 8-hour TWA inhalation exposure.

The inhalation exposure modeling proceeds in two parts:

1. Estimation of air emission rate for the worker activity. This step is done in modeling for air releases described in Section 4.
2. With the air emission rate as an input, EPA estimates the inhalation exposure concentration using the *EPA/OPPT Mass Balance Model*.

The EPA/OPPT Mass Balance Model estimates a worker inhalation exposure to an estimated concentration of chemical vapors within the worker's breathing zone. Additional information on this model is described in Appendix A.1).

EPA used the following approach to obtain high-end and central tendency occupational exposure estimates:

1. Identify worker activities and potential sources of exposures from each process.
2. Identify or develop model equations for estimating exposures from each source.
3. Identify model input parameter values from relevant literature sources, including activity durations associated with sources of exposures.
4. If a range of input values is available for an input parameter, determine the associated distribution of input values.
5. Calculate exposure concentrations associated with each activity.
6. Calculate full shift TWAs based on the exposure concentration and activity duration associated with each exposure source.
7. Calculate exposure metrics (*e.g.*, acute exposure concentration, intermediate average daily concentration, ADC) from full shift TWAs.

For the OES in which EPA modeled inhalation exposure, EPA performed a Monte Carlo simulation to capture variability in the model input parameters. The simulation used the Latin hypercube sampling method in @Risk Industrial Edition, Version 7.0.0, which generates a sample of possible values. The Agency performed the model at 100,000 iterations to capture a broad range of possible input values. The model generates statistics, and any desired percentile may be selected. EPA selected the 50th percentile and 95th percentile to estimate releases.

Additional details on the inhalation modeling approaches utilized in this assessment are provided in Appendix B.1 and B.3. Additionally, the *Draft 1,1,2-Trichloroethane Repackaging Occupational Exposure Model* ([U.S. EPA, 2026q](#)) includes parameters, calculations, and model release results for the Repackaging OES.

10.1.4 Estimating Dermal Exposure— Modeling

EPA did not identify any dermal exposure monitoring data for any OES through systematic review or through other reasonably available sources (*e.g.*, public comments). Therefore, to assess dermal exposure, the Agency used the EPA Dermal Exposure to Volatile Liquids Model (DEVL) to calculate the acute absorbed dose rate (AADR) for each OES.

In risk evaluations, EPA has used both flux-based and fraction absorbed-based approaches to estimate dermal exposure. The distinction between the flux-based and fraction absorbed-based dermal approaches is based on whether the applied dose of the chemical on the skin is expected to deplete during the exposure period. If it does deplete, then the fraction absorbed approach is used. For volatile chemicals in occupational settings, EPA utilizes a fraction absorbed approach. This approach assumes that the chemical is both absorbed into the skin and lost to evaporation, and the dose is likely to deplete before the end of the work day ([Frasch et al., 2014](#)). This differs from non-volatile chemicals where the depletion of the applied dose is entirely dependent on the rate of absorption into the skin.

The exposure concentration is determined based on EPA's review of currently available products and formulations containing 1,1,2-trichloroethane. The dose estimates assume one dermal exposure event (applied dose) per work day and approximately 0.47 to 0.96% of the applied dose is absorbed through the skin, based on fractional absorption data that was developed from a TSCA section 4 test order ([Labcorp Early Development, 2023](#)). The value for fraction absorbed can vary by weight fraction. EPA required testing of fraction absorption for neat 1,1,2-trichloroethane and also at several dilute concentrations (50%, 10%, and 1%). Dilute Concentration testing was performed in two carriers: isopropyl myristate (IPM) and 1,2-dichloroethane. Additional information on the testing performed is summarized in Section 2.2.1 of the *Draft Human Health and Environmental Hazard Assessment for 1,1,2-Trichloroethane Technical Support Document* ([U.S. EPA, 2026l](#)).

The dermal absorption study reported some lost mass and high variability in the measured fraction absorbed among the test replicates as well across test concentrations. In addition, the % fraction absorbed also varied with the percent of test substance. EPA therefore adjusted the test order provided fraction absorbed mean values for loss of mass and variability. The adjustment calculations are described in the *Draft Human Health and Environmental Hazard Assessment for 1,1,2-Trichloroethane Technical Support Document* ([U.S. EPA, 2026l](#)). OES-specific 1,1,2-trichloroethane concentrations are mapped to the most appropriate test concentration of 1,1,2-trichloroethane, informing the fractional absorption percent to be used in the OES-specific dermal modeling (Table 10-2).

Table 10-2. Summary of Fraction Absorbed Parameter Values

Table 16-2 Summary of Fractional Absorption Parameter Values

Test Concentration of 1,1,2-Trichloroethane	Fractional Absorption Used (FABS) ^a	Reference
Neat ^b	0.96%	(Labcorp Early Development, 2023)
50% 1,1,2-trichloroethane in 1,2-dichloroethane sample	0.84%	
10% 1,1,2-trichloroethane in 1,2-dichloroethane sample	0.47%	
1% 1,1,2-trichloroethane in 1,2-dichloroethane sample	0.63%	

^a Represents a mass balance corrected mean fractional absorption value. Mass balance corrections were performed to account for mass balance less than 95%, absorption less than 5%, and the coefficient of variation (e.g., high % coefficient of variation >25%), in accordance with 2022 OECD GD156 and 2017 EFSA dermal guidance (OECD, 2022). These calculations and adjustments are further described in Section 2.2.1 and Table 2-1 of the Draft Human Health and Environmental Hazard Assessment for 1,1,2-Trichloroethane Technical Support Document (U.S. EPA, 2026l).

^b As described in the Draft Human Health and Environmental Hazard Assessment for 1,1,2-Trichloroethane Technical Support Document (U.S. EPA, 2026l), the neat 1,1,2-trichloroethane OECD 428 dermal absorption testing had six testing replicates. The replicate with 9.72% absorption could be excluded from the final mean and SD calculations since that skin sample failed the skin QC step (trans epidermal water loss or TEWL). However,

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Test Concentration of 1,1,2-Trichloroethane	Fractional Absorption Used (FABS) ^a	Reference
the dermal absorption replicate with 1.02% absorption was included in the analysis for a total of five replicates.		

EPA utilized fractional absorption values for 1,1,2-trichloroethane in 1,2-dichloroethane to estimate dermal exposure for dilute concentration scenarios. While dermal absorption testing was also performed in IPM, dilute concentrations in the 1,2-dichloroethane carrier were utilized due to their relevance and representativeness of the exposure scenarios being assessed in the risk evaluation (e.g., manufacturing of 1,1,2-trichloroethane as a byproduct during the intentional manufacturing of 1,2-dichloroethane). More information on the fractional absorption parameters utilized to evaluate each OES is described in Sections 10.2.1 through 10.2.10, as well as in Appendix A.8.

In the dermal exposure modeling equation, the frequency of events (FT) is shown as a linear relationship with the acute absorbed dose; however, this fails to account for time between contact events. Since the chemical simultaneously evaporates from and absorbs into the skin, dermal exposure is a function of both the number of contact events per day and the time between contact events. EPA did not identify information on how many contact events may occur and the time between contact events. Therefore, EPA assumed a single contact event per day for estimating dermal exposures.

The values of the dermal load (Q_u) were based on experimental studies of non-aqueous liquids to measure the quantity remaining on the skin after contact. The liquids utilized in the studies included mineral oil, cooking oil, and bath oil. The oils were selected for their suitability for human use (non-toxic) and their varying viscosities (160.2 cst, 59.2 cst, and 33.3 cst respectively). In the study, an initial wipe test was performed that consisted of the subjects wiping their hands with a cloth saturated with the test substance. The amount of liquid retained on the hands was measured immediately after the application. The values from the study ranged from 0.7 to 2.1 mg/cm² with a midpoint of 1.4 mg/cm² (U.S. EPA, 1992c). The study utilized oils as these had better retention and ease of measuring the amount of chemical retained on skin. Given 1,1,2-trichloroethane is a less viscous and more volatile liquid than the oils used in the study, these dermal loadings values may be an overestimate. The fraction absorbed as provided by the test order multiplied by the loading is the portion that is actually absorbed with the majority of the amount on the skin volatilized. In summary, for volatile liquids, EPA does not estimate a dermal dose without accounting for fraction absorbed vs. the fraction volatilized.

EPA used a Monte Carlo simulation with 100,000 iterations and the Latin Hypercube sampling method using the DEVL Model. Recommendations from the SACC on the dermal analysis included in the *Risk Evaluation for 1,1-Dichloroethane* (U.S. EPA, 2025, 2024b) included one to correct for losses of volatile chemicals from similar test order data and to utilize probabilistic modeling to refine the dermal absorption. These recommendations were incorporated into the 1,1,2-trichloroethane dermal assessment.

In summary, the DEVL Model estimates the absorbed dose, which is the dose of volatile chemical absorbed through the stratum corneum of the skin based on the empirical fractional absorption data that was statistically adjusted due to test data variability. EPA uses these values in the risk assessment acknowledging that this represents a conservative estimate of the dose that is systemically absorbed into the body. The loading values used are from the wipe study and do not reflect absorption and volatilization. The fraction absorbed values from the test order then reflect absorption and volatilization to estimate the amount absorbed into the skin which EPA designates as the absorbed dose.

Specific details of the dermal exposure assessment for each OES can be found in Section 10.2 and

equations for estimating dermal exposures can be found in Appendix A.8.

EPA did not assess dermal exposures to ONUs because ONUs are not expected to directly handle 1,1, 2-trichloroethane as part of their duties. Therefore, ONUs are not expected to have dermal exposures in the workplace during the course of their work.

10.1.5 Estimating Acute, Intermediate, and Chronic (Non-Cancer and Cancer) Inhalation and Dermal Exposures

The estimated full-shift TWA inhalation exposures were used to calculate acute exposure concentrations (AC), intermediate average daily concentrations ($ADC_{\text{intermediate}}$), average daily concentrations (ADC) for chronic, non-cancer risks, lifetime average daily concentrations (LADC) for chronic, cancer risks. This report also assesses 1,1,2-trichloroethane dermal exposures to workers in occupational settings, presented as a dermal acute absorbed dose rate (AADR), as described in Section 10.2 and in Appendix A.8. For each COU, the estimated exposures (AADR) were used to calculate acute, intermediate, and chronic (non-cancer and cancer) dermal doses.

These calculations require additional parameter inputs, such as years of exposure, exposure duration and frequency, and lifetime years. Equations, parameter inputs, and sample calculations for these exposures can be found in Appendix B.2.

For the final exposure result metrics, each of the input parameters (*e.g.*, air concentrations or dermal doses, working years, exposure frequency, lifetime years) may be a point estimate (*i.e.*, a single descriptor or statistic such as central tendency or high-end) or a full distribution. EPA considered three general approaches for estimating the final exposure result metrics:

- Deterministic calculations: EPA used combinations of point estimates of each parameter to estimate a central tendency and high-end for each final exposure metric result. The Agency documented the method and rationale for selecting parametric combinations to be representative of central tendency and high-end.
- Probabilistic (stochastic) calculations: EPA used Monte Carlo simulations using the full distribution of each parameter to calculate a full distribution of the final exposure metric results and selecting the 50th and 95th percentiles of this resulting distribution as the central tendency and high-end, respectively.
- Combination of deterministic and probabilistic calculations: EPA had full distributions for some parameters but point estimates of the remaining parameters. For example, the Agency used Monte Carlo modeling to estimate exposure concentrations but only had point estimates of exposure duration and frequency as well as lifetime years. In such cases, EPA documented the approach and rationale for combining point estimates with distribution results for estimating central tendency and high-end results.

10.1.6 Consideration of Exposure Controls and Personal Protective Equipment (PPE)

This section contains general information on engineering controls and personal protective equipment. The Agency's estimates of occupational exposure presented in this document do not assume the use of personal protective equipment (PPE); however, the effect of PPE on EPA's occupational exposure estimates is presented in the "Risk Reduction" tab in the *Draft Risk Calculator for 1,1,2-Trichloroethane* ([U.S. EPA, 2026q](#)), and is discussed in the *Draft Risk Evaluation for 1,1,2-Trichloroethane* ([U.S. EPA, 2026r](#)).

Occupational Safety and Health Administration (OSHA) and National Institute for Occupational Safety

and Health (NIOSH) recommend employers utilize the hierarchy of controls¹³ to address hazardous exposures in the workplace. The hierarchy of controls strategy outlines, in descending order of priority, elimination, substitution, engineering controls, administrative controls, and personal protective equipment (PPE). The hierarchy of controls prioritizes the most effective measures, which eliminate or substitute the harmful chemical (*e.g.*, use a different process, substitute with a less hazardous material), thereby preventing or reducing exposure potential. Following elimination and substitution, the hierarchy recommends engineering controls to isolate employees from the hazard, followed by administrative controls or changes in work practices to reduce exposure potential (*e.g.*, source enclosure, local exhaust ventilation systems). Administrative controls are policies and procedures instituted and overseen by the employer to protect worker exposures. OSHA and NIOSH recommend the use of PPE (*e.g.*, respirators, gloves) as the last means of control, when the other control measures cannot reduce workplace exposure to an acceptable level.

The remainder of this section discusses respiratory protection and glove protection, including protection factors for various respirators and dermal protection strategies:

10.1.6.1 Respiratory Protection

OSHA's Respiratory Protection Standard (29 CFR 1910.134) requires employers in certain industries to address workplace hazards by implementing engineering control measures and, if these are not feasible, providing respirators that are applicable and suitable for the purpose intended. Respirator selection provisions are provided in CFR 1910.134(d) and require that appropriate respirators be selected based on the respiratory hazard(s) to which the worker will be exposed, in addition to workplace and user factors that affect respirator performance and reliability. Assigned protection factors (APFs) are provided in Table 1 under CFR 1910.134(d)(3)(i)(A) (see below in Table 10-3) and refer to the level of respiratory protection that a respirator or class of respirators is expected to provide to employees when the employer implements a respiratory protection program according to the requirements of OSHA's Respiratory Protection Standard. Workers are required to use respirators that meet or exceed the required level of protection listed in Table 10-3. Implementation of a full respiratory protection program requires employers to provide training, appropriate selection, fit testing, cleaning, and change-out schedules in order to have confidence in the efficacy of the respiratory protection.

If respirators are necessary in atmospheres that are not immediately dangerous to life or health, workers must use NIOSH-certified air-purifying respirators or NIOSH-approved supplied-air respirators with the appropriate APF. Respirators must meet or exceed the required level of protection listed in Table 10-3. Based on the APF, inhalation exposures may be reduced by a factor of 5 to 10,000 if respirators are properly fitted and worn.

EPA does not quantitatively apply respirator protection factors to inhalation exposure estimates, but does include information, such as from Test Order submissions, on respirators used at the facilities monitored and from industries within an OES. In the risk evaluation (not part of this TSD), if there are estimated unreasonable risks in comparison to benchmark values, EPA estimates the protection factor needed for an acceptable risk and performs a qualitative review to whether the information on respirator use described can provide the protection level needed.

¹³ https://www.osha.gov/sites/default/files/Hierarchy_of_Controls_02.01.23_form_508_2.pdf (accessed December 16, 2025)

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Table 10-3. Assigned Protection Factors for Respirators in OSHA Standard 29 CFR 1910.134

Type of Respirator	Quarter Mask	Half Mask	Full Facepiece	Helmet/Hood	Loose-Fitting Facepiece
1. Air-Purifying Respirator	5	10	50	-	-
2. Power Air-Purifying Respirator (PAPR)	-	50	1,000	25/1,000	25
3. Supplied-Air Respirator (SAR) or Airline Respirator					
• Demand mode	-	10	50	-	-
• Continuous flow mode	-	50	1,000	25/1,000	25
• Pressure-demand or other positive-pressure mode	-	50	1,000	-	-
4. Self-Contained Breathing Apparatus (SCBA)					
• Demand mode	-	10	50	50	-
• Pressure-demand or other positive-pressure mode (e.g., open/closed circuit)	-	-	10,000	10,000	-
Source: 29 CFR 1910.134(d)(3)(i)(A)					

Dermal Protection

OSHA's hand protection standard (29 CFR 1910.138) requires employers select and require employees to use appropriate hand protection when expected to be exposed to hazards such as those from skin absorption of harmful substances; severe cuts or lacerations; severe abrasions; punctures; chemical burns; thermal burns; and harmful temperature extremes. Dermal protection selection provisions are provided in CFR 1910.138(b) and require that appropriate hand protection is selected based on the performance characteristics of the hand protection relative to the task(s) to be performed, conditions present, duration of use, and the hazards to which employees will be exposed.

Unlike respiratory protection, OSHA standards do not provide quantitative protection factors associated with various hand protection PPE, such as gloves, and data about the frequency of effective glove use—that is, the proper use of effective gloves—is very limited in industrial settings. Initial literature review suggests that there is unlikely to be sufficient data to justify a specific probability distribution for effective glove use for a chemical or industry. Instead, the impact of effective glove use is explored by considering different percentages of effectiveness.

Where available, EPA includes information, such as from test order submissions, on gloves worn at the facilities monitored, or for facilities within an OES. EPA does not quantitatively apply dermal protection factors to dermal exposure estimates from the modeling approaches. Where dermal risks are identified EPA performs a qualitative review comparing the level of dermal risk exceedance with the information on dermal protection that is available.

10.1.7 Evidence Integration and Assignment of Confidence Ratings

Evidence integration for the occupational exposure assessment includes analysis, synthesis, and integration of information and data to produce estimates of occupational exposures. During evidence integration, EPA considered the likely location, duration, intensity, frequency, and quantity of exposures while also considering factors that increase or decrease the strength of evidence when analyzing and integrating the data. Data sources are rated with one of four possibilities: *high*, *medium*, *low*, and

unacceptable. Key factors EPA considered when integrating evidence includes the following:

1. **Data Quality:** EPA only integrated data or information rated as high, medium, or low obtained during the data evaluation phase. Data and information rated as uninformative are not used for quantitative exposure estimates. In general, higher rankings are given preference over lower ratings; however, lower ranked data may be used over higher ranked data when specific aspects of the data are carefully examined and compared. For example, a lower ranked dataset that precisely matches the OES of interest may be used over a higher ranked study that does not as closely match the OES of interest.
2. **Data Hierarchy:** EPA used both measured and modeled data to obtain accurate and representative estimates (e.g., central tendency, high-end) of the occupational exposures resulting directly from a specific source, medium, or product. If available, measured exposure data are given preference over modeled data, with the highest preference given to data that are both chemical-specific and directly representative of the OES/exposure source.

EPA considered both data quality and data hierarchy when determining evidence integration strategies. The final integration of the occupational exposure evidence combined decisions regarding the strength of the available information, including information on plausibility and coherence across each evidence stream.

After the occupational exposure assessment for an OES is completed, EPA assesses the weight of scientific evidence for the OES and assigns a confidence rating. EPA evaluated the weight of scientific evidence supporting the occupational exposure assessment based on the strengths, limitations, and uncertainties associated with the occupational exposure estimates. The conclusion is summarized using confidence descriptors: Robust, Moderate, Slight, or Indeterminate. EPA considers factors including the quantity and quality of the data/information, applicability of the exposure data to the OES (including considerations of temporal relevance, locational relevance) and the representativeness of the estimate for the whole industry. The weight of scientific evidence conclusions and overall confidence for each OES are described in Section 10.3.

10.1.8 Estimating the Number of Workers and Occupational Non-Users Potentially Exposed

When available, EPA first utilized CDR data to estimate the number of workers potentially exposed to 1,1,2-trichloroethane.

EPA supplemented available CDR data with a method that involves estimating the number of sites for 1,1,2-trichloroethane for an OES with an estimate of the average number of workers for sites with an OES. The remainder of this section describes the specific steps that were done in this assessment for estimating the number of workers for 1,1,2-trichloroethane. Additionally, the *Draft Estimates of Number of Workers and ONUs for 1,1,2-Trichloroethane* ([U.S. EPA, 2026i](#)) provides the data and methods used to estimate the number of workers and ONUs per OES for 1,1,2-trichloroethane.

Estimating Number of Sites for 1,1,2-Trichloroethane for an OES

This is the result of mapping of sites from data for 1,1,2-trichloroethane collected from data sources including TRI, DMR, NEI and CDR. For several OES, the number of sites was estimated from environmental release modeling.

Estimating the Average Number of Workers per Site for the OES

EPA estimated the average number of workers per site following the steps described below:

1. Identified the North American Industry Classification System (NAICS) codes for the industry sectors associated with the OES.
2. Estimated total employment by industry/occupation combination using the Bureau of Labor Statistics' Occupational Employment Statistics data (BLS Data).
3. Refined the Occupational Employment Statistics estimates where they are not sufficiently granular by using the U.S. Census' Statistics of U.S. Businesses (SUSB) (SUSB Data) data on total employment by 6-digit NAICS.
4. Used the estimated workers/ONUs per site in the 6-digit NAICS code and multiply by the number of sites estimated from CDR, TRI, Discharge Monitoring Report (DMR) and/or National Emissions Inventory (NEI). In DMR data, sites report Standard Industrial Classification (SIC) codes rather than NAICS codes; therefore, EPA mapped each reported SIC code to a NAICS code for use in this analysis.
5. Combined the data generated in Steps 1 through 4 to produce an estimate of the number of employees using 1,1,2-trichloroethane in each industry/occupation combination and sum these to arrive at a total estimate of the number of employees with exposure within the OES.

There are uncertainties surrounding the estimated number of workers potentially exposed to 1,1,2-trichloroethane. First, BLS employment data for each industry/occupation combination are only available at the 3-, 4-, or 5-digit NAICS level—rather than at the full 6-digit NAICS level. This lack of specificity could result in an overestimate of the number of exposed workers if some 6-digit NAICS are included in the less granular BLS estimates but are not likely to use 1,1,2-trichloroethane for the assessed applications. EPA addressed this issue by refining the Occupational Employment Statistics data using total employment data from the U.S. Census' SUSB. The effects of this uncertainty on the number of worker estimates are unknown, as the uncertainties may result in either over or underestimation of the estimates depending on the actual distribution.

Second, EPA's determinations of industries (represented by NAICS codes) and occupations (represented by SOC codes) that are associated with the OESs assessed in this report are based on EPA's understanding of how 1,1,2-trichloroethane is used in each industry. The designations of which industries and occupations have potential exposures is a matter of professional judgment; therefore, the possibility exists for the erroneous inclusion or exclusion of some industries or occupations. This may result in inaccuracy but would be unlikely to systematically either overestimate or underestimate the count of exposed workers.

For additional details on how the number of workers and ONUs were determined for 1,1,2-trichloroethane, including how worker and ONU designations were made, refer to Appendix D.

10.2 Occupational Exposure Assessment by OES

The following sections provides details on the occupational exposure assessment that was done for each OES that was assessed for 1,1,2-trichloroethane. Process descriptions for each OES are provided in Section 4.2. EPA assessed occupational exposure for each of the COUs identified for 1,1,2-trichloroethane. For certain COUs with multiple OES, EPA assessed OES based on data availability.

10.2.1 Manufacturing as a Byproduct in Chemical Manufacturing – OES #1

10.2.1.1 Exposure Groups and Worker Activities

As described in Section 4.2.1, EPA received information on the production of 1,1,2-trichloroethane as a non-isolated byproduct from the Vinyl Institute in response to a test order issued under section 4(a) of TSCA.

The Final Study Report submitted to EPA by the Vinyl Institute ([Stantec ChemRisk, 2024a](#)) detailed worker activities per similar exposure group (SEG) that occurred during inhalation monitoring at sites where 1,1,2-trichloroethane was manufactured as a byproduct during the manufacture of 1,2-dichloroethane. The Study Report also identified task-level SEGs to represent tasks that regularly occurred during full-shift SEG sampling. EPA had sufficient information to assess the following exposure groups: operator/ process technicians (also referred to as ‘operator’), maintenance technicians, logistics/ distribution technicians (also referred to as logistics technician), laboratory technicians, and ONUs.

EPA assumes that the activities detailed by test order summary report are applicable to manufacturing of 1,1,2-trichloroethane as a byproduct at facilities throughout the country, and that workers may experience inhalation and dermal exposure to 1,1,2-trichloroethane during these tasks.

- Operator /Process Technician

The Final Study Report ([Stantec ChemRisk, 2024a](#)) operators at facilities that manufactured 1,1,2-trichloroethane as a byproduct perform a wide variety of routine tasks and also perform tasks with variable nature of exposure (such as process area walk-throughs and monitoring equipment for leaks). The Final Study Report detailed five task-level SEGs for the operator/process technician: open loop sample collection, unspecified concentration; closed loop sample collection, unspecified concentration; closed loop sample collection, high concentration; maintenance preparation; and other tasks with exposure potential (See Table 3 of the Final Study Report).

Routine daily tasks performed by the operators during the inhalation monitoring study included: operating production control panels, recording process parameters into a database (*e.g.*, ingredients, weights, temperatures, pressures, etc.), conducting walk-throughs of the production areas; approving, monitoring, and closing work permits; overseeing line breaks and process openings for maintenance; unlocking and locking equipment; training other workers; and conducting safety reviews. The study authors described nine other additional tasks conducted by operators and process technicians during the full shift sampling, which included sample collection, sample preparation, equipment troubleshooting, clearing process waste containers, preparing process lines, performing minor process adjustments and maintenance, performing air monitoring, monitoring controls, and decommissioning equipment.

Additionally, the Stantec ChemRisk Final Study Report described non-daily, regular tasks that occurred during sampling, including preparing equipment for major maintenance activities and line-up changes to send product in process lines to storage tank ([Stantec ChemRisk, 2024a](#)). These tasks occurred on a weekly, biweekly, monthly, or as needed basis. Non-routine tasks were noted as being infrequent and included responding to process equipment leaks.

Additionally, it was noted that operators may enter confined spaces at some facilities as part of occasional equipment maintenance activities, with proper PPE and safety permits. This task was not captured in the inhalation monitoring study.

- Maintenance Technician

As described in the Stantec ChemRisk Final Study Report, maintenance technicians “primarily” maintain, remove, install, repair, and troubleshoot equipment and machinery in process areas or maintenance shops (p. 8). Maintenance technicians were reported to perform a variety of routine tasks, including tasks in maintenance shops as well as major maintenance of open process lines and equipment.

Two task-level SEGs for the maintenance technician were identified in the Final Study Report: 1) line breaks and equipment opening, and 2) other tasks with exposure potential.

Additional tasks performed during full shift monitoring included identifying addressing leaks; cleaning and calibrating equipment; oiling equipment; and conducting permitting and safety checks, process rounds, preventative maintenance, equipment and line flushes, and equipment repairs and replacements. Weekly, monthly, and yearly maintenance tasks were also described in the Stantec Final Study Report.

- Logistics/Distribution Technician

Logistics/distribution technicians were reported to “primarily” perform tasks related to receiving and/or shipping chemicals used in the production process ([Stantec ChemRisk, 2024a](#)) . Routine daily tasks were reported to included inspections, permitting, spotting for drivers, connecting/disconnecting hoses during chemical transfers, purging hoses, filling storage tanks, and loading and offloading bulk chemicals. Task-level SEGs were railcar loading/offloading, truck loading/offloading, barge loading/offloading, and other tasks with exposure potential.

Sample collection for quality assurance/quality control reportedly occurred on a weekly or monthly basis. The frequency of loading and offloading activities varied by demand. Line breaking and equipment opening tasks reportedly occurred on an “infrequent basis.”

- Laboratory Technician

As described in the Final Study Report, routine tasks performed by the laboratory technicians during the study report included preparing samples for analysis, preparing chemical solutions or standards, and performing data input, interpretation, and analysis. Task level SEGs were: (1) sample processing, and (2) other tasks with exposure potential. Laboratory standard preparations reportedly occurred on a weekly basis, and sample analyses performed varied in frequency (daily, twice weekly, twice monthly, or as needed). Additionally, at one site, laboratory technicians reportedly performed sample collection from production areas on a weekly basis.

- Occupational Non-User

ONUs in the inhalation sampling study included process and project engineers, maintenance and process supervisors, control room operators, environmental health and safety technicians, senior process advisors, and administrators. According to the Final Study Report, routine daily tasks performed by ONUS included office work, control board operations, warehouse work, environmental inspections, and other indoor tasks. ONUs were described as entering various process areas to conduct area walk-throughs, observe maintenance work and loading/unloading tasks, and conduct inspections on a non-routine basis. No task-level SEGs were identified.

Worker Demographic Data

EPA had industry specific data on length of service (years) for workers at the facilities where the inhalation monitoring was performed ([EPA-HQ-OPPT-2018-0427-0181](#)). These facilities manufacture 1,2-dichloroethane and also generate 1,1,2-trichloroethane as a byproduct. Demographic information for the overall workforce and by SEG was reported, including the mean and range of length of service in years. This information was collected from the same facilities that were included in the inhalation monitoring study, and the length of service was aggregated across all sites that reported inhalation monitoring data. The overall mean length of service was reported as being calculated as a weighted average based on the number of workers per SEG reported by each site. For manufacturing, the overall mean length of service across five facilities (n = 494 workers) was reported as 8.9 years. Mean length of service varied by SEG; the mean length of service by SEG ranged from 4.6 years (logistics technicians)

to 15.6 years (laboratory technicians). Only one site reported a range for length of service with an overall range of 0 to 33 years.

10.2.1.2 Occupational Inhalation Exposure Results

For this scenario, the highest method from the exposure assessment hierarchy that was available was chemical specific, personal breathing zone data from a test order submission. Specifically, occupational inhalation data for 1,1,2-trichloroethane during manufacturing as a non-isolated byproduct were provided via a test order submission from the Vinyl Institute ([Stantec ChemRisk, 2024a](#)). EPA identified 116 worker and 29 ONU full-shift PBZ samples across four representative facilities from the test order data to estimate inhalation exposures. The total number of non-detects was 32, and the limit of detection ranged from <0.06 to <0.07 ppb. For all datasets, the geometric standard deviation was greater than three; therefore, EPA assessed non-detects at the limit of detection divided by two.

The worker samples collected were from operators/process technicians, logistics/distribution technicians, maintenance technicians, and laboratory technicians at the site. From this monitoring data, EPA calculated the 50th and 95th percentile 8-hr TWA concentrations to represent a central tendency and high-end estimate of potential occupational inhalation exposures, respectively, for this scenario. The results of these calculations are presented in Table 10-4.

Table 10-4. Inhalation Exposures to 1,1,2-Trichloroethane During Manufacturing as a Byproduct in Chemical Manufacturing

Exposure Group	Number of Samples	Number of Detected Samples ^a	8-Hour TWA (ppm)	
			Central Tendency	High-End
Operator/Process Technician	49	49	4.6E-03	9.1E-02
Logistics/Distribution Technicians	15	11	5.1E-04	3.8E-02
Maintenance Technicians	23	16	1.5E-04	0.27
Laboratory Technicians	29	19	1.7E-04	3.2E-02
ONUs	29	18	1.2E-04	3.8E-03
ONU = occupational non-user; TWA = time-weighted average ^a Limit of detection ranged from 6.0E-05 to 7.0E-05 ppm, depending on SEG. For all datasets, the geometric standard deviation was greater than three; therefore, EPA assessed non-detects at the limit of detection divided by 2. The Vinyl Institute Final Study Report compared four methods for handling data below the LOD (including use of LOD/2) and noted that there were “[n]o substantial differences” in estimated statistics computed by the four different methods (Stantec ChemRisk, 2024a).				

10.2.1.3 Occupational Dermal Exposure Results

EPA estimated dermal exposures for this OES using the dermal modeling approach outlined in Section 10.1.4 above and Appendix A.8. The concentration evaluated for this dermal exposure ranges from 0.045 to 45 % based on information on the byproduct concentration streams provided in the Vinyl Institute Final Study Report ([Stantec ChemRisk, 2024a](#)).

Table 10-5 summarizes the acute absorbed dose rate for 1,1,2-trichloroethane during manufacturing as a byproduct. The high-end exposure doses are the 95th percentiles of the respective simulation output and

the central tendency exposures are the 50th percentiles. OES-specific parameters for dermal exposures are described in Appendix A.8.

Table 10-5. Summary of Dermal Exposure Doses to 1,1,2-Trichloroethane for Manufacturing as a Byproduct in Chemical Manufacturing

Modeled Scenario	Acute Absorbed Dose Rate (mg/day)	
	Central Tendency	High-End
Average Adult Worker ^a	0.74	4.2
^a Conditions where no gloves are used, or for any glove/gauntlet use without permeation data and without employee training.		

10.2.1.4 Exposure Values for Risk Estimates

Using the 8-hour TWA inhalation concentrations presented in Table 10-4, EPA calculated the acute exposure (AC), intermediate Average Daily Concentration (ADC_{intermediate}), average daily concentration (ADC), and lifetime average daily concentrations (LADC), as described in Section 10.1.5 (“Estimating Acute, Intermediate, and Chronic (Non-Cancer and Cancer) Inhalation and Dermal Exposures”). The results of these calculations are shown in Table 10-6. To calculate the LADC, EPA utilized the working years demographic data from the Vinyl Institute; EPA selected 8.9 years as the central tendency estimate and 33 years as the high-end estimate for working years.

8022 **Table 10-6. Inhalation Exposure Metrics for Manufacturing as a Byproduct in Chemical Manufacturing**

Exposure Group	Acute Exposure Concentrations (ppm)		Intermediate Average Daily Concentration (ppm)		Average Daily Concentration (ppm)		Lifetime Average Daily Concentration (ppm)	
	Central Tendency	High-End	Central Tendency	High-End	Central Tendency	High-End	Central Tendency	High-End
Operator/ Process Technician	3.1E-03	6.2E-02	2.3E-03	4.5E-02	2.1E-03	4.2E-02	8.5E-04	2.2E-02
Logistics Technicians	3.5E-04	2.6E-02	2.6E-04	1.9E-02	2.4E-04	1.8E-02	9.5E-05	9.0E-03
Maintenance Technicians	1.0E-04	0.18	7.4E-05	0.13	6.9E-05	0.12	2.8E-05	6.3E-02
Laboratory Technicians	1.1E-04	2.2E-02	8.3E-05	1.6E-02	7.7E-05	1.5E-02	3.1E-05	7.7E-03
Occupational Non-Users (ONUs)	8.1E-05	2.6E-03	5.9E-05	1.9E-03	5.5E-05	1.8E-03	2.2E-05	9.2E-04

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Table 10-7 summarizes the acute absorbed dose (AAD), intermediate absorbed dose (IAD), chronic absorbed dose, non-cancer (CAD), and lifetime chronic absorbed dose, cancer (LCAD) for 1,1,2-trichloroethane during manufacturing as a byproduct.

Table 10-7. Dermal Exposure Metrics for Manufacturing as a Byproduct in Chemical Manufacturing

Exposure Group	Acute Absorbed Dose (mg/kg-day)		Intermediate Absorbed Dose (mg/kg-day)		Chronic Absorbed Dose, Non-Cancer (mg/kg-day)		Lifetime Chronic Absorbed Dose, Cancer (mg/kg-day)	
	Central Tendency	High-End	Central Tendency	High-End	Central Tendency	High-End	Central Tendency	High-End
Average Adult Worker	9.3E-03	5.3E-02	6.8E-03	3.9E-02	6.4E-03	3.6E-02	2.7E-03	1.5E-02

10.2.1.5 Information on Exposure Controls and Personal Protective Equipment

The Final Study Report submitted by the Vinyl Institute as part of the test order submission provided information on engineering controls, administrative controls, and PPE use within the selected representative facilities ([Stantec ChemRisk, 2024a](#)). This information was collected as part of initial surveys of member companies and during the inhalation sampling.

Engineering Controls

According to the Final Study Report, engineering controls were present in all representative facilities and varied by process area and representative facility (p. 21). Activities in the production, logistics, and maintenance areas occurred “primarily” outside, in “open work areas with no airflow restrictions” (p. 21). Indoor work areas ranged in size and included the process labs and control rooms.

Within production areas, engineering controls were used “to reduce potential for worker exposures during work with and around equipment containing process chemicals”, and included use of closed loop sampling systems, outdoor alarms to monitor for leaks or emissions, nitrogen purges and sweeps to remove impurities prior to accessing opened process lines, valve blocking of product flow to isolated areas, and emptying of residual product from isolated area (p. 21). Engineering controls in the logistics area were used to limit exposure and to detect leaks during product and chemical loading and unloading activities, and included nitrogen purge practice, solution spray to monitor leaks, and physical blockades and barrier to loading and unloading areas. Within laboratories, which were all indoors, engineering controls included fume hoods, enclosed GC analyses, fans, and local exhaust ventilation.

The use of specific controls described above varied by representative facility. For example, the Final Study Report described that “most” outdoor process areas were equipped with alarms, but that only “some” facilities utilized the closed loop sampling systems (p. 21). Additionally, the Final Study report described that engineering controls across facilities “aligned with the generic SOP” (p. 21).

Administrative Controls

Information on administrative controls at the facilities where inhalation monitoring was performed was also provided in the test order report submitted by the Vinyl Institute. Specific administrative controls varied by facility. According to the test order submission, “all” facilities monitored utilized restricted

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entry procedures, and “most” facilities used written SOPs for all job tasks and required employee training on SOPs (p. 21). Other specific controls utilized included permits for all work conducted on site, rotating schedules, stop work authority, and PPE matrices and hazard assessments posted in control rooms.

Personal Protective Equipment

The Final Study Report published by the Vinyl Institute provided descriptions of the use of PPE in the identified facilities during standard, task-specific, and emergency operations ([Stantec ChemRisk, 2024a](#)). PPE worn by workers during the inhalation monitoring study was also provided. According to the Final Study Report ([Stantec ChemRisk, 2024a](#)), standard PPE was described as “PPE worn during normal operations on a full to near full-shift basis”; task-specific PPE was described as PPE “used during specific batch events, worn for the duration of the task or during specific steps in the task as specified in the company-specific SOP”; and emergency PPE was described as PPE “used only in the event of an upset condition (e.g., spill, leak, accidental release).” A summary of the use of PPE information is provided below.

According to the Final Study Report, each representative facility utilized similar standard PPE, task-specific PPE, and emergency-use PPE. The test order report noted that the PPE type used was dependent on the process area and task performed as well as specifications in company-specific SOPs (details of which were not provided). The Study reported that PPE use varied by process area and task performed, and individuals in each SEG required different types of PPE based on their process area, tasks performed, and company specific SOP. Tables 8 to 10 of the Final Study Report provided a summary of different types of PPE used in production process, logistics work, and laboratory work areas.

- **Respirator Use**

According to the final test order report, operators, maintenance, logistics, and laboratory personnel utilized different respiratory protection depending on the task performed and the type of chemical exposure associated with each task. Respiratory protection was not included as standard PPE in any work areas (production process, logistics, and laboratory) (see Table 9-10 of the test order report) ([Stantec ChemRisk, 2024a](#)). A summary of task-based PPE described in the inhalation monitoring results is provided below:

Operators were described as wearing half-face air-purifying respirators during open loop sample collection tasks, and full-face respirators of varying types during other tasks such as leak response activities. This corresponds to an assigned protection factor (APF) when the employer implements a continuing, effective respiratory protection program under the OSHA Respiratory Protection Standard. Based on the results of the study sampling, respiratory protection (documented by a yes/no response) was reported for 27% of the full-shift and 53% of task-based samples collected on operators.

Maintenance technicians were described as wearing full-face airline respirators (APF 1,000) during major maintenance tasks (e.g., line breaks and other equipment openings). Based on the test order sampling results, respiratory protection (documented by a yes/no response) was reported for 13% of the full-shift and 47% of task-based samples collected on maintenance technicians.

Logistics technicians were described as wearing half- or full-face respirators (APF 10 or 50) during loading or offloading tasks, which required connecting and disconnecting process lines to railcars, barges, and trucks. Based on the test order sampling results, respiratory protection (documented by a yes/no response) was reported for 60% of the full-shift and 41% of task-based samples collected on

logistics technicians.

Certain laboratory technicians were described as wearing full-face air purifying respirators during hazardous waste handling and disposal. Additionally, it was described that laboratory technicians wore half-face respirators (APF 10) during preparation of dry standards, but that such use was not observed during the inhalation sampling. Based on the test order sampling results, respiratory protection (documented by a yes/no response) was reported for 3% of the full-shift and 4% of task-based samples collected on laboratory technicians.

ONUS were described as not wearing respiratory protection during any routine tasks. Based on the test order sampling results, respiratory protection (documented by a yes/no response) was reported for 21% of the full-shift samples collected on ONU.

- Dermal PPE

The test order report provided information on dermal PPE, including gloves and other clothing items, used in various work areas. According to the test order report, within the production process areas standard dermal PPE worn included fire-resistant clothing, coveralls or nomex shirts, hard hats, leather gloves, safety glasses, and steel toed boots ([Stantec ChemRisk, 2024a](#)). Task-based PPE included chemical-resistant apron, chemical boots, face shield, nitrile gloves, and viton/butyl gloves. Similarly, in logistics work areas, standard dermal PPE included fire-resistant clothing, safety glasses, and steel toed boots, and task specific dermal PPE included chemical boots, chemical splash goggles, and heavy-duty nitrile gloves.

In the laboratory areas, standard PPE included fire resistant clothing, lab coat, safety glasses, chemical splash goggles, nitrile gloves, and closed-toe shoes/steel toed boots, while task-specific PPE included face shields and nitrile gloves.

Table 10-8 presents the reported glove usage (documented by a yes/no response) for each SEG monitored during the inhalation sampling study. Based on the test order sampling results, dermal protection (documented by a yes/no response of if gloves were worn) was reported for 3 to 100% of the full-shift and 65 to 100% of task-based samples, depending on SEG. Overall, glove use was documented for 53% of the full-shift and 78% of the task length samples. There was no documentation on glove types, glove changeout, glove efficacy, or duration with which gloves were worn, or what was worn relative to each specific task.

Table 10-8. Reported Glove Usage per Similar Exposure Group (SEG)

SEG	Full-Shift		Task Length	
	# of Samples with Reported Glove Use	% of Samples with Reported Glove Use	# of Samples with Reported Glove Use	% of Samples with Reported Glove Use
Operator (OP)	26	53%	29	76%
Lab Technician (LBT)	29	100%	23	100%
Logistics Technician (LGT)	9	60%	11	65%
Maintenance Technician (MT)	12	52%	11	65%

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SEG	Full-Shift		Task Length	
	# of Samples with Reported Glove Use	% of Samples with Reported Glove Use	# of Samples with Reported Glove Use	% of Samples with Reported Glove Use
Operational Non-User (ONU)	1	3%	N/A	N/A
Total	77	53%	74	78%

10.2.1.6 Estimates of Number of Workers and Occupational Non-Users

EPA used data from BLS and the SUSB specific to the OES to estimate the number of workers and ONUs per site potentially exposed to 1,1,2-trichloroethane during manufacturing as a byproduct ([U.S. BLS, 2023](#); [U.S. Census Bureau, 2017](#)). As further described in Section 10.1.8, this approach involved first identifying the relevant NAICS codes for the OES. The next step is the identification of relevant SOC codes within the BLS data for the identified NAICS codes, from which total number of workers can be determined. This number is divided by the number of sites identified to obtain the exposed workers per site. Appendix D includes further details regarding methodology for estimating the number of workers and ONUs per site. EPA assigned the following NAICS codes for this OES:

- 325199 – All Other Basic Organic Chemical Manufacturing;
- 3251100 – Petrochemical Manufacturing; and
- 325180 – Other Basic Inorganic Chemical Manufacturing.

Table 10-9 summarizes the per site estimates for this OES based on the methodology described.

Table 10-9. Estimated Average Number of Workers per Site Potentially Exposed to 1,1,2-Trichloroethane During Manufacturing as a Byproduct

NAICS Code	Potentially Exposed Workers per Site ^a	Potentially Exposed ONUs per Site
325199 – All Other Basic Organic Chemical Manufacturing	33	16
3251100 – Petrochemical Manufacturing		
325180 – Other Basic Inorganic Chemical Manufacturing		
NAICS = North American Industry Classification System; ONU = occupational non-user		
^a Number of workers and ONUs per site are calculated by dividing the exposed number of workers or ONUs by the number of establishments.		

10.2.2 Repackaging for Laboratory Chemical Use – OES #3

10.2.2.1 Exposure Groups and Worker Activities

During repackaging for laboratory chemical use, worker exposures via inhalation of 1,1,2-trichloroethane vapors may occur when transferring 1,1,2-trichloroethane from the import drums into smaller containers. Workers may also be exposed via inhalation of vapor or dermal contact with liquid 1,1,2-trichloroethane when cleaning import drums following emptying. Workers may also be exposed via inhalation of vapor or dermal contact with liquid 1,1,2-trichloroethane at repackaging sites during loading and offloading from ships, trucks, totes, barges, and railcars. In these cases, activities may

include connecting and disconnecting hoses during chemical transfers, purging hoses, filling storage tanks ([U.S. EPA, 2022c](#)). EPA did not have information on specific exposure groups, and assessed the general categories of workers and ONUs.

ONUs include supervisors, managers, and other employees who work at the import site, where repackaging occurs, but do not directly handle 1,1,2-trichloroethane. Therefore, EPA expects the ONUs to have lower inhalation exposures, lower vapor-through-skin uptake (vapor absorption through skin), and no dermal exposures compared to workers who handle the chemicals directly.

10.2.2.2 Occupational Inhalation Exposure Results

Inhalation monitoring data for repackaging of 1,1,2-trichloroethane was not available; therefore, EPA modeled occupational exposures for this scenario. Specifically, EPA conducted a systematic review and did not identify any sources containing monitoring data for 1,1,2-trichloroethane for this OES. Exposures for logistics technicians during manufacturing may potentially be used as analogous data; however, it is unclear whether the activities at the manufacturing sites would capture smaller scale operations that may not occur in fully closed systems or occur with direct pouring operations, or may not have the same level of engineering and administrative controls. EPA also did not identify suitable surrogate monitoring data for this scenario.

For this scenario, EPA applied the EPA Mass Balance Inhalation Model to exposure points described in the July 2022 Chemical Repackaging Generic Scenario ([U.S. EPA, 2022c](#)), particularly for the emptying of drums, filling of containers, and cleaning of drums process described in the process description. The EPA Mass Balance Inhalation Model estimates the concentration of the chemical in the breathing zone of the worker based on a vapor generation rate (G). An 8-hour TWA is then estimated and averaged over eight hours assuming no exposure occurs outside of those activities. Appendix A.3 also describes the model equations and other input parameters used in the Monte Carlo simulation for this OES. Worker exposures were modeled for this OES; EPA did not have the approaches to separately model ONU exposures. Therefore, EPA utilized the central tendency exposure estimates for workers to represent ONU exposures.

Table 10-10. Summary of Modeled Inhalation Exposures to 1,1,2-Trichloroethane for Repackaging for Laboratory Chemical Use – Daily Activities

Exposure Concentration Type	8-hour TWA (ppm)	
	Central Tendency	High-End
8-hour TWA exposure concentration	4.0E-02	0.25

10.2.2.3 Occupational Dermal Exposure Results

EPA estimated dermal exposures for this OES using the dermal modeling approach outlined in Section 10.1.4 above and Appendix 11.5.1A.8. The concentration evaluated for this dermal exposure ranges from 0.1 to 100 % based on product safety data sheets identified for laboratory chemicals containing 1,1,2-trichloroethane ([Sigma-Aldrich Inc, 2020](#); [Santa Cruz Biotechnology, 2019](#); [SPEX CertiPrep LLC, 2019](#); [Phenova, 2018](#); [ThermoFisher Scientific, 2018](#); [Matheson Tri-Gas, 2017](#)). Table 10-11 summarizes the acute absorbed dose rate for 1,1,2-trichloroethane during repackaging. The high-end exposure doses are the 95th percentiles of the respective simulation output and the central tendency exposures are the 50th percentiles. OES-specific parameters for dermal exposures are described in Appendix A.8.

Table 10-11. Summary of Dermal Exposure Doses to 1,1,2-Trichloroethane for Repackaging

Modeled Scenario	Acute Absorbed Dose Rate (mg/day)	
	Central Tendency	High-End
Average Adult Worker ^a	1.6	15
^a Conditions where no gloves are used, or for any glove/gauntlet use without permeation data and without employee training.		

10.2.2.4 Exposure Values for Risk Estimates

Using the 8-hour TWA inhalation concentrations presented in Table 10-10, EPA calculated the acute concentration (AC), intermediate average daily concentration (ADC_{intermediate}), average daily concentration (ADC), and lifetime average daily concentration (LADC), as described in Section 10.1.5. The results of these calculations are shown in Table 10-12 below.

Table 10-12. Inhalation Exposure Metrics for Repackaging

Exposure Group	Acute Exposure Concentrations (ppm)		Intermediate Average Daily Concentration (ppm)		Average Daily Concentration (ppm)		Lifetime Average Daily Concentration (ppm)	
	Central Tendency	High-End	Central Tendency	High-End	Central Tendency	High-End	Central Tendency	High-End
Worker	3.4E-02	0.21	2.0E-02	0.12	1.9E-02	0.12	6.6E-03	4.5E-02
Occupational Non-User (ONU)	3.4E-02	3.4E-02	2.0E-02	2.0E-02	1.9E-02	1.9E-02	6.6E-03	9.6E-03

Table 10-13 summarizes the acute absorbed dose (AAD), intermediate absorbed dose (IAD_{intermediate}), chronic absorbed dose, non-cancer (CAD), and lifetime chronic absorbed dose, cancer (LCAD) for 1,1,2-trichloroethane during repackaging.

Table 10-13. Dermal Exposure Metrics for Repackaging of 1,1,2-Trichloroethane

Exposure Group	Acute Absorbed Dose (mg/kg-day)		Intermediate Absorbed Dose (mg/kg-day)		Chronic Absorbed Dose, Non-Cancer (mg/kg-day)		Lifetime Chronic Absorbed Dose, Cancer (mg/kg-day)	
	Central Tendency	High-End	Central Tendency	High-End	Central Tendency	High-End	Central Tendency	High-End
Average Adult Worker	2.0E-02	0.18	1.2E-02	0.11	1.1E-02	0.10	4.0E-03	4.2E-02

10.2.2.5 Information on Exposure Controls and Personal Protective Equipment

EPA identified limited information on control technologies utilized at repackaging sites. According to the 2009 Emission Scenario Document for Transport and Storage of Chemicals, the controls applied to the transfer process will be different depending on the container being filled or emptied, and the type of chemical being transferred (such as solids, volatile liquids, viscous liquids) ([OECD, 2009b](#)). The

Repackaging Generic Scenario lists two repackaging sites from a 2013 Health and Safety Laboratory Study in which local exhaust ventilation was the primary air quality control utilized ([U.S. EPA, 2022c](#)).

When filling containers, emissions can potentially occur from overfill and spills. However, the use of automated filling equipment, along with secondary containment systems, should minimize the emission to the environment for overfill and spills. Containment methods include bunds, kerbs, drip trays or any other systems that will prevent a spilled product escaping are recommended ([OECD, 2009b](#)).

Limited information was found regarding typical PPE workers use during repackaging operations. The Repackaging Generic Scenario notes one chemical wholesaler website that indicates commonly used PPE includes safety glasses, face shields, aprons, and gloves ([U.S. EPA, 2022c](#)).

10.2.2.6 Estimates of Number of Workers and Occupational Non-Users

EPA used data from BLS and the SUBS specific to the OES to estimate the number of workers and ONUs per site potentially exposed to 1,1,2-trichloroethane during repackaging ([U.S. BLS, 2023](#); [U.S. Census Bureau, 2017](#)). As further described in Section 10.1.8, this approach involved first identifying the relevant NAICS codes for the OES. The next step is the identification of relevant SOC codes within the BLS data for the identified NAICS codes, from which total number of workers can be determined. This number is divided by the number of sites identified to obtain the exposed workers per site. Appendix D includes further details regarding methodology for estimating the number of workers and ONUs per site. EPA assigned the following NAICS codes for this OES:

- 424610 – Plastics Materials and Basic Forms and Shapes Merchant Wholesalers
- 424690 – Other Chemical and Allied Products Merchant Wholesalers
- 424710 – Petroleum Bulk Stations and Terminals
- 424720 – Petroleum and Petroleum Products Merchant Wholesalers (except Bulk Stations and Terminals)

Table 10-14. Estimated Average Number of Workers per Site Potentially Exposed to 1,1,2-Trichloroethane During Repackaging

NAICS Code	Potentially Exposed Workers per Site ^a	Potentially Exposed ONUs per Site
424610 – Plastics Materials and Basic Forms and Shapes Merchant Wholesalers	1	1
424690 – Other Chemical and Allied Products Merchant Wholesalers		
424710 – Petroleum Bulk Stations and Terminals		
424720 – Petroleum and Petroleum Products Merchant Wholesalers (except Bulk Stations and Terminals)		
NAICS = North American Industry Classification System		
^a Number of workers and occupational non-users (ONUs) per site are calculated by dividing the exposed number of workers or ONUs by the number of establishments.		

10.2.3 Processing as a Reactant – OES #4

10.2.3.1 Exposure Groups and Worker Activities

During the processing of 1,1,2-trichloroethane as a reactive intermediate, workers are potentially exposed to 1,1,2-trichloroethane when unloading transport containers, cleaning transport containers, and cleaning reaction vessels or other equipment. These activities are all potential sources of worker exposure via inhalation of vapor or dermal contact with liquids. The final study report published by the Vinyl Institute Consortium ([Stantec ChemRisk, 2024a](#)) detailed worker activities per exposure group that occurred at 1,1,2-trichloroethane manufacturing sites. These exposure groups included operators/process technicians, laboratory technicians, logistics/distribution technicians, maintenance technicians, and ONUs. EPA expects that these same exposure groups could be present at sites that perform processing as a reactant, and therefore assessed the same exposure groups for this OES. This data was chosen as an analogous scenario due to similarities in expected tasks performed during chemical manufacturing and processing scenarios.

ONUs include employees (*e.g.*, supervisors, managers) at the processing site that do not directly handle 1,1,2-trichloroethane. Therefore, ONUs are expected to have lower inhalation exposures, lower vapor through-skin uptake, and no expected dermal exposure.

10.2.3.2 Occupational Inhalation Exposure Results

EPA used analogous data from the Manufacturing as a byproduct OES to assess processing exposures when it is used as a reactant at lower concentrations. Refer to Section 10.2.1.2 for additional details on the inhalation monitoring data used for this assessment. EPA assessed non-detects at the limit of detection divided by two. The worker samples collected were from operators/process technicians, logistics/distribution technicians, maintenance technicians, and laboratory technicians at the site. From this monitoring data, EPA calculated the 50th and 95th percentile 8-hr TWA concentrations to represent a central tendency and high-end estimate of potential occupational inhalation exposures, respectively, for this scenario. The inhalation monitoring results are presented in Table 10-15.

Table 10-15. Inhalation Exposures to 1,1,2-Trichloroethane for Processing of 1,1,2-Trichloroethane as a Reactant (Byproduct)

Exposure Group	Number of Samples	Number of Detected Samples ^a	8-Hour TWA (ppm)	
			Central Tendency	High-End
Operator/Process Technician	49	49	4.6E-03	9.1E-02
Logistics/Distribution Technicians	15	11	5.1E-04	3.8E-02
Maintenance Technicians	23	16	1.5E-04	0.27
Laboratory Technicians	29	19	1.7E-04	3.2E-02
ONUs	29	18	1.2E-04	3.8E-03

^a Limit of detection ranged from 6.0E-05 ppm to 7.0E-05 ppm, depending on similar exposure group (SEG).

10.2.3.3 Occupational Dermal Exposure Results

EPA estimated dermal exposures for this OES using the dermal modeling approach outlined in Section 10.1.4 above and Appendix A.8. The concentration range evaluated for this dermal exposure is 1 to 100 %, based on expected concentrations from manufacturing as a primary product and byproduct. Table

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10-16 summarizes the acute absorbed dose rate for 1,1,2-trichloroethane during processing as a reactant. The high-end exposure doses are the 95th percentiles of the respective simulation output and the central tendency exposures are the 50th percentiles. OES-specific parameters for dermal exposures are described in Appendix A.8.

Table 10-16. Summary of Dermal Exposure Doses for Processing of 1,1,2-Trichloroethane as a Reactant

Modeled Scenario	Acute Absorbed Dose Rate (mg/day)	
	Central Tendency	High-End
Average Adult Worker ^a	2.2	9.8
^a Conditions where no gloves are used, or for any glove/gauntlet use without permeation data and without employee training.		

10.2.3.4 Exposure Values for Risk Estimates

Using the 8-hour TWA inhalation concentrations presented in Table 10-15, EPA calculated the acute concentration (AC), intermediate average daily concentration (ADC_{intermediate}), average daily concentration (ADC), and lifetime average daily concentration (LADC), as described in Section 10.1.5. The results of these calculations are shown in Table 10-17 below.

Table 10-17. Inhalation Exposure Metrics for Processing of 1,1,2-Trichloroethane as a Reactant (Byproduct)

Exposure Group	Acute Exposure Concentrations (ppm)		Intermediate Average Daily Concentration (ppm)		Average Daily Concentration (ppm)		Lifetime Average Daily Concentration (ppm)	
	Central Tendency	High-End	Central Tendency	High-End	Central Tendency	High-End	Central Tendency	High-End
Operator/Process Technician	3.1E-03	6.2E-02	2.3E-03	4.5E-02	2.1E-03	4.2E-02	8.5E-04	2.2E-02
Logistics Technicians	3.5E-04	2.6E-02	2.6E-04	1.9E-02	2.4E-04	1.8E-02	9.5E-05	9.0E-03
Maintenance Technicians	1.0E-04	0.18	7.4E-05	0.13	6.9E-05	0.12	2.8E-05	6.3E-02
Laboratory Technicians	1.1E-04	2.2E-02	8.3E-05	1.6E-02	7.7E-05	1.5E-02	3.1E-05	7.7E-03
Occupational Non-Users (ONUs)	8.1E-05	2.6E-03	5.9E-05	1.9E-03	5.5E-05	1.8E-03	2.2E-05	9.2E-04

Table 10-18 summarizes the acute absorbed dose (AAD), intermediate absorbed dose (IAD_{intermediate}), chronic absorbed dose, non-cancer (CAD), and lifetime chronic absorbed dose, cancer (LCAD) for 1,1,2-trichloroethane during processing as a reactant.

Table 10-18. Dermal Exposure Metrics for Processing of 1,1,2-Trichloroethane as a Reactant

Exposure Group	Acute Absorbed Dose (mg/kg-day)		Intermediate Absorbed Dose (mg/kg-day)		Chronic Absorbed Dose, Non-Cancer (mg/kg-day)		Lifetime Chronic Absorbed Dose, Cancer (mg/kg-day)	
	Central Tendency	High-End	Central Tendency	High-End	Central Tendency	High-End	Central Tendency	High-End
Average Adult Worker	2.7E-02	0.12	2.0E-02	9.0E-02	1.9E-02	8.4E-02	6.8E-03	3.4E-02

10.2.3.5 Information on Exposure Controls and Personal Protective Equipment

Information on exposure controls and personal protective equipment from the inhalation monitoring study for manufacturing as a byproduct is summarized in Section 10.2.1.

10.2.3.6 Estimates of Number of Workers and Occupational Non-Users

EPA used data from BLS and the SUSB specific to the OES to estimate the number of workers and ONUs per site potentially exposed to 1,1,2-trichloroethane during processing as a reactant ([U.S. BLS, 2023](#); [U.S. Census Bureau, 2017](#)). As further described in Section 10.1.8, this approach involved first identifying the relevant NAICS codes for the OES. The next step is the identification of relevant SOC codes within the BLS data for the identified NAICS codes, from which total number of workers can be determined. This number is divided by the number of sites identified to obtain the exposed workers per site. Appendix D includes further details regarding methodology for estimating the number of workers and ONUs per site. EPA assigned the following NAICS codes for this OES:

- 325211 – Plastics Material and Resin Manufacturing
- 325199 – All Other Basic Organic Chemical Manufacturing
- 3251100 – Petrochemical Manufacturing
- 325180 – Other Basic Inorganic Chemical Manufacturing

Table 10-19 summarizes the per site estimates for this OES based on the methodology described.

Table 10-19. Estimated Average Number of Workers per Site Potentially Exposed to 1,1,2-Trichloroethane During Processing as a Reactant

NAICS Code	Potentially Exposed Workers per Site ^a	Potentially Exposed ONUs per Site
325211 – Plastics Material and Resin Manufacturing	27	15
325199 – All Other Basic Organic Chemical Manufacturing		
3251100 – Petrochemical Manufacturing		
325180 – Other Basic Inorganic Chemical Manufacturing		
NAICS = North American Industry Classification System		
^a Number of workers and occupational non-users (ONUs) per site are calculated by dividing the exposed number of workers or ONUs by the number of establishments.		

10.2.4 Formulation of Adhesives and Sealants – OES #5**10.2.4.1 Exposure Groups and Worker Activities**

Workers are potentially exposed to 1,1,2-trichloroethane during formulation of adhesives and sealants during container unloading, container cleaning, equipment cleaning, and packaging of formulation into containers. They may also be exposed to vapors due to volatilization during the mixing process itself, during product sample collection and analysis, and process maintenance. EPA did not find information that indicates the extent that engineering controls and worker PPE are used at facilities that process 1,1,2-trichloroethane into adhesive or sealant formulations. EPA did not have sufficient information to assess exposure groups; and therefore, assessed the general categories of “worker” and ONU”.

ONUs include supervisors, managers, and other employees who work at sites which process 1,1,2-trichloroethane into formulations, mixtures, or reaction products but do not directly handle 1,1,2-trichloroethane. Therefore, EPA expects ONUs to have lower inhalation exposures, and no expected dermal exposures than workers who handle the chemical directly.

10.2.4.2 Occupational Inhalation Exposure Results

For this scenario, the highest method from the exposure assessment hierarchy that was available was analogous data from the manufacturing of 1,1,2-trichloroethane as a byproduct. EPA did not identify any 1,1,2-trichloroethane specific exposure monitoring data for the formulation of adhesives specifically. EPA expects the worker activities and sources of exposure between the two scenarios to be similar, as process descriptions are similar between the two manufacturing scenarios (See Section 4.2.1 and Section 4.2.5). Refer to Section 10.2.1.2 for additional details on the inhalation monitoring data used for this assessment. The results are presented in Table 10-20.

Table 10-20. Inhalation Exposures to 1,1,2-Trichloroethane During Formulation as an Adhesive or Sealant

Exposure Group	Number of Samples	Number of Detected Samples ^a	8-Hour TWA (ppm)	
			Central Tendency	High-End
Operator/Process Technician	49	49	4.6E-03	9.1E-02
Logistics/Distribution Technicians	15	11	5.1E-04	3.8E-02
Maintenance Technicians	23	16	1.5E-04	0.27
Laboratory Technicians	29	19	1.7E-04	3.2E-02
ONUs	29	18	1.2E-04	3.8E-03
ONU = occupational non-user; SEG = similar exposure group ^a Limit of detection ranged from 6.0E-05 to 7.0E-05 ppm, depending on SEG. For all datasets, the geometric standard deviation was greater than three; therefore, EPA assessed non-detects at the limit of detection divided by 2.				

10.2.4.3 Occupational Dermal Exposure Results

EPA estimated dermal exposures for this OES using the dermal modeling approach outlined in Section 10.1.4 above and Appendix A.8. The concentration range evaluated for this dermal exposure is 1 to 100 %. The distribution is based on a product safety data sheet for an adhesive containing 1,1,2-trichloroethane ([Huntsman, 2018](#)), as well as the expected distribution during manufacturing. 1,1,2-

Trichloroethane is expected to arrive at formulation sites in its manufactured form, so workers may be exposed to higher concentrations when handling raw 1,1,2-trichloroethane. Table 10-21 summarizes the acute absorbed dose rate for 1,1,2-trichloroethane during formulation. The high-end exposure doses are the 95th percentiles of the respective simulation output and the central tendency exposures are the 50th percentiles. OES-specific parameters for dermal exposures are described in Appendix A.8.

Table 10-21. Summary of Dermal Exposure Doses for Formulation as an Adhesive or Sealant

Modeled Scenario	Acute Absorbed Dose Rate (mg/day)	
	Central Tendency	High-End
Average Adult Worker ^a	0.77	4.3
^a Conditions where no gloves are used, or for any glove/gauntlet use without permeation data and without employee training.		

10.2.4.4 Exposure Values for Risk Estimates

Using the 8-hour TWA inhalation concentrations presented in Table 10-20, EPA calculated the acute concentration (AC), intermediate average daily concentration (ADC_{intermediate}), average daily concentration (ADC), and lifetime average daily concentration (LADC), as described in Section 10.1.5. The results of these calculations are shown in Table 10-22 below.

Table 10-22. Inhalation Exposure Metrics for Formulation as an Adhesive or Sealant

Exposure Group	Acute Exposure Concentrations (ppm)		Intermediate Average Daily Concentration (ppm)		Average Daily Concentration (ppm)		Lifetime Average Daily Concentration (ppm)	
	Central Tendency	High-End	Central Tendency	High-End	Central Tendency	High-End	Central Tendency	High-End
Operator/ Process Technician	3.1E-03	6.2E-02	2.3E-03	4.5E-02	2.1E-03	4.2E-02	8.5E-04	2.2E-02
Logistics Technicians	3.5E-04	2.6E-02	2.6E-04	1.9E-02	2.4E-04	1.8E-02	9.5E-05	9.0E-03
Maintenance Technicians	1.0E-04	0.18	7.4E-05	0.13	6.9E-05	0.12	2.8E-05	6.3E-02
Laboratory Technicians	1.1E-04	2.2E-02	8.3E-05	1.6E-02	7.7E-05	1.5E-02	3.1E-05	7.7E-03
Occupational Non-Users (ONUs)	8.1E-05	2.6E-03	5.9E-05	1.9E-03	5.5E-05	1.8E-03	2.2E-05	9.2E-04

Table 10-23 summarizes the acute absorbed dose (AAD), intermediate absorbed dose (IAD_{intermediate}), chronic absorbed dose, non-cancer (CAD), and lifetime chronic absorbed dose, cancer (LCAD) for 1,1,2-trichloroethane during formulation as an adhesive or sealant.

Table 10-24. Dermal Exposure Metrics for Formulation as an Adhesive or Sealant

Exposure Group	Acute Absorbed Dose (mg/kg-day)		Intermediate Absorbed Dose (mg/kg-day)		Chronic Absorbed Dose, Non-Cancer (mg/kg-day)		Lifetime Chronic Absorbed Dose, Cancer (mg/kg-day)	
	Central Tendency	High-End	Central Tendency	High-End	Central Tendency	High-End	Central Tendency	High-End
Average Adult Worker	9.7E-03	5.3E-02	7.1E-03	3.9E-02	6.6E-03	3.6E-02	2.5E-03	1.5E-02

10.2.4.5 Estimates of Number of Workers and Occupational Non-Users

EPA used data from BLS and the SUSB specific to the OES to estimate the number of workers and ONUs per site potentially exposed to 1,1,2-trichloroethane during formulation of adhesives and sealants ([U.S. BLS, 2023](#); [U.S. Census Bureau, 2017](#)). As further described in Section 10.1.8, this approach involved first identifying the relevant NAICS codes for the OES. The next step is the identification of relevant SOC codes within the BLS data for the identified NAICS codes, from which total number of workers can be determined. This number is divided by the number of sites identified to obtain the exposed workers per site. Appendix D includes further details regarding methodology for estimating the number of workers and ONUs per site. EPA assigned the following NAICS codes for this OES:

- 325520 – Adhesive Manufacturing

Table 10-25 summarizes the per site estimates for this OES based on the methodology described.

Table 10-25. Estimated Average Number of Workers per Site Potentially Exposed to 1,1,2-Trichloroethane During Formulation of Adhesives and Sealants

NAICS Code	Potentially Exposed Workers per Site ^a	Potentially Exposed ONUs per Site
325520 – Adhesive Manufacturing	4	9

NAICS = North American Industry Classification System
^a Number of workers and occupational non-users (ONUs) per site are calculated by dividing the exposed number of workers or ONUs by the number of establishments.

10.2.5 Use of Adhesives and Sealants – OES #6

10.2.5.1 Exposure Groups and Worker Activities

Worker exposure to 1,1,2-trichloroethane may occur via inhalation of mist or vapors as well as dermal contact to vapors or liquid from use of adhesives and sealants during container cleaning and unloading, equipment cleaning, spraying or roll coating, and curing or drying activities. EPA did not have information on specific exposure groups, and assessed the general categories of workers and ONUs.

ONUs include supervisors, managers, and other employees who work in the application area but do not directly handle or apply 1,1,2-trichloroethane products. ONUs are potentially exposed via inhalation while present in the application area; however, EPA expects ONUs to have lower inhalation exposures than workers who handle or apply the products and no expected dermal exposures.

10.2.5.2 Occupational Inhalation Exposure Results

For this scenario, the highest method from the exposure assessment hierarchy that was available was surrogate data from trichloroethylene (TCE) during use of paints, coatings, adhesives, and sealants. The monitoring data were obtained from OSHA facility inspections and a NIOSH Health Hazard Evaluation report (OSHA, 2017; Chrostek, 1981). The data encompasses exposures from four facilities and includes 22 samples for workers and two samples for ONUs. All samples were above the limit of detection.

EPA selected this data based on the exposure assessment hierarchy, as this was the best surrogate dataset identified, and use of surrogate data is preferred over the use of other modeling approaches. EPA performed a vapor pressure correction to account for the differences in vapor pressure between both chemicals (TCE vapor pressure of 69 mmHg, 1,1,2-trichloroethane vapor pressure of 23 mmHg).

Additionally, the weight fraction of TCE present in the adhesives utilized during the inhalation sampling is unknown. However, a review of available products utilized in the inhalation monitoring studies indicates that TCE concentrations in adhesive products may fall within the ranges of 5-15%, 40-60%, and >90%. For adhesive and sealant products containing 1,1,2-trichloroethane, concentrations may range from 1-10% ((Huntsman, 2018); EPA-HQ-OPPT-2018-0421-0003). EPA estimated potential 1,1,2-trichloroethane exposures by adjusting the TCE exposure concentrations according to assumed differences in chemical weight fractions within adhesives products. EPA assessed three potential scenarios: (1) 90% TCE and 10% 1,1,2-trichloroethane (9:1), (2) 50% TCE and 10% 1,1,2-trichloroethane (5:1), and (3) 10% TCE and 10% 1,1,2-trichloroethane (1:1). For each of these scenarios, EPA estimated the 50th and 95th percentile values to represent the central tendency and high-end exposures. The results of these calculations are shown in Table 10-26.

Table 10-26. Inhalation Exposures to 1,1,2-Trichloroethane for Industrial/Commercial Use of Adhesives and Sealants

Exposure Group	Number of Samples	Number of Detected Samples	8-Hour TWA (ppm)					
			10%:10% ^a		50%:10% ^a		90%:10% ^a	
			CT	HE	CT	HE	CT	HE
Worker	22	22	1.5	13	0.31	2.63	0.17	1.46
ONU	2	2	0.30	0.33	6.0E-02	7.0E-02	3.0E-02	4.0E-02
CT = central tendency; HE = high-end; ONU = occupational non-user; TWA = time-weighted average 1,1,2-Trichloroethane vapor pressure: 23 mmHg Trichloroethylene vapor pressure: 69 mmHg ^a Weight fraction scenario of trichloroethylene to 1,1,2-trichloroethane								

10.2.5.3 Occupational Dermal Exposure Results

EPA estimated dermal exposures for this OES using the dermal modeling approach outlined in Section 10.1.4 above and Appendix A.8. The concentration range evaluated for this dermal exposure is one to five % based on a product safety data sheet for an adhesive containing 1,1,2-trichloroethane (Huntsman, 2018). Table 10-27 summarizes the acute absorbed dose rate for 1,1,2-trichloroethane during use as an adhesive or sealant. The high-end exposure doses are the 95th percentiles of the respective simulation output and the central tendency exposures are the 50th percentiles. OES-specific parameters for dermal exposures are described in Appendix A.8.

Table 10-27. Summary of Dermal Exposure Doses for Industrial/Commercial Use of Adhesives and Sealants

Modeled Scenario	Acute Absorbed Dose Rate (mg/day)	
	Central Tendency	High-End
Average Adult Worker ^a	0.19	0.73
^a Conditions where no gloves are used, or for any glove/gauntlet use without permeation data and without employee training.		

10.2.5.4 Exposure Values for Risk Estimates

Using the 8-hour TWA inhalation concentrations presented in Table 10-26, EPA calculated the acute concentration (AC), intermediate average daily concentration (ADC_{intermediate}), average daily concentration (ADC), and lifetime average daily concentration (LADC), as described in Section 10.1.5. The results of these calculations are shown in Table 10-28 below.

Table 10-28. Inhalation Exposure Metrics for Industrial/Commercial Use of Adhesives and Sealants

Weight Fraction Scenario	Exposure Group	Acute Exposure Concentrations (ppm)		Intermediate Average Daily Concentration (ppm)		Average Daily Concentration (ppm)		Lifetime Average Daily Concentration (ppm)	
		CT	HE	CT	HE	CT	HE	CT	HE
90% TCE to 10% 1,1,2-trichloroethane	Worker	1.0	8.8	0.75	6.5	0.70	6.1	0.28	3.1
	ONU	0.20	0.22	0.15	0.16	0.14	0.15	0.06	0.08
50% TCE to 10% 1,1,2-trichloroethane	Worker	0.21	1.79	0.153	1.31	0.14	1.23	0.06	0.63
	ONU	0.04	0.05	0.030	0.03	0.03	0.03	0.01	0.02
10% TCE to 10% 1,1,2-trichloroethane	Worker	0.12	1.00	0.085	0.73	0.08	0.68	0.03	0.35
	ONU	0.02	0.03	0.017	0.02	0.02	0.02	0.01	0.01
CT = central tendency; HE = high-end; ONU = occupational non-user; TCE = trichloroethylene									

Table 10-29 summarizes the acute absorbed dose (AAD), intermediate absorbed dose (AAC_{intermediate}), chronic absorbed dose, non-cancer (CAD), and chronic absorbed dose, cancer (CAD) for 1,1,2-trichloroethane during use as an adhesive or sealant.

Table 10-29. Dermal Exposure Metrics for Industrial/Commercial Use of Adhesives and Sealants

Exposure Group	Acute Absorbed Dose (mg/kg-day)		Intermediate Absorbed Dose (mg/kg-day)		Chronic Absorbed Dose, Non-Cancer (mg/kg-day)		Lifetime Chronic Absorbed Dose, Cancer (mg/kg-day)	
	Central Tendency	High-End	Central Tendency	High-End	Central Tendency	High-End	Central Tendency	High-End
Average Adult Worker	9.3E-03	5.3E-02	6.8E-03	3.9E-02	6.4E-03	3.6E-02	2.7E-03	1.5E-02

10.2.5.5 Information on Exposure Controls and Personal Protective Equipment

Typical PPE for the application and use of adhesive formulations focuses on minimizing exposure due to spray application or VOC emissions. Chemical PMN submissions submitted to EPA by adhesive chemical manufacturers show that all manufacturers recommend the use of gloves and safety glasses with a side shield or goggles. Approximately half of the submissions also recommended the use of some kind of ventilation and respirators if necessary ([OECD, 2015](#)).

10.2.5.6 Estimates of Number of Workers and Occupational Non-Users

EPA used data from BLS and the SUSB specific to the OES to estimate the number of workers and ONUs per site potentially exposed to 1,1,2-trichloroethane during the use of industrial/commercial use of adhesives and sealants ([U.S. BLS, 2023](#); [U.S. Census Bureau, 2017](#)). As further described in Section 10.1.8, this approach involved first identifying the relevant NAICS codes for the OES. The next step is the identification of relevant SOC codes within the BLS data for the identified NAICS codes, from which total number of workers can be determined. This number is divided by the number of sites identified to obtain the exposed workers per site. Appendix D includes further details regarding methodology for estimating the number of workers and ONUs per site. EPA assigned the following NAICS codes for the commercial use of adhesives and sealants:

- 236220 – Commercial and Institutional Building Construction
- 238190 – Other Foundation, Structure, and Building Exterior Contractors
- 238310 – Drywall and Insulation Contractors
- 238320 – Painting and Wall Covering Contractors
- 238330 – Flooring Contractors
- 238340 – Tile and Terrazzo Contractors
- 238350 – Finish Carpentry Contractors
- 238390 – Other Building Finishing Contractors
- 811111 – General Automotive Repair
- 811114 – Specialized Automotive Repair
- 811121 – Automotive Body, Paint, and Interior Repair and Maintenance
- 811122 – Automotive Glass Replacement Shops
- 811191 – Automotive Oil Change and Lubrication Shops
- 811198 – All Other Automotive Repair and Maintenance

Table 10-30 summarizes the per site estimates for this OES based on the methodology described.

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Table 10-30. Estimated Average Number of Workers per Site Potentially Exposed to 1,1,2-Trichloroethane During the Commercial Use of Adhesives and Sealants

NAICS Code	Potentially Exposed Workers per Site ^a	Potentially Exposed ONUs per Site
236220 – Commercial and Institutional Building Construction	3	1
238190 – Other Foundation, Structure, and Building Exterior Contractors		
238310 – Drywall and Insulation Contractors		
238320 – Painting and Wall Covering Contractors		
238330 – Flooring Contractors		
238340 – Tile and Terrazzo Contractors		
238350 – Finish Carpentry Contractors		
238390 – Other Building Finishing Contractors		
811111 – General Automotive Repair		
811114 – Specialized Automotive Repair		
811121 – Automotive Body, Paint, and Interior Repair and Maintenance		
811122 – Automotive Glass Replacement Shops		
811191 – Automotive Oil Change and Lubrication Shops		
811198 – All Other Automotive Repair and Maintenance		
NAICS = North American Industry Classification System; ONU = occupational non-user		
^a Number of workers and ONUs per site are calculated by dividing the exposed number of workers or ONUs by the number of establishments.		

EPA assigned the following NAICS codes for the industrial use of adhesives and sealants:

- 322220 – Paper Bag and Coated and Treated Paper Manufacturing;
- 341111 – Electronic Computer Manufacturing;
- 341112 – Computer Storage Device Manufacturing;
- 341118 – Computer Terminal and Other Computer;
- 334220 – Radio and Television Broadcasting and Wireless Communications Equipment Manufacturing;
- 334290 – Other Communications Equipment Manufacturing;
- 334310 – Audio and Video Equipment Manufacturing;
- 334412 – Bare Printed Circuit Board Manufacturing;
- 334413 – Semiconductor and Related Device Manufacturing;
- 334416 – Capacitor, Resistor, Coil, Transformer, and Other Inductor Manufacturing;
- 334117 – Electronic Connector Manufacturing;
- 334118 – Printed Circuit Assembly (Electronic Assembly) Manufacturing;
- 334119 – Other Electronic Component Manufacturing;

- 8540 • 335131 – Residential Electric Lighting Fixture Manufacturing;
- 8541 • 335132 – Commercial, Industrial, and Institutional Electric Lighting Fixture Manufacturing;
- 8542 • 335139 – Electric Lamp Bulb and Other Lighting Equipment Manufacturing;
- 8543 • 335210 – Small Electrical Appliance Manufacturing;
- 8544 • 335220 – Major Household Appliance Manufacturing;
- 8545 • 335311 – Power, Distribution, and Specialty Transformer Manufacturing;
- 8546 • 332312 – Motor and Generator Manufacturing;
- 8547 • 335313 – Switchgear and Switchboard Apparatus Manufacturing;
- 8548 • 335314 – Relay and Industrial Coating Manufacturing;
- 8549 • 335910 – Battery Manufacturing;
- 8550 • 335921 – Fiber Optic Cable Manufacturing;
- 8551 • 335929 – Other Communication and Energy Wire Manufacturing;
- 8552 • 335931 – Current-Carrying Wiring Device Manufacturing;
- 8553 • 335932 – Noncurrent-Carrying Wiring Device Manufacturing;
- 8554 • 335991 – Carbon and Graphite Product Manufacturing;
- 8555 • 335999 – All Other Miscellaneous Electrical Equipment and Component Manufacturing;
- 8556 • 336110 – Automobile and Light Duty Motor Vehicle Manufacturing;
- 8557 • 336120 – Heavy Duty Truck Manufacturing;
- 8558 • 336211 – Motor Vehicle Body Manufacturing;
- 8559 • 336212 – Truck Trailer Manufacturing;
- 8560 • 336213 – Motor Home Manufacturing;
- 8561 • 336214 – Travel Trailer and Camper Manufacturing;
- 8562 • 336310 – Motor Vehicle Gasoline Engine and Engine Parts Manufacturing;
- 8563 • 336320 – Motor Vehicle Electrical and Electronic Equipment Manufacturing;
- 8564 • 336330 – Motor Vehicle Steering and Suspension Components (except Spring) Manufacturing;
- 8565 • 335340 – Motor Vehicle Brake System Manufacturing;
- 8566 • 335350 – Motor Vehicle Transmission and Power Train Parts Manufacturing;
- 8567 • 335360 – Motor Vehicle Seating and Interior Trim Manufacturing;
- 8568 • 335370 – Motor Vehicle Metal Stamping;
- 8569 • 336390 – Other Motor Vehicle Parts Manufacturing;
- 8570 • 336411 – Aircraft Manufacturing;
- 8571 • 336412 – Aircraft Engine and Engine Parts Manufacturing;
- 8572 • 336313 – Other Aircraft Parts and Auxiliary Equipment Manufacturing;
- 8573 • 336314 – Guided Missile and Space Vehicle Manufacturing;
- 8574 • 336315 – Guided Missile and Space Vehicle Propulsion Unit and Propulsion Unit Parts
8575 Manufacturing;
- 8576 • 335319 – Other Guided Missile and Space Vehicle Parts and Auxiliary Equipment
8577 Manufacturing;
- 8578 • 336611 – Ship Building and Repairing;
- 8579 • 336612 – Boat Building;
- 8580 • 336991 – Motorcycle, Bicycle, and Parts Manufacturing;
- 8581 • 336992 – Military Armored Vehicle, Tank, and Tank Component Manufacturing; and
- 8582 • 336999 – All Other Transportation Equipment Manufacturing.
- 8583

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Table 10-31. Estimated Average Number of Workers per Site Potentially Exposed to 1,1,2-Trichloroethane During the Industrial Use of Adhesives and Sealants

Thermorethane During the Industrial Use of Handcuffs and Seals		
NAICS Code	Potentially Exposed Workers per Site ^a	Potentially Exposed ONUs per Site ^a
322220 – Paper Bag and Coated and Treated Paper Manufacturing	43	19
334100 – Computer and Peripheral Equipment Manufacturing		
334200 – Communications Equipment Manufacturing		
334300 – Audio and Video Equipment Manufacturing		
334400 – Semiconductor and Other Electronic Component Manufacturing		
335100 – Electric Lighting Equipment Manufacturing		
335200 – Household Appliance Manufacturing		
335300 – Electrical Equipment Manufacturing		
335900 – Other Electrical Equipment and Component Manufacturing		
336100 – Motor Vehicle Manufacturing		
336200 – Motor Vehicle Body and Trailer Manufacturing		
336300 – Motor Vehicle Parts Manufacturing		
336400 – Aerospace Product and Parts Manufacturing		
336411 – Aircraft Manufacturing		
336600 – Ship and Boat Building		
336900 – Other Transportation Equipment Manufacturing		
NAICS = North American Industry Classification System; ONU = occupational non-user		
^a Number of workers and ONUs per site are calculated by dividing the exposed number of workers or ONUs by the number of establishments.		

10.2.6 Use of Cleaning and Degreasing Solvents – OES #7, 8

10.2.6.1 Exposure Groups and Worker Activities

Workers are potentially exposed to 1,1,2-trichloroethane during use of cleaning and degreasing solvents while unloading the chemical from transport containers, during degreaser operation, and during cleaning and maintenance activities. Because 1,1,2-trichloroethane is volatile, inhalation exposure to vapor and mist is expected to be the primary exposure route; however, dermal exposure to the liquid form may also occur. EPA did not have sufficient information to assess exposure groups; therefore, EPA assessed using the generic exposure groups of “worker” and ONU”.

ONUs include supervisors, managers, and other workers at sites which use 1,1,2-trichloroethane for non-aerosol cleaning and degreasing but do not directly handle 1,1,2-trichloroethane. Therefore, EPA

expects ONUs to have lower inhalation exposures, and no expected dermal exposure than workers who handle the chemical directly.

10.2.6.2 Occupational Inhalation Exposure Results

For this scenario, the highest method from the exposure assessment hierarchy that was available was surrogate data. According to reported NEI data, 1,1,2-trichloroethane is used in both open-top vapor degreasing (OTVD) and cold solvent cleaning/stripping (U.S. EPA, 2023a, 2020a). EPA assessed occupational inhalation exposures for OTVD and cold cleaning separately.

No monitoring data were found for 1,1,2-trichloroethane in cleaning/degreasing solvents used for OTVD. Therefore, EPA used surrogate data from volatile liquids assessed in previous EPA Risk Evaluations to evaluate this scenario. EPA identified a total of 331 worker and 97 ONU samples from perchloroethylene, trichloroethylene, and 1-bromopropane; all samples were above the limit of detection. The data were for use in open-top vapor degreasing in a variety of industries including metal product fabrication, valve manufacturing, aerospace parts manufacturing, air conditioning prep and assembly, and AC motor parts (Miller, 2019; OSHA, 2019, 2013; U.S. EPA, 2006b; NIOSH, 2002a, b, d; Reh and Nemhauser, 2001; Barsan, 1991; Seitz and Driscoll, 1989; Daniels et al., 1988; NIOSH, 1984, 1982; Ruhe et al., 1981; Lewis, 1980; Gilles et al., 1977; Rosensteel and Lucas, 1975; NIOSH, 1973).

TCE has a vapor pressure of 69 mmHg, PCE has a vapor pressure of 18.5 mmHg, and 1-Bromopropane has a vapor pressure of 110.89 mmHg, vs. 23 mmHg for 1,1,2-trichloroethane. EPA assumed solvents would be used in neat form so corrected for vapor pressure differences only for surrogate chemicals vs. 1,1,2-trichloroethane. Surrogate data corrections were made for all data points.

From this monitoring data, EPA calculated the 50th and 95th percentile 8-hr TWA concentrations to represent a central tendency and high-end estimate of potential occupational inhalation exposures, respectively, for this scenario. A vapor pressure correction was performed to account for differences in chemical vapor pressure. Mole fraction data were unavailable; therefore, EPA assumed a mole fraction of one. The results of these calculations are shown in Table 10-32.

Table 10-32. Inhalation Exposures to 1,1,2-Trichloroethane for Use of Cleaning/Degreasing Solvents (OTVD)

Exposure Group	Number of Samples	Number of Detected Samples	8-Hour TWA (ppm)	
			Central Tendency	High-End
Worker	331	331	2.1	28
ONU	97	97	2.1E-02	1.8
ONU = occupational non-user; TWA = time-weighted average 1,1,2-Trichloroethane vapor pressure: 23 mmHg Perchloroethylene vapor pressure: 18.5 mmHg Trichloroethylene vapor pressure: 69 mmHg 1-Bromopropane vapor pressure: 110.89 mmHg				

No monitoring data were found for 1,1,2-trichloroethane in cleaning/degreasing solvents used for OTVD. Therefore, EPA used surrogate data from perchloroethylene to evaluate this scenario. EPA identified 29 worker and five ONU samples for perchloroethylene use in cold cleaning from a NIOSH In-Depth Survey Report (NIOSH, 2002c) and a study submitted to EPA by Vulcan Chemicals (Vulcan

[Chemicals, 1994](#)) under TSCA.

From this monitoring data, EPA calculated the 50th and 95th percentile 8-hr TWA concentrations to represent a central tendency and high-end estimate of potential occupational inhalation exposures, respectively, for this scenario. A vapor pressure correction was performed to account for differences in chemical vapor pressure (23 mmHG for 1,1,2-trichloroethane and 18.5 mmHg for perchloroethylene). Mole fraction data were unavailable; therefore EPA assumed a mole fraction of one. The results of these calculations are shown in Table 10-33.

Table 10-33. Inhalation Exposures to 1,1,2-Trichloroethane for Use of Cleaning/Degreasing Solvents (Cold Cleaning)

Exposure Group	Number of Samples	Number of Detected Samples	8-Hour TWA (ppm)	
			Central Tendency	High-End
Worker	29	29	3.0	5.1
ONU			3.0	3.0
ONU = occupational non-user; TWA = time-weighted average				

10.2.6.3 Occupational Dermal Exposure Results

EPA estimated dermal exposures for this OES using the dermal modeling approach outlined in Section 10.1.4 above and Appendix A.8. The concentration evaluated for this dermal exposure is 100 % based on the ESD on the Use of Vapour Degreasers ([OECD, 2021](#)). Table 10-34 summarizes the acute absorbed dose rate for 1,1,2-trichloroethane during use as a cleaning/degreasing solvent. The high-end exposure doses are the 95th percentiles of the respective simulation output and the central tendency exposures are the 50th percentiles. OES-specific parameters for dermal exposures are described in Appendix A.8.

Table 10-34. Summary of Dermal Exposure Doses for Use of Cleaning/Degreasing Solvents

Modeled Scenario	Acute Absorbed Dose Rate (mg/day)	
	Central Tendency	High-End
Average Adult Worker ^a	6.6	16
^a Conditions where no gloves are used, or for any glove/gauntlet use without permeation data and without employee training.		

10.2.6.4 Exposure Values for Risk Estimates

Using the 8-hour TWA inhalation concentrations presented in Table 10-32 and Table 10-33, EPA calculated the acute concentration (AC), intermediate average daily concentration (ADC_{intermediate}), average daily concentration (ADC), and lifetime average daily concentration (LADC), as described in Section 10.1.5. The results of these calculations are shown in Table 10-35 and Table 10-36 below.

Table 10-35. Inhalation Exposure Metrics for Use of Cleaning/Degreasing Solvents (OTVD)

Exposure Group	Acute Exposure Concentrations (ppm)		Intermediate Average Daily Concentration (ppm)		Average Daily Concentration (ppm)		Lifetime Average Daily Concentration (ppm)	
	Central Tendency	High-End	Central Tendency	High-End	Central Tendency	High-End	Central Tendency	High-End
Worker	1.4	19	1.0	14	0.98	13	0.39	6.7
Occupational Non-User (ONU)	1.4E-02	1.2	1.0E-02	0.90	9.8E-03	0.84	3.9E-03	0.43

Table 10-36. Inhalation Exposure Metrics for Use of Cleaning/Degreasing Solvents (Cold Cleaning)

Exposure Group	Acute Exposure Concentrations (ppm)		Intermediate Average Daily Concentration (ppm)		Average Daily Concentration (ppm)		Lifetime Average Daily Concentration (ppm)	
	Central Tendency	High-End	Central Tendency	High-End	Central Tendency	High-End	Central Tendency	High-End
Worker	2.1	3.5	1.5	2.5	1.4	2.4	0.56	1.2
Occupational Non-User (ONU)	2.1	2.1	1.5	1.5	1.4	1.4	0.56	0.72

Table 10-37 summarizes the acute absorbed dose (AAD), intermediate absorbed dose ($IAD_{\text{intermediate}}$), chronic absorbed dose, non-cancer (CAD), and lifetime chronic absorbed dose, cancer (LCAD) for 1,1,2-trichloroethane during use as a cleaning/degreasing solvent.

Table 10-37. Dermal Exposure Metrics for Use of Cleaning/Degreasing Solvents

Exposure Group	Acute Absorbed Dose (mg/kg-day)		Intermediate Absorbed Dose (mg/kg-day)		Chronic Absorbed Dose, Non-Cancer (mg/kg-day)		Lifetime Chronic Absorbed Dose, Cancer (mg/kg-day)	
	Central Tendency	High-End	Central Tendency	High-End	Central Tendency	High-End	Central Tendency	High-End
Average Adult Worker	8.2E-02	0.20	6.0E-02	0.15	5.6E-02	0.14	2.1E-02	5.8E-02

10.2.6.5 Information on Exposure Controls and Personal Protective Equipment

According to the Emission Scenario Document on the Use of Vapour Degreasers, control equipment may include covers on top of OTVDs, freeboard refrigeration devices, increased freeboard ratio, and carbon adsorption systems. Personal protective equipment may include respirators and gloves ([OECD, 2021](#)).

10.2.6.6 Estimates of Number of Workers and Occupational Non-Users

EPA used data from BLS and the SUSB specific to the OES to estimate the number of workers and ONUs per site potentially exposed to 1,1,2-trichloroethane during the use of cleaning/degreasing solvents ([U.S. BLS, 2023](#); [U.S. Census Bureau, 2017](#)). As further described in Section 10.1.8, this approach involved first identifying the relevant NAICS codes for the OES. The next step is the identification of relevant SOC codes within the BLS data for the identified NAICS codes, from which total number of workers can be determined. This number is divided by the number of sites identified to obtain the exposed workers per site. Appendix D includes further details regarding methodology for estimating the number of workers and ONUs per site. EPA assigned the following NAICS codes for this OES:

- 336110 – Automobile and Light Duty Motor Vehicle Manufacturing;
- 336120 – Heavy Duty Truck Manufacturing;
- 336211 – Motor Vehicle Body Manufacturing;
- 336212 – Truck Trailer Manufacturing;
- 336213 – Motor Home Manufacturing;
- 336214 – Travel Trailer and Camper Manufacturing;
- 336310 – Motor Vehicle Gasoline Engine and Engine Parts Manufacturing;
- 336320 – Motor Vehicle Electrical and Electronic Equipment Manufacturing;
- 336330 – Motor Vehicle Steering and Suspension Components (except Spring) Manufacturing;
- 336340 – Motor Vehicle Brake System Manufacturing;
- 336350 – Motor Vehicle Transmission and Power Train Parts Manufacturing;
- 336360 – Motor Vehicle Seating and Interior Trim Manufacturing;
- 336370 – Motor Vehicle Metal Stamping;
- 336390 – Other Motor Vehicle Parts Manufacturing;
- 336411 – Aircraft Manufacturing;
- 336412 – Aircraft Engine and Engine Parts Manufacturing;
- 336413 – Other Aircraft Parts and Auxiliary Equipment Manufacturing;
- 336414 – Guided Missile and Space Vehicle Manufacturing;
- 336415 – Guided Missile and Space Vehicle Propulsion Unit and Propulsion Unit Parts Manufacturing;
- 336419 – Other Guided Missile and Space Vehicle Parts and Auxiliary Equipment Manufacturing;
- 336611 – Ship Building and Repairing;
- 336612 – Boat Building;
- 336991 – Motorcycle, Bicycle, and Parts Manufacturing;
- 336992 – Military Armored Vehicle, Tank, and Tank Component Manufacturing; and
- 336999 – All Other Transportation Equipment Manufacturing.

Table 10-38 summarizes the per site estimates for this OES based on the methodology described.

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8722
8723**Table 10-38. Estimated Average Number of Workers per Site Potentially Exposed to 1,1,2-Trichloroethane During the Use of Cleaning/Degreasing Solvents**

NAICS Code	Potentially Exposed Workers per Site ^a	Potentially Exposed ONUs per Site ^a
336110 – Automobile and Light Duty Motor Vehicle Manufacturing	76	22
336120 – Heavy Duty Truck Manufacturing		
336211 – Motor Vehicle Body Manufacturing		
336212 – Truck Trailer Manufacturing		
336213 – Motor Home Manufacturing		
336214 – Travel Trailer and Camper Manufacturing		
336310 – Motor Vehicle Gasoline Engine and Engine Parts Manufacturing		
336320 – Motor Vehicle Electrical and Electronic Equipment Manufacturing		
336330 – Motor Vehicle Steering and Suspension Components (except Spring) Manufacturing		
336340 – Motor Vehicle Brake System Manufacturing		
336350 – Motor Vehicle Transmission and Power Train Parts Manufacturing		
336360 – Motor Vehicle Seating and Interior Trim Manufacturing		
336370 – Motor Vehicle Metal Stamping		
336390 – Other Motor Vehicle Parts Manufacturing		
336411 – Aircraft Manufacturing		
336412 – Aircraft Engine and Engine Parts Manufacturing		
336413 – Other Aircraft Parts and Auxiliary Equipment Manufacturing		
336414 – Guided Missile and Space Vehicle Manufacturing		
336415 – Guided Missile and Space Vehicle Propulsion Unit and Propulsion Unit Parts Manufacturing		
336419 – Other Guided Missile and Space Vehicle Parts and Auxiliary Equipment Manufacturing		
336611 – Ship Building and Repairing		
336612 – Boat Building		
336991 – Motorcycle, Bicycle, and Parts Manufacturing		
336992 – Military Armored Vehicle, Tank, and Tank Component Manufacturing		

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NAICS Code	Potentially Exposed Workers per Site ^a	Potentially Exposed ONUs per Site ^a
336999 – All Other Transportation Equipment Manufacturing		
NAICS = North America Industry Classification System; ONU = occupational non-user ^a Number of workers and ONUs per site are calculated by dividing the exposed number of workers or ONUs by the number of establishments.		

10.2.7 Use of Laboratory Chemicals – OES #9

10.2.7.1 Exposure Groups and Worker Activities

During the use of 1,1,2-trichloroethane as a laboratory chemical, workers are potentially exposed to the chemical during the following activities: transferring 1,1,2-trichloroethane from transport containers to labware, sampling/analyses, and container/equipment cleaning. During these activities workers may be exposed via inhalation of vapor or dermal contact with 1,1,2-trichloroethane. EPA assessed exposure to workers and ONUs.

ONUs include supervisors, managers, and workers present at the laboratory site but do not directly handle 1,1,2-trichloroethane. Therefore, EPA expects ONUs to have lower inhalation exposures, lower vapor-through-skin uptake, and no expected dermal exposure than workers who handle 1,1,2-trichloroethane as a laboratory chemical.

10.2.7.2 Occupational Inhalation Exposure Results

For this scenario, the highest method from the exposure assessment hierarchy that was available was analogous data from the Manufacturing as a Byproduct OES. For this scenario, inhalation data were provided via a test order submission from the Vinyl Institute ([Stantec ChemRisk, 2024a](#)). Within this data set, EPA identified 29 full-shift PBZ samples for laboratory technicians. These laboratory technicians conducted routine daily tasks such as preparing samples for analysis, preparing chemical solutions or standards, and performing data input, interpretation, and analysis. Some activities, such as sample collection from production areas, may not occur in a commercial lab setting; however, EPA assumes that the other tasks described for laboratory technicians in a manufacturing setting would be similar to tasks performed by laboratory technicians in a commercial laboratory setting. However, some tasks may include potential exposure scenarios that are not representative of commercial laboratory work, such as sample collection; EPA has considered this in the Risk Evaluation. The Agency did not identify any ONU PBZ samples relevant to laboratory work. Therefore, EPA used the central tendency from workers to represent ONU exposures.

At byproduct manufacturing facilities, workers may be exposed to up to 50% 1,1,2-trichloroethane by weight ([Stantec ChemRisk, 2024a](#)), whereas workers at commercial laboratories may be exposed to up to 100% trichloroethane by weight ([Sigma-Aldrich Inc, 2020](#); [Matheson Tri-Gas, 2017](#)). To account for these differences in concentration, EPA applied a mole fraction adjustment to evaluate exposures at commercial laboratories. The results of these calculations are shown in Table 10-39.

Table 10-39. Inhalation Exposures to 1,1,2-Trichloroethane for Use of Laboratory Chemicals

Exposure Group	Number of Samples	Number of Detected Samples ^a	8-Hour TWA (ppm)	
			Central Tendency	High-End
Worker	29	19	3.9E-04	7.6E-02
ONU			3.9E-04	3.9E-04
ONU = occupational non-user; TWA = time-weighted average				
^a The limit of detection for laboratory technicians is 6.0E-05 ppm.				

10.2.7.3 Occupational Dermal Exposure Results

EPA estimated dermal exposures for this OES using the dermal approach outlined in Section 10.1.4 above and Appendix A.8. The concentration evaluated for this dermal exposure ranges from 0.1 to 100 % based on product safety data sheets identified for laboratory chemicals containing 1,1,2-trichloroethane ([Sigma-Aldrich Inc, 2020](#); [Santa Cruz Biotechnology, 2019](#); [SPEX CertiPrep LLC, 2019](#); [Phenova, 2018](#); [ThermoFisher Scientific, 2018](#); [Matheson Tri-Gas, 2017](#)). Table 10-40 summarizes the acute absorbed dose rate for 1,1,2-trichloroethane during laboratory chemical use. The high-end exposure doses are the 95th percentiles of the respective simulation output and the central tendency exposures are the 50th percentiles. OES-specific parameters for dermal exposures are described in Appendix A.8.

Table 10-40. Summary of Dermal Exposure Doses for Use of Laboratory Chemicals

Modeled Scenario	Acute Absorbed Dose Rate (mg/day)	
	Central Tendency	High-End
Average Adult Worker ^a	1.6	15
^a Conditions where no gloves are used, or for any glove/gauntlet use without permeation data and without employee training.		

10.2.7.4 Exposure Values for Risk Estimates

Method for Assessing OES Exposure: DEVL Probabilistic Modeling with Monte Carlo

Using the 8-hour TWA inhalation concentrations presented in Table 10-39, EPA calculated the acute concentration (AC), intermediate average daily concentration (ADC_{intermediate}), average daily concentration (ADC), and lifetime average daily concentration (LADC), as described in Section 10.1.5. The results of these calculations are shown in Table 10-41 below.

Table 10-41. Inhalation Exposure Metrics for Use of Laboratory Chemicals

Exposure Group	Acute Exposure Concentrations (ppm)		Intermediate Average Daily Concentration (ppm)		Average Daily Concentration (ppm)		Lifetime Average Daily Concentration (ppm)	
	Central Tendency	High-End	Central Tendency	High-End	Central Tendency	High-End	Central Tendency	High-End
Worker	2.7E-04	5.2E-02	1.9E-04	3.8E-02	1.8E-04	3.5E-02	7.2E-05	1.8E-02

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Exposure Group	Acute Exposure Concentrations (ppm)		Intermediate Average Daily Concentration (ppm)		Average Daily Concentration (ppm)		Lifetime Average Daily Concentration (ppm)	
	Central Tendency	High-End	Central Tendency	High-End	Central Tendency	High-End	Central Tendency	High-End
Occupational Non-User (ONU)	2.7E-04	2.7E-04	1.9E-04	1.9E-04	1.8E-04	1.8E-04	7.2E-05	9.3E-05

Table 10-42 summarizes the acute absorbed dose (AAD), intermediate absorbed dose (IAD_{intermediate}), chronic absorbed dose, non-cancer (CAD), and lifetime chronic absorbed dose, cancer (LCAD) for 1,1,2-trichloroethane during use as a laboratory chemical.

Table 10-42. Dermal Exposure Metrics for Use of Laboratory Chemicals

Exposure Group	Acute Absorbed Dose (mg/kg-day)		Intermediate Absorbed Dose (mg/kg-day)		Chronic Absorbed Dose, Non-Cancer (mg/kg-day)		Lifetime Chronic Absorbed Dose, Cancer (mg/kg-day)	
	Central Tendency	High-End	Central Tendency	High-End	Central Tendency	High-End	Central Tendency	High-End
Average Adult Worker	2.0E-02	0.18	1.2E-02	0.11	1.1E-02	0.10	4.0E-03	4.2E-02

10.2.7.5 Information on Exposure Controls and Personal Protective Equipment

The Final Study Report submitted to EPA by the Vinyl Institute ([Stantec ChemRisk, 2024a](#)) provided information on exposure controls and PPE used by laboratory technicians at chemical manufacturing facilities. Within laboratories, engineering controls included fume hoods, enclosed GC analyses, fans, and local exhaust ventilation.

Certain laboratory technicians were described as wearing full-face air purifying respirators during hazardous waste handling and disposal. Additionally, it was described that laboratory technicians wore half-face respirators (APF 10) during preparation of dry standards, but that such use was not observed during the inhalation sampling. Based on the test order sampling results, respiratory protection (documented by a yes/no response) was reported for 3% of the full-shift and 4% of task-based samples collected on laboratory technicians ([Stantec ChemRisk, 2024a](#)).

10.2.7.6 Estimates of Number of Workers and Occupational Non-Users

EPA used data from BLS and the SUSB specific to the OES to estimate the number of workers and ONUs per site potentially exposed to 1,1,2-trichloroethane during use as a laboratory chemical ([U.S. BLS, 2023](#); [U.S. Census Bureau, 2017](#)). As further described in Section 10.1.8, this approach involved first identifying the relevant NAICS codes for the OES. The next step is the identification of relevant SOC codes within the BLS data for the identified NAICS codes, from which total number of workers can be determined. This number is divided by the number of sites identified to obtain the exposed workers per site. Appendix D includes further details regarding methodology for estimating the number of workers and ONUs per site. EPA assigned the following NAICS codes for this OES:

- 541713 – Research and Development in Nanotechnology
- 541714 – Research and Development in Biotechnology (except Nanobiotechnology)
- 541380 – Testing Laboratories and Services
- 541715 – Research and Development in the Physical, Engineering, and Life Sciences (except Nanotechnology and Biotechnology)

Table 10-43 summarizes the per site estimates for this OES based on the methodology described.

Table 10-43. Estimated Average Number of Workers per Site Potentially Exposed to 1,1,2-Trichloroethane During Use of Laboratory Chemicals

NAICS Code	Potentially Exposed Workers per Site ^a	Potentially Exposed ONUs per Site
541713 – Research and Development in Nanotechnology	6	10
541714 – Research and Development in Biotechnology (except Nanobiotechnology)		
541380 – Testing Laboratories and Services		
541715 – Research and Development in the Physical, Engineering, and Life Sciences (except Nanotechnology and Biotechnology)		
NAICS = North America Industry Classification System		
^a Number of workers and occupational non-users (ONUs) per site are calculated by dividing the exposed number of workers or ONUs by the number of establishments.		

10.2.8 Disposal to Incineration – OES #10

10.2.8.1 Exposure Groups and Worker Activities

Workers are potentially exposed to 1,1,2-trichloroethane via inhalation of vapors or dermal contact with liquids during the unloading and cleaning of transport containers. EPA did not find information that indicates the extent that engineering controls and worker PPE are used at facilities that handle, treat, and dispose of waste containing 1,1,2-trichloroethane. EPA had sufficient information to assess the following exposure groups: logistics technician, maintenance technician, and ONU.

ONUs for this scenario include supervisors, managers, and other employees that may be in the waste handling or treatment area. ONUs do not directly handle the chemical and are therefore expected to have lower inhalation exposures, and no dermal exposures through contact with liquids or solids, than workers that engage in tasks related to the handling or treatment of waste containing 1,1,2-trichloroethane.

10.2.8.2 Occupational Inhalation Exposure Results

For this scenario, the highest method from the exposure assessment hierarchy that was available was analogous data from the Manufacturing as a Byproduct OES. For this scenario, inhalation data were provided via a test order submission from the Vinyl Institute ([Stantec ChemRisk, 2024a](#)). Within this data set, EPA identified 15 full-shift PBZ samples for logistics technicians and 7 full-shift PBZ samples for maintenance technicians. EPA selected these two worker groups because their job activities are expected to be similar to tasks performed at incineration facilities. Specifically, the unloading and loading activities conducted by logistics technicians are assumed to be similar to material handling

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activities performed by workers at incineration facilities. Maintenance technicians primarily maintain, remove, install, repair, and troubleshoot equipment, and also perform tasks such as tube replacements in reboilers and gas incinerator piping.

The Agency did not identify any ONU PBZ samples. Therefore, EPA used the central tendency from logistics technicians to represent ONU exposures as a conservative estimate.

From this monitoring data, EPA calculated the 50th and 95th percentile 8-hr TWA concentrations to represent a central tendency and high-end estimate of potential occupational inhalation exposures, respectively, for this scenario. The results of these calculations are shown in Table 10-44.

Table 10-44. Inhalation Exposures to 1,1,2-Trichloroethane for Disposal to Incineration

Exposure Group	Number of Samples	Number of Detected Samples ^a	8-Hour TWA (ppm)	
			Central Tendency	High-End
Worker – Logistics Technician	15	11	5.1E-04	3.8E-02
Worker – Maintenance Technician	7	16	1.5E-04	0.27
ONU	-	-	5.1E-04	5.1E-04

ONU = occupational non-user; SEG = similar exposure group; TWA = time-weighted average
^a The limit of detection ranged from 6.0E-05 ppm to 7.0E-05 ppm, depending on SEG.

10.2.8.3 Occupational Dermal Exposure Results

EPA estimated dermal exposures for this OES using the dermal modeling approach outlined in Section 10.1.4 above and Appendix A.8. The concentration evaluated for this dermal exposure ranges from 0.045 to 100 % based on upstream 1,1,2-trichloroethane concentrations. Table 10-45 summarizes the acute absorbed dose rate for 1,1,2-trichloroethane during disposal. The high-end exposure doses are the 95th percentiles of the respective simulation output and the central tendency exposures are the 50th percentiles. OES-specific parameters for dermal exposures are described in Appendix A.8.

Table 10-45. Summary of Dermal Exposure Doses for Disposal to Incineration

Modeled Scenario	Acute Absorbed Dose Rate (mg/day)	
	Central Tendency	High-End
Average Adult Worker ^a	2.2	9.8

^a Conditions where no gloves are used, or for any glove/gauntlet use without permeation data and without employee training.

10.2.8.4 Exposure Values for Risk Estimates

Using the 8-hour TWA inhalation concentrations presented in Table 10-44, EPA calculated the acute concentration (AC), intermediate average daily concentration (ADC_{intermediate}), average daily concentration (ADC), and lifetime average daily concentration (LADC), as described in Section 10.1.50. The results of these calculations are shown in Table 10-46 below.

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Table 10-46. Inhalation Exposure Metrics for Disposal to Incineration

Exposure Group	Acute Exposure Concentrations (ppm)		Intermediate Average Daily Concentration (ppm)		Average Daily Concentration (ppm)		Lifetime Average Daily Concentration (ppm)	
	Central Tendency	High-End	Central Tendency	High-End	Central Tendency	High-End	Central Tendency	High-End
Worker – Logistics Technician	3.5E-04	2.6E-02	2.6E-04	1.9E-02	2.4E-04	1.8E-02	9.5E-05	9.0E-03
Worker – Maintenance Technician	1.0E-04	0.18	7.4E-05	0.13	6.9E-05	0.12	2.8E-05	6.3E-02
Occupational Non-User (ONU)	3.5E-04	3.5E-04	2.6E-04	2.6E-04	2.4E-04	2.4E-04	9.5E-05	1.2E-04

Table 10-47 summarizes the acute absorbed dose (AAD), intermediate absorbed dose (IAD_{intermediate}), chronic absorbed dose, non-cancer (CAD), and lifetime chronic absorbed dose, cancer (LCAD) for 1,1,2-trichloroethane during disposal.

Table 10-47. Dermal Exposure Metrics for Disposal to Incineration

Exposure Group	Acute Absorbed Dose (mg/kg-day)		Intermediate Absorbed Dose (mg/kg-day)		Chronic Absorbed Dose, Non-Cancer (mg/kg-day)		Lifetime Chronic Absorbed Dose, Cancer (mg/kg-day)	
	Central Tendency	High-End	Central Tendency	High-End	Central Tendency	High-End	Central Tendency	High-End
Average Adult Worker	2.7E-02	0.12	2.0E-02	9.0E-02	1.9E-02	8.4E-02	6,8E-03	3.4E-02

10.2.8.5 Information on Exposure Controls and Personal Protective Equipment

EPA did not find information that indicates the extent that engineering controls and worker PPE are used at incineration facilities.

10.2.8.6 Estimates of Number of Workers and Occupational Non-Users

EPA used data from BLS and the SUSB specific to the OES to estimate the number of workers and ONUs per site potentially exposed to 1,1,2-trichloroethane during disposal to incineration ([U.S. BLS, 2023](#); [U.S. Census Bureau, 2017](#)). As further described in Section 10.1.8, this approach involved first identifying the relevant NAICS codes for the OES. The next step is the identification of relevant SOC codes within the BLS data for the identified NAICS codes, from which total number of workers can be determined. This number is divided by the number of sites identified to obtain the exposed workers per site. Appendix D includes further details regarding methodology for estimating the number of workers and ONUs per site. EPA assigned the following NAICS codes for this OES:

- 562211 – Hazardous Waste Treatment and Disposal
- 327310 – Cement Manufacturing

- 327992 – Ground or Treated Mineral and Earth Manufacturing
- 562213 – Solid Waste Combustors and Incinerators

Table 10-48 summarizes the per site estimates for this OES based on the methodology described. These NAICS codes were selected because each can include the burning of waste materials.

Table 10-48. Estimated Average Number of Workers per Site Potentially Exposed to 1,1,2-Trichloroethane During Disposal to Incineration

NAICS Code	Potentially Exposed Workers per Site ^a	Potentially Exposed ONUs per Site
562211 – Hazardous Waste Treatment and Disposal	10	11
327310 – Cement Manufacturing		
327992 – Ground or Treated Mineral and Earth Manufacturing		
562213 – Solid Waste Combustors and Incinerators		
NAICS = North America Industry Classification System; ONU = occupational non-user		
^a Number of workers and ONUs per site are calculated by dividing the exposed number of workers or ONUs by the number of establishments.		

10.2.9 Disposal to Landfill – OES #11

10.2.9.1 Exposure Groups and Worker Activities

Workers are potentially exposed to 1,1,2-trichloroethane via inhalation of vapors or dermal contact with liquids during the unloading and cleaning of transport containers. EPA did not find information that indicates the extent that engineering controls and worker PPE are used at facilities that handle, treat, and dispose of waste containing 1,1,2-trichloroethane. EPA did not have sufficient information to assess exposure groups; therefore, EPA assessed using the generic exposure groups of “worker” and ONU”.

ONUs for this scenario include supervisors, managers, and other employees that may be in the waste handling or treatment area. ONUs do not directly handle the chemical and are therefore expected to have lower inhalation exposures, and no dermal exposures through contact with liquids or solids, than workers that engage in tasks related to the handling or treatment of waste containing 1,1,2-trichloroethane.

10.2.9.2 Occupational Inhalation Exposure Results

For this scenario, the highest method from the exposure assessment hierarchy that was available was existing 1,1,2-trichloroethane area monitoring data from systematic review. EPA identified 1,1,2-trichloroethane inhalation monitoring data from six hazardous waste sites and a sanitary landfill in New Jersey ([Harkov et al., 1985](#)). Sampling locations include leachate ponds, exposed drums, vents, areas with soil discoloration, and areas in close proximity to homes. The study provided 115 area samples. Discrete data were not provided; therefore, EPA used the central tendency and high-end geometric means to represent 50th percentile and 95th percentile potential occupational inhalation exposures, respectively, for this scenario. The number of samples below the detection limit were not provided. The results of these calculations are shown in Table 10-49.

Table 10-49. Inhalation Exposures to 1,1,2-Trichloroethane for Disposal to Landfill

Exposure Group	Number of Samples	8-Hour TWA (ppm)	
		Central Tendency	High-End
Worker	115	1.4E-06	5.2E-06
ONU	-	1.4E-06	1.4E-06

ONU = occupational non-user; TWA = time-weighted average

10.2.9.3 Occupational Dermal Exposure Results

EPA estimated dermal exposures for this OES using the dermal modeling approach outlined in Section 10.1.4 above and Appendix A.8. The concentration evaluated for this dermal exposure ranges from 0.045 to 100 % based on upstream 1,1,2-trichloroethane concentrations. Table 10-50 summarizes the acute absorbed dose rate for 1,1,2-trichloroethane during disposal. The high-end exposure doses are the 95th percentiles of the respective simulation output and the central tendency exposures are the 50th percentiles. OES-specific parameters for dermal exposures are described in Appendix A.8.

Table 10-50. Summary of Dermal Exposure Doses for Disposal to Landfill

Modeled Scenario	Acute Absorbed Dose Rate (mg/day)	
	Central Tendency	High-End
Average Adult Worker ^a	2.2	9.8

^a Conditions where no gloves are used, or for any glove/gauntlet use without permeation data and without employee training.

10.2.9.4 Exposure Values for Risk Estimates

Using the 8-hour TWA inhalation concentrations presented in Table 10-49, EPA calculated the acute concentration (AC), intermediate average daily concentration (ADC_{intermediate}), average daily concentration (ADC), and lifetime average daily concentration (LADC), as described in Section 10.1.50. The results of these calculations are shown in Table 10-51 below.

Table 10-51. Inhalation Exposure Metrics for Disposal to Landfill

Exposure Group	Acute Exposure Concentrations (ppm)		Intermediate Average Daily Concentration (ppm)		Average Daily Concentration (ppm)		Lifetime Average Daily Concentration (ppm)	
	Central Tendency	High-End	Central Tendency	High-End	Central Tendency	High-End	Central Tendency	High-End
Worker	9.7E-07	3.5E-06	7.1E-07	2.6E-06	6.6E-07	2.4E-06	2.6E-07	1.2E-06
Occupational Non-User (ONU)	9.7E-07	9.7E-07	7.1E-07	7.1E-07	6.6E-07	6.6E-07	2.6E-07	3.4E-07

Table 10-52 summarizes the acute absorbed dose (AAD), intermediate absorbed dose IAD_{intermediate}), chronic absorbed dose, non-cancer (CAD), and lifetime chronic absorbed dose, cancer (LCAD) for 1,1,2-trichloroethane during disposal.

Table 10-52. Dermal Exposure Metrics for Disposal to Landfill

Exposure Group	Acute Absorbed Dose (mg/kg-day)		Intermediate Absorbed Dose (mg/kg-day)		Chronic Absorbed Dose, Non-Cancer (mg/kg-day)		Lifetime Chronic absorbed Dose, Cancer (mg/kg-day)	
	Central Tendency	High-End	Central Tendency	High-End	Central Tendency	High-End	Central Tendency	High-End
Average Adult Worker	2.7E-02	0.12	2.0E-02	9.0E-02	1.9E-02	8.4E-02	6.8E-03	3.4E-02

10.2.9.5 Information on Exposure Controls and Personal Protective Equipment

EPA did not find information that indicates the extent that engineering controls and worker PPE are used at landfill facilities.

10.2.9.6 Estimates of Number of Workers and Occupational Non-Users

EPA used data from BLS and the SUSB specific to the OES to estimate the number of workers and ONUs per site potentially exposed to 1,1,2-trichloroethane during disposal to landfill ([U.S. BLS, 2023](#); [U.S. Census Bureau, 2017](#)). As further described in Section 10.1.8, this approach involved first identifying the relevant NAICS codes for the OES. The next step is the identification of relevant SOC codes within the BLS data for the identified NAICS codes, from which total number of workers can be determined. This number is divided by the number of sites identified to obtain the exposed workers per site. Appendix D includes further details regarding methodology for estimating the number of workers and ONUs per site. EPA assigned the following NAICS codes for this OES:

- 562213 – Solid Waste Landfill

Table 10-53 summarizes the per site estimates for this OES based on the methodology described.

Table 10-53. Estimated Average Number of Workers per Site Potentially Exposed to 1,1,2-Trichloroethane During Disposal to Landfill

NAICS Code	Potentially Exposed Workers per Site ^a	Potentially Exposed ONUs per Site
562213 – Solid Waste Landfill	1	5
NAICS = North American Industry Classification System; ONU = occupational non-user ^a Number of workers and ONUs per site are calculated by dividing the exposed number of workers or ONUs by the number of establishments.		

10.2.10 Disposal to POTW/WWT – OES #13

For this assessment, EPA evaluated worker exposures at publicly owned treatment works (POTW) and non-POTW wastewater treatment (WWT) facilities together.

10.2.10.1 Exposure Groups and Worker Activities

Workers are potentially exposed to 1,1,2-trichloroethane via inhalation of vapors or dermal contact with liquids during the unloading and cleaning of transport containers. EPA did not have sufficient information to assess exposure groups; therefore, EPA assessed using the generic exposure groups of “worker” and ONU”.

ONUs for this scenario include supervisors, managers, and other employees that may be in the waste handling or treatment area. ONUs do not directly handle the chemical and are therefore expected to have lower inhalation exposures, and no dermal exposures through contact with liquids or solids, than workers that engage in tasks related to the handling or treatment of waste containing 1,1,2-trichloroethane.

10.2.10.2 Occupational Inhalation Exposure Results

EPA identified two full-shift inhalation monitoring samples that indicate work in wastewater process areas. Both samples were above the limit of detection. EPA used the average of the two values for the central tendency and the high value for the high-end exposure estimate. Due to the limited number of samples specific to 1,1,2-trichloroethane, EPA also considered surrogate monitoring data from wastewater treatment that was specific to 1,2-dichloroethane. This information was received via a test order submission and public comment from the Vinyl Institute (VI, 2026; Stantec ChemRisk, 2024). From these two sources, EPA identified 71 operator samples; 35 of which were below the limit of detection (range: 0.024 ppm to 0.28 ppm). This data was chosen due to the similarity in chemicals (both being volatile solvents), and high quality of the test order submission data (recent data with high number of samples). Vapor pressure adjustment was performed to account for the differences in vapor pressure between the two chemicals (1,1,2-trichloroethane vapor pressure: 23 mmHg; 1,2-dichloroethane vapor pressure: 78.9 mmHg).

Estimated 8-hour TWA concentrations are presented in Table 10-54.

Table 10-54. Inhalation Exposures to 1,1,2-Trichloroethane for Disposal to POTW/WWT

Scenario	Exposure Group	Number of Samples	8-Hour TWA (ppm)		Reference
			Central Tendency	High-End	
1,1,2-	Worker	2	2.1E-02	4.3E-02	(Stantec)

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Scenario	Exposure Group	Number of Samples	8-Hour TWA (ppm)		Reference
			Central Tendency	High-End	
Trichloroethane analogous data	ONU	1	8.0E-05	8.0E-05	ChemRisk, 2024a)
1,2-Dichloroethane surrogate data (vapor pressure corrected)	Worker	70	4.1E-02	0.21	(Stantec ChemRisk, 2024b) EPA-HQ-OPPT-2018-0427-0181
	ONU	3	1.3E-02	3.8E-02	
ONU = occupational non-user; POTW = publicly owned treatment works; TWA = time-weighted average; WWT = wastewater treatment 1,1,2-Trichloroethane vapor pressure: 23 mmHg 1,2-Dichloroethane vapor pressure: 78.9 mmHg					

10.2.10.3 Occupational Dermal Exposure Results

EPA estimated dermal exposures for this OES using the dermal modeling approach outlined in Section 10.1.4 above and Appendix A.8. The concentration evaluated for this dermal exposure ranges from 0.045 to 100 % based on upstream 1,1,2-trichloroethane concentrations. Table 10-55 the acute absorbed dose rate for 1,1,2-trichloroethane during disposal. The high-end exposure doses are the 95th percentiles of the respective simulation output and the central tendency exposures are the 50th percentiles. OES-specific parameters for dermal exposures are described in Appendix A.8.

Table 10-55. Summary of Dermal Exposure Doses for Disposal to POTW/WWT

Modeled Scenario	Acute Absorbed Dose Rate (mg/day)	
	Central Tendency	High-End
Average Adult Worker ^a	2.2	9.8
POTW = publicly owned treatment works; WWT = wastewater treatment ^a Conditions where no gloves are used, or for any glove/gauntlet use without permeation data and without employee training.		

10.2.10.4 Exposure Values for Risk Estimates

Using the 8-hour TWA inhalation concentrations presented in Table 10-54, EPA calculated the acute concentration (AC), intermediate average daily concentration (ADC_{intermediate}), average daily concentration (ADC), and lifetime average daily concentration (LADC), as described in Section 10.1.5. The results of these calculations are shown in Table 10-56 below.

Table 10-56. Inhalation Exposure Metrics for Disposal to POTW/WWT

Chemical Data Source	Exposure Group	Acute Exposure Concentrations (ppm)		Intermediate Average Daily Concentration (ppm)		Average Daily Concentration (ppm)		Lifetime Average Daily Concentration (ppm)	
		Central Tendency	High-End	Central Tendency	High-End	Central Tendency	High-End	Central Tendency	High-End
1,1,2-Trichloroethane analogous	Worker	1.5E-02	2.9E-02	1.1E-02	2.1E-02	1.0E-02	2.0E-02	4.0E-03	1.0E-02
	ONU	5.5E-05	5.5E-05	4.0E-05	4.0E-05	3.7E-05	3.7E-05	1.5E-05	1.9E-05
1,2-Dichloroethane surrogate	Worker	2.8E-02	0.14	2.0E-02	0.10	1.9E-02	9.8E-02	7.6E-03	5.0E-02
	ONU	9.1E-03	2.6E-02	6.7E-03	1.9E-02	6.2E-03	1.8E-02	2.5E-03	9.1E-03
ONU = occupational non-user; POTW = publicly owned treatment works; WWT = wastewater treatment									

Table 10-57 summarizes the acute absorbed dose (AAD), intermediate absorbed dose (IAD_{intermediate}), chronic absorbed dose, non-cancer (CAD), and lifetime chronic absorbed dose, cancer (LCAD) for 1,1,2-trichloroethane during disposal.

Table 10-57. Dermal Exposure Metrics for Disposal to POTW/WWT

Exposure Group	Acute Absorbed Dose (mg/kg-day)		Intermediate Absorbed Dose (mg/kg-day)		Chronic Absorbed Dose, Cancer (mg/kg-day)		Lifetime Chronic Absorbed Dose, Cancer (mg/kg-day)	
	Central Tendency	High-End	Central Tendency	High-End	Central Tendency	High-End	Central Tendency	High-End
Average Adult Worker	5.2E-02	0.15	3.8E-02	0.11	3.6E-02	1.0E-01	1.3E-02	4.1E-02
POTW = publicly owned treatment works; WWT = wastewater treatment								

10.2.10.5 Information on Exposure Controls and PPE

Use of respiratory protection was not documented for any of the three 1,1,2-trichloroethane inhalation monitoring samples utilized in this analysis. EPA identified information on respiratory protection worn by workers in biological wastewater treatment areas and facilities associated with 1,2-dichloroethane manufacturing and processing facilities [which would include facilities that manufacturing 1,1,2-trichloroethane as an unwanted byproduct during the manufacture of 1,2-dichloroethane) (EPA-HQ-OPPT-2018-0427-0181). Specifically, some operators that worked in wastewater process areas were described as wearing half-face air purifying respirators. Other workers were not described as wearing respiratory protection.

10.2.10.6 Estimates of Number of Workers and Occupational Non-Users

EPA used data from BLS and the SUSB specific to the OES to estimate the number of workers and ONUs per site potentially exposed to 1,1,2-trichloroethane during disposal to POTW/WWT ([U.S. BLS, 2023](#); [U.S. Census Bureau, 2017](#)). As further described in Section 10.1.8, this approach involved first identifying the relevant NAICS codes for the OES. The next step is the identification of relevant SOC codes within the BLS data for the identified NAICS codes, from which total number of workers can be

determined. This number is divided by the number of sites identified to obtain the exposed workers per site. Appendix D includes further details regarding methodology for estimating the number of workers and ONUs per site. EPA assigned the following NAICS codes for this OES:

- 221320 – Sewage Treatment Facilities

Table 10-58 summarizes the per site estimates for this OES based on the methodology described.

Table 10-58. Estimated Average Number of Workers per Site Potentially Exposed to 1,1,2-Trichloroethane During Disposal to POTW/WWT

NAICS Code	Potentially Exposed Workers per Site ^a	Potentially Exposed ONUs per Site
221320 – Sewage Treatment Facilities	1	1
NAICS = North America Industry Classification System; ONU = occupational non-user; POTW = publicly owned treatment works; WWT = wastewater treatment ^a Number of workers and ONUs per site are calculated by dividing the exposed number of workers or ONUs by the number of establishments.		

10.2.11 Distribution in Commerce – OES # 15

Exposures associated with Distribution in Commerce can result from loading at the producing site, leaks and spills that can occur during transportation, releases and exposures that can occur during temporary warehousing/storage on the way to delivery to customer site and then unloading at the customer site.

Loading at the Producing Site

This is assessed as part of the OES that produces 1,1,2-trichloroethane product or formulations

Leaks and Spills That Occur During Transportation

TSCA Risk Evaluations do not cover catastrophic accidents but assess leaks and spills that might be expected to occur during transportation. See Section 4.

Temporary Warehousing/Storage: EPA considers temporary warehousing sites part of the distribution in commerce OES. EPA assesses exposure for activities that can occur at these sites involving transfers leading to sources of exposure and release under the OES of Repackaging.

Unloading at the Customer Site

This is assessed as part of the OES that receives 1,1,2-trichloroethane product and formulations.

10.3 Weight of Scientific Evidence Conclusions for Occupational Exposure Assessment

For each OES, EPA considered the (1) assessment approach; (2) quality of the data and models; and (3) strengths, limitations, assumptions, and key sources of uncertainties in the assessment results to determine the weight of scientific evidence (WOSE) rating. EPA also considered factors that increase or decrease the strength of the evidence supporting the release estimate (*e.g.*, quality of the data/information), the applicability of the release data to the OES (*e.g.*, temporal relevance, locational relevance), and the representativeness of the estimate for the whole industry. The Agency used the descriptors of robust, moderate, slight, or indeterminant to categorize the available scientific evidence using its best professional judgment, according to the Draft Systematic Review Protocol ([U.S. EPA](#),

[2021b](#)). For example, a conclusion of moderate is appropriate where exposure data are generated from a generic model with high data quality and some chemical-specific or industry-specific inputs, such that the exposure estimate is a reasonable representation of potential sites within the OES. A conclusion of slight is appropriate where there is limited information that does not sufficiently cover all sites within the OES, and the assumptions and uncertainties are not fully known or documented. See the 2021 Systematic Review Protocol for additional information on weight of scientific evidence conclusions.

WOSE ratings for the occupational exposure estimates for each OES, including details on the basis EPA used to determine the rating, are provided in the sections and tables that follow.

EPA estimated occupational exposure using several sources of air monitoring data; however, the source used the most in this assessment was an inhalation exposure monitoring study submitted to the Agency by the Vinyl Institute in response to a test order ([Stantec ChemRisk, 2024a](#)). These data were determined to have overall data quality ratings of high through EPA's systematic review process. Other studies used had data quality ratings of high or medium.

10.3.1 Overall Confidence in Exposure Estimates

Table 10-59 summarizes EPA's overall confidence in the occupational exposure estimates for each OES.

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Table 10-59. Weight of Scientific Evidence Conclusion in Exposure Estimates

OES	Weight of Scientific Evidence Conclusion in Occupational Inhalation Exposure Estimates	Conclusion
Manufacturing as a Byproduct	Evidence Found: For this OES, EPA used inhalation monitoring data from facilities that manufacture 1,1,2-trichloroethane as a byproduct provided via a test order submission from the Vinyl Institute (Stantec ChemRisk, 2024a). Strengths: The primary strengths of the inhalation occupational exposure estimates for this OES include the use of personal breathing zone samples directly applicable to this OES, which are preferable to other assessment approaches such as modeling or the use of OELs, and the high number of samples available for workers and ONUs. EPA used full-shift PBZ air concentration data to assess inhalation exposures, with the data source having a high data quality rating from the systematic review process. Another strength is that the data used from Vinyl Institute were 1,1,2-trichloroethane specific from multiple facilities that manufacture the chemical as a byproduct; the data included 116 worker and 29 ONU full-shift (8–12 hour) PBZ samples across 4 byproduct manufacturing facilities. Out of the 145 total samples, 32 were below the method detection limit (<0.06 to <0.07 ppb). Another strength is that the monitoring data was collected in accordance with sampling plan that has been reviewed and approved by EPA, and includes all the metadata. Additionally, EPA had industry and site-specific information on working years that were utilized in the cancer exposure estimates. Limitations/Assumptions/Uncertainties: There were data in the test order summary report that indicated that certain tasks are done on a daily basis, while others are done less frequently. Overall, EPA assumed 250 exposure days/year based on 1,1,2-trichloroethane exposure each working day for a typical worker schedule. EPA acknowledges that certain tasks are not performed on a daily basis and has considered this in the risk characterization. Weight of Scientific Evidence Conclusion: Based on these strengths and limitations, EPA has concluded that the weight of scientific evidence for this assessment provides a robust estimate of exposures.	Robust
Import-Repackaging for Laboratory Chemical Use	Evidence Found: EPA did not identify monitoring data for this OES; therefore, the Agency modeled inhalation exposures using EPA/Office of Pollution Prevention and Toxics (OPPT) models combined with Monte Carlo modeling. Strengths: A strength of the Monte Carlo modeling approach is that setting the range of model input values and conducting probabilistic modeling provides a full distribution of potential exposure values which are more likely than a discrete value to capture actual exposure at sites. Limitations/Assumptions/Uncertainties: EPA used assumptions and values from the July	Slight to Moderate

OES	Weight of Scientific Evidence Conclusion in Occupational Inhalation Exposure Estimates	Conclusion
	2022 Chemical Repackaging GS (U.S. EPA, 2022c). The primary limitation is the uncertainty in the representativeness of values toward the true distribution of potential inhalation exposures. Also, EPA assumed that one import container is unloaded/day for repackaging, so the number of containers unloaded/year is equal to the number of exposure days/year. For ONUs, EPA did not identify data or modeling approaches applicable to estimation of ONU exposure for repackaging and used a default assumption of the central tendency from modeled workers inhalation exposures to represent ONU inhalation exposures. Weight of Scientific Evidence Conclusion: Based on these strengths and limitations, EPA has concluded that the weight of scientific evidence for the repackaging assessment based on the modeling approach is moderate for workers, and slight to moderate for ONUs.	
Processing as a Reactant	Evidence Found: EPA did not identify monitoring data for the processing of 1,1,2-trichloroethane as a reactant. For this OES, EPA used inhalation monitoring data from facilities that manufacture 1,1,2-trichloroethane as a byproduct provided via a test order submission from the Vinyl Institute as analogous data for processing as a reactant (Stantec ChemRisk, 2024a). Strengths: The primary strengths of this evaluation is that it utilized chemical specific data that was collected as part of a test order process, as described above in the “Manufacturing as a byproduct” OES WOSE description. This dataset included personal breathing zone samples collected over a full-shift duration, and a sufficient number of samples for multiple worker SEGs and ONUs. Samples were collected across four facilities. While these samples are specific to manufacturing of 1,1,2-trichloroethane, EPA expects that similar tasks and processes would be used during processing operations. Limitations/Assumptions/Uncertainties: A limitation is that it is specific to one industry (manufacturing as a byproduct), and it is uncertain as to if the measured concentrations and exposure frequencies accurately represent processing across all industries. EPA assumed 250 exposure days/year based on 1,1,2-trichloroethane exposure each working day for a typical worker schedule; There were data in the test order summary report that indicated that certain tasks are done on a daily basis, while others are done less frequently. Weight of Scientific Evidence Conclusion: Based on these strengths and limitations, EPA has concluded that the weight of scientific evidence for this assessment provides a moderate estimate of exposures.	Moderate
Formulation of Adhesives and Sealants	Evidence Found: EPA did not identify any inhalation monitoring data during the formulation of 1,1,2-trichloroethane into adhesives and sealants; therefore, EPA used analogous monitoring	Moderate

OES	Weight of Scientific Evidence Conclusion in Occupational Inhalation Exposure Estimates	Conclusion
	data from Manufacturing as a byproduct provided via a test order submission from the Vinyl Institute (Stantec ChemRisk, 2024a). Strengths: The primary strengths of this evaluation is that it utilized chemical specific data that was collected as part of a test order process, as described above in the “Manufacturing as a byproduct” OES WOSE description. This dataset included personal breathing zone samples collected over a full-shift duration, and a sufficient number of samples for multiple worker SEGs and ONUs. Samples were collected across four facilities. While these samples are specific to manufacturing of 1,1,2-trichloroethane, EPA expects that similar tasks and processes would be used during formulation of adhesives. Limitations/Assumptions/Uncertainties: A limitation is that it is specific to one industry (manufacturing as a byproduct), and it is uncertain as to if the measured concentrations and exposure frequencies accurately represent processing across all industries. EPA assumed 250 exposure days/year based on 1,1,2-trichloroethane exposure each working day for a typical worker schedule. Additionally, it is uncertain if all SEGs represented in the test order are also represented at formulation sites. Weight of Scientific Evidence Conclusion: Based on these strengths and limitations, EPA has concluded that the weight of scientific evidence for this assessment provides a moderate estimate of exposures.	
Use of Adhesives and Sealants	Evidence Found: EPA did not identify inhalation exposure monitoring data related to the use of 1,1,2-trichloroethane in the use of adhesives and sealants. Based on available data, EPA used surrogate data from trichloroethylene during use of paints, coatings, adhesives, and sealants. The dataset, obtained from NIOSH HHEs as well as 3 OSHA facility inspections, contained 22 samples for workers and 2 samples for ONUs, and encompassed facilities using trichloroethylene in adhesive and coating applications. The studies had a medium to high data quality rating from the systematic review process. Strengths: The primary strength of these data is the use of personal breathing zone data, and they are expected to be applicable to 1,1,2-trichloroethane activities. Limitations/Assumptions/Uncertainties: The primary limitation of this assessment is that it is based on data from different chemicals, which will cause inherent uncertainties due to differences in the chemical properties and possibly handling. For example, trichloroethylene and 1,1,2-trichloroethane have substantial differences in vapor pressure (69 mmHg for trichloroethylene vs. 23 mmHg for 1,1,2-trichloroethane). EPA assumed 250 exposure	Moderate

OES	Weight of Scientific Evidence Conclusion in Occupational Inhalation Exposure Estimates	Conclusion
	days/year based on exposure each working day for a typical worker schedule. It is uncertain whether this captures actual worker schedules and exposures. Additionally, the dataset contains inhalation monitoring collected at facilities that were inspected due to potential OSHA violations, which adds additional uncertainty as these data may not represent all facility conditions. Weight of Scientific Evidence Conclusion: Based on these strengths and limitations, EPA has concluded that the weight of scientific evidence for this assessment provides a moderate estimate of exposures.	
Use of Cleaning and Degreasing Solvents	Evidence Found: EPA did not identify inhalation exposure monitoring data related to the use of 1,1,2-trichloroethane in the use of cleaning and degreasing solvents. Based on available data, EPA used surrogate data from trichloroethylene, perchloroethylene, and 1-bromopropane during open-top vapor degreasing and cold cleaning. The open-top vapor degreasing datasets contained 331 samples for workers and 29 samples for ONUs, and had medium to high data quality ratings from the systematic review process. The cold cleaning dataset contained 29 samples for workers and had a high data quality rating from the systematic review process. Strengths: The primary strength of these data is the use of personal breathing zone data, and they are expected to be applicable to 1,1,2-trichloroethane activities. Limitations/Assumptions/Uncertainties: The primary limitation of this assessment is that it is based on data from different chemicals, which will cause inherent uncertainties due to differences in the chemical properties and possibly handling, and EPA assumed 250 exposure days/year based on exposure each working day for a typical worker schedule. It is uncertain whether this captures actual worker schedules and exposures. Weight of Scientific Evidence Conclusion: Based on these strengths and limitations, EPA has concluded that the weight of scientific evidence for this assessment provides a moderate estimate of exposures.	Moderate
Use of Laboratory Chemicals	Evidence Found: For this OES, EPA used analogous inhalation data from the Manufacturing as a byproduct OES, which was provided by a test order submission from the Vinyl Institute. Inhalation data from the Exposure Group “laboratory technicians” were used in this assessment. Strengths: EPA used inhalation data to assess inhalation exposures. The primary strength of these data is that they are PBZ and capture many tasks that are expected to occur in a commercial laboratory setting.	Moderate

OES	Weight of Scientific Evidence Conclusion in Occupational Inhalation Exposure Estimates	Conclusion
	Limitations/Assumptions/Uncertainties: The primary limitations include: (1) the data are for laboratory technicians in a manufacturing setting, rather than a commercial setting, and so the dataset may contain exposure from activities or environments that would not occur in a commercial setting; and (2) the lack of data for ONUs. Additionally, EPA assumed 250 exposure days/year based on 1,1,2-trichloroethane exposure each working day for a typical worker schedule; it is uncertain whether this captures actual worker schedules and exposures. Weight of Scientific Evidence Conclusion: Based on these strengths and limitations, EPA has concluded that the weight of scientific evidence for this assessment provides a moderate estimate of exposures.	
Waste Handling, Treatment, and Disposal (Incineration)	Evidence Found: For this OES, EPA used analogous inhalation data from the Manufacturing as a byproduct OES, which was provided by a test order submission from the Vinyl Institute. Inhalation data from the Exposure Groups “maintenance technician” and “logistics technician” were used in this assessment. Strengths: The primary strength of these data is that they are PBZ and capture tasks that are expected to occur in an incineration facility. This is chemical specific data that was collected as part of a test order process, as described above in the “Manufacturing as a byproduct” OES WOSE description. Limitations/Assumptions/Uncertainties: The primary limitations include: (1) the data are for workers in a manufacturing setting, rather than an incineration facility, and so the dataset may contain exposure from activities or environments that would not occur in an incineration facility; and (2) the lack of data for ONUs. Additionally, EPA assumed 250 exposure days/year based on 1,1,2-trichloroethane exposure each working day for a typical worker schedule; it is uncertain whether this captures actual worker schedules and exposures. Weight of Scientific Evidence Conclusion: Based on these strengths and limitations, EPA has concluded that the weight of scientific evidence for this assessment provides a moderate estimate of exposures.	Moderate
Waste Handling, Treatment, and Disposal (Landfill)	Evidence Found: For this OES, EPA identified 115 area samples that were used in this assessment (Harkov et al., 1985). Strengths: The Agency used 1,1,2-trichloroethane inhalation data to assess inhalation exposures, having a medium data quality rating from systematic review. The primary strength of these data is that they are directly applicable concentration data that portray the	Slight to moderate

OES	Weight of Scientific Evidence Conclusion in Occupational Inhalation Exposure Estimates	Conclusion
	concentration of 1,1,2-trichloroethane in the air at six hazardous waste sites and one sanitary landfill. Limitations/Assumptions/Uncertainties: The primary limitations of these data are: (1) the age of the data (1985); (2) only area samples were available as opposed to PBZ air concentration data; and (3) only summary statistics were available in the study as opposed to discrete measurements. Additionally, EPA assumed 250 exposure days/year based on 1,1,2-trichloroethane exposure each working day for a typical worker schedule; it is uncertain whether this captures actual worker schedules and exposures. Weight of Scientific Evidence Conclusion: Based on these strengths and limitations, EPA has concluded that the weight of scientific evidence for this assessment provides a slight to moderate estimate of exposures. For ONUs, EPA did not identify data or modeling approaches applicable to estimation of ONU exposure for disposal by landfill and used a default assumption of the central tendency from the workers inhalation exposures to represent ONU inhalation exposures.	
Waste Handling, Treatment, and Disposal (POTW and Non-POTW WWT)	Evidence Found: For this OES, EPA used analogous 1,1,2-trichloroethane manufacturing data for workers and ONUs related to wastewater treatment and surrogate data from 1,2-dichloroethane. The analogous 1,1,2-trichloroethane dataset included discrete PBZ monitoring data for workers (two samples) and ONUs (one sample) which were provided as part of the 1,1,2-trichloroethane test order (Stantec ChemRisk, 2024a). The surrogate 1,2-dichloroethane dataset included discrete PBZ monitoring data for workers (70 samples) and ONUs (three samples) that were used in an assessment provided by the Vinyl Institute (add citations). Strengths: The Agency used inhalation data to assess inhalation exposures, having a high data quality rating from systematic review. The primary strength of these data is the use of applicable PBZ data obtained from workers in the wastewater treatment area of a manufacturing plant. The data represent exposure due to several processes that commonly occur at wastewater treatment plants. The analogous and surrogate data were also well aligned for workers, with sample concentrations within an order of magnitude. Limitations/Assumptions/Uncertainties: The primary limitations of these data are: (1) the limited number of analogous worker and ONU samples; (2) the supplemental data are from a surrogate chemical, 1,2-dichloroethane, which also included a limited number of samples from workers. Additionally, the surrogate data had a high limit of detection (LOD) relative to potential benchmarks (LOD range: 0.024 to 0.21 ppm), and a large number of samples were below the limit of detection (35 samples below the LOD). Additionally, EPA assumed 250	Moderate

OES	Weight of Scientific Evidence Conclusion in Occupational Inhalation Exposure Estimates	Conclusion
	exposure days/year based on 1,1,2-trichloroethane exposure each working day for a typical worker schedule; it is uncertain whether this captures actual worker schedules and exposures. Weight of Scientific Evidence Conclusion: Based on these strengths and limitations, EPA has concluded that the weight of scientific evidence for this assessment provides a moderate estimate of exposures.	
Dermal Exposure	EPA estimated dermal exposures using modeling methodologies, which are supported by moderate evidence. The Agency used the EPA Dermal Exposure to Volatile Liquids combined with Monte Carlo modeling to calculate the dermal retained dose. EPA used data on 1,1,2-trichloroethane for the fraction absorption parameter (Labcorp Early Development, 2023) and OES-specific data for the weight percent parameter in the model. Strengths: A strength of the Monte Carlo modeling approach is that variation in model input values and a range of potential exposure values is more likely than a discrete value to capture actual exposure at sites. Limitations/Assumptions/Uncertainties: The primary limitation is the uncertainty in the representativeness of value used in the DEVL model for dermal loading toward the true distribution. Therefore, the weight of scientific evidence for the modeling methodologies specifically for all OES is moderate. Note that EPA did not assess dermal exposures to ONUs as EPA does not expect ONUs to directly handle 1,1,2-trichloroethane as part of their duties, and thus ONUs are not expected to have routine dermal exposures during the course of their work. Depending on the COU, ONUs may have incidental dermal exposures due to surface contamination, but EPA did not consider these exposures to be significant and thus they were not assessed.	Moderate
COU = condition of use; EPA = Environmental Protection Agency; LOD = limit of detection; OES = occupational exposure scenario; ONU = occupational non-user; OSHA = Occupational Safety and Health Administration; PBZ = personal breathing zone; POTW = publicly owned treatment works; WWT = wastewater treatment		

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11 CONSUMER EXPOSURE ASSESSMENT

11.1 Approach and Methodology

The main steps in performing a consumer exposure assessment are summarized below:

1. Identification and mapping of product and article examples following the consumer COU table, product and article identification.
2. Compilation of manufacturers use instructions for products and articles to determine patterns of use.
3. Selection of exposure routes and exposed populations according to product/article use descriptions.
4. Identification of data gaps and further search to fill gaps with studies, chemical surrogates or product and article proxies, or professional judgment.
5. Selection of appropriate modeling tools based on available information and chemical properties.
6. Gathering of input parameters per exposure scenario.
7. Parameterization of selected modeling tools and generation of exposure estimates for relevant populations, scenarios, and routes.
8. Evaluation of exposure estimates uncertainties, limitations, and strengths.
9. Confidence determination for the exposure concentrations and scenarios modeled.

EPA considered and reviewed reasonably available information to inform the scope of this consumer oral, inhalation, and dermal exposure assessment for 1,1,2-trichloroethane. Details of this process are provided in the following sections. Overall, this consumer exposure assessment for 1,1,2-trichloroethane quantitatively assesses inhalation exposures to 1,1,2-trichloroethane for the consumer along with possible dermal exposure that could also result from using the consumer products containing 1,1,2-trichloroethane. Oral exposures via mouthing, dust ingestions, and hand-to-mouth were qualitatively evaluated. Oral exposures to 1,1,2-trichloroethane from consumer products are not expected to occur. This exposure assessment evaluates a singular consumer product which could result in consumer exposure to 1,1,2-trichloroethane. EPA considered acute (1-day) and chronic (1-year) inhalation non-cancer durations in this assessment.

A quantitative analysis was conducted when the exposure route was relevant based on the product or article use description and there was sufficient data to parameterize the model. The qualitative analysis is a discussion of exposure based on physical and chemical properties, and/or available monitoring data, if available. When a quantitative analysis was conducted, exposure from the consumer COUs was estimated by modeling each product or article. Each product was individually assessed to determine whether all or some exposure routes were applicable, and approaches were developed accordingly.

Exposure via inhalation was modeled using EPA's Consumer Exposure Model Version 3.2. All exposure estimates for identified consumer products were calculated in CEM. Ingestion exposures were not evaluated for the consumer products identified as reasonably expected use of the products would not result in exposure via inhalation. The dermal exposure to 1,1,2-trichloroethane was estimated using a computational framework implemented within a spreadsheet ([U.S. EPA, 2026e](#)). For each exposure route, EPA used all reasonably available resources as rationale for any assumptions made in calculating exposure. These resources include the CEM User Guide ([U.S. EPA, 2023b](#)), Westat Survey Household Solvent Products: A National Survey ([Westat Inc, 1987](#)), and Safety Data Sheets (SDS) for all consumer products identified to contain 1,1,2-trichloroethane. These sources were used to characterize low-, medium-, and high exposure, where possible and according to condition of use. For concentration of 1,1,2-trichloroethane in products data, if a range was reported, EPA used the minimum and maximum of

the range as a concentration input for the low and high intensity use exposure scenarios. For the medium intensity use exposure scenario the average of the reported range minimum and maximum concentrations were used.

11.1.1 Consumer Conditions of Use and Exposure Scenarios

EPA searched for consumer products and articles containing 1,1,2-trichloroethane through systematic review via peer-reviewed literature along with reviewing databases such as Chemical Data Reporting (CDR) and all reasonably available sources. Products are generally consumable liquids, aerosols, or semi-solids that are used a given number of times before they are exhausted. Articles are generally solids, polymers, foams, metals, or woods, which are present within indoor environments for the duration of their useful life, which may be several years. EPA only identified five products that contained 1,1,2-trichloroethane with no identified articles. These products were all categorized under the COU of Adhesives and sealants with very similar patterns of use. Only two products were identified to be available to consumers in the U.S. These products, an epoxy plastic bonder and an acrylic-based structural adhesive paste, are generally described as structural adhesives used to repair household items including plastics like polyvinyl chloride (PVC) and polycarbonate and metals such as aluminium. EPA used the products available in the U.S. as a base for modeling scenarios in the CEM used to model inhalation resulting from the use of consumer products. Additionally, the SDS ([U.S. EPA, 2026ai](#)) from these two products confirmed the presence of 1,1,2-trichloroethane and the weight fractions at which it is present in the products.

Where possible, SDSs were cross-checked with company websites to ensure that each product is reasonably available for purchase by consumers. In instances where a product could not be purchased by a consumer, EPA did not evaluate the products in a do-it-yourself scenario (DIY). In addition to 1,1,2-trichloroethane weight fractions, EPA obtained additional information about physical characteristics and potential uses of specific products and articles from technical specifications, manufacturer websites, and vendor websites. These data were used in the assessment to define exposure scenarios. The following sections provide summary of specific products and articles with 1,1,2-trichloroethane content identified for each item.

11.1.2 Consumer Exposure Routes Evaluated

Liquid and paste products with 1,1,2-trichloroethane content were identified using reasonably available information, largely via safety data sheets. Products with similar 1,1,2-trichloroethane content and expected use patterns were grouped together for modeling purposes. Liquid and paste products were quantitatively assessed for both inhalation and dermal exposure. Ingestion was only qualitatively assessed due to the unlikely nature of mouthing or ingestion of the products given the patterns of use and the age group anticipated to be the known users. The inhalation exposure model was completed using CEM while the dermal exposure model was completed outside of CEM using a computational framework implemented within a spreadsheet.

Adhesives and Sealants for Home DIY Projects

There were no additional consumer products or articles containing 1,1,2-trichloroethane found during systematic review. The database review of 1,1,2-trichloroethane did not provide any additional products available for consumer use within the U.S. market. The adhesives identified as 1,1,2-trichloroethane containing products (via SDSs) ([U.S. EPA, 2026ai](#)) were an epoxy plastic bonder and an acrylic-based structural adhesive. The epoxy plastic bonder is used to fuse and repair a wide variety of household plastic surfaces including PVC, polycarbonate, acrylic, as well as aluminum and stainless steel. The other product was an acrylic-based structural adhesive paste used in similar scenarios. The epoxy plastic bonder consists of a two-part formula containing both resin (contains 1,1,2-trichloroethane) and

hardener. For this assessment, it is important to note only the resin contains 1,1,2-trichloroethane. When the syringe is used to apply the 1:1 mix of the resin only the resin will be of interest. The acrylic-base structural adhesive has a similar dual dispenser of resin and hardener. Resin and hardener are applied in a 1:1 mixture. Only 50% of total mass delivered would be resin. The adhesives were assessed for 1,1,2-trichloroethane exposure by inhalation and dermal pathways. 1,1,2-Trichloroethane is considered a volatile compound, so it is reasonable to expect some exposure via inhalation from applying a product. Both products are typically applied by hand. It is reasonable to expect a chance at some dermal exposure. The weight fractions reported on these products ranged from 0.1 to 1%. The minimum and maximum weight fractions were used in low- and high-exposure scenarios, respectively, and the average of the minimum and maximum reported values, 0.5%, was used in the medium exposure scenario. The reported weight fractions only account for 1,1,2-trichloroethane in the resin but not in the hardener. This results in the actual weight fraction being half of the reported weight fraction when the product is applied to a surface.

EPA assessed exposure to 1,1,2-trichloroethane in these two adhesives using the same low, medium and high inputs within an analysis containing the same base for duration of use and frequency of use. These two products have the same patterns of use and are expected to be used in very much the same way. EPA found the acrylic based structural adhesive available in similar quantities as the epoxy plastic bonder. The exposure scenario would still be appropriate for both products because the weight fractions reported are the same and the assumptions made would align with both products. Additionally, both products are applied in a 1:1 ratio of hardener and resin.

11.1.3 Consumer Exposure Model (CEM)

The CEM Version 3.2 ([U.S. EPA, 2023b](#)) was selected for the consumer modeling as the most appropriate model based on the type of input data available for 1,1,2-trichloroethane containing products. The advantages of using CEM to assess exposures to consumers and bystanders are as follows:

- The CEM 3.2 model has been peer-reviewed (ERG,2016, HERO);
- CEM 3.2 accommodates the distinct inputs available for products and articles containing 1,1,2-trichloroethane, such as weight fractions, product density, and frequency of use; and
- CEM 3.2 uses the same calculation engine to compute indoor air concentrations from a source as the higher-tier Multi-Chamber Concentration and Exposure Model (MCCEM) but does not require measured chamber emission values

CEM 3.2 has capabilities to model user inhalation exposure to 1,1,2-trichloroethane from products containing the chemical while the product is in use. CEM 3.2 generates exposure estimates based on user-provided input parameters and various assumptions (or defaults). The model contains a variety of pre-populated scenarios for specific product and article categories and allows the user to define generic categories for any product or article where the prepopulated scenarios are not adequate. User inputs for physical and chemical properties of products and articles are utilized to calculate emission profiles of semi-volatile organic compounds (SVOCs) and are applicable to VOCs. 1,1,2-trichloroethane is considered a VOC, therefore it is appropriate to assess inhalation exposure concentrations via CEM modeling. There are six emission calculation profiles within CEM (E1–E6) that represent specific use conditions and properties of various products and articles. A description of these models is summarized in the CEM user guide and associated appendices ([U.S. EPA, 2023b](#)).

CEM 3.2 estimates acute dose rates and chronic average daily doses for inhalation, ingestion, and dermal exposures of consumer products and articles. However, for the purposes of this assessment, EPA performed dermal calculations outside of CEM 3.2, see Section 11.1.4.1 for the approach description and input parameters. EPA did not assess ingestion for the scenario analyzed because the patterns of use

did not support this exposure pathway. CEM 3.2 acute exposures are for an exposure duration of 1 day, and chronic exposures for the duration of 1 year. The model provides estimates for various lifestages:

- Adult (21+ years)
- Youth 2 (16–20 years)
- Youth 1 (11–15 years)
- Child (6–10 years)
- Small Child (3–5 years)
- Infant (1–2 years)
- Infant (<1 year)

Exposure inputs for these various life stages are provided in the EPA's CEM Version 3.2 Appendices (U.S. EPA, 2023b). For this assessment it was reasonably determined that the applicable lifestages for consumer usage modeled would apply only from the adult, youth 2, and youth 1 life stage.

For products, CEM 3.2 uses a two-zone representation of the building of use when predicting indoor air concentrations. Zone 1 represents the room where the consumer product is used. Zone 2 represents the remainder of the building. Each zone is considered well-mixed. The model allows for further division of Zone 1 into a near field and far field to accommodate situations where a higher concentration of product is expected very near the product user during the period of use. Zone 1-near field represents the breathing zone of the user at the location of the product use, while Zone 1-far field represents the remainder of the Zone 1 room. The modeled concentrations in the two zones are a function of the time-varying emission rate in Zone 1, the volumes of Zones 1 and 2, the air flows between each zone and outdoor air, and the air flows between the two zones.

Following product use, the user and bystander may follow one of three pre-defined activity patterns: full time worker, part time worker, and stay-at-home. The activity use pattern determines which Zone is relevant for the user and bystander and the duration of the exposures. The user and bystander inhale airborne concentrations within these zones, which can vary over time, resulting in the overall estimated exposure for each individual. The stay-at-home activity pattern was selected for this assessment for all scenarios as the most conservative behavior pattern. For the “stay-at-home” activity pattern used in these analyses, both users and bystanders are assumed to be in the home most of the day (21 hours). The stay-at-home activity pattern was selected for this assessment for all scenarios as the most conservative behavior pattern. It assumes that occupants are inside the home for a total of 21 hours per day, in an automobile 1 hour per day, and outside 2 hours per day. Of the hours spent in the home, 10 hours are spent in the bedroom, 7 hours are spent in the living room, 2 hours are spent in the kitchen, and 1 hour is spent in both the utility room and bathroom. However, normal activity patterns can be overridden by the selected duration and room of product used; and any age group selected as a user remains in zone 1 (or near field if specified) for the duration of product use.

11.1.3.1 Modeling Inputs and Parameterization

The COUs that were evaluated for 1,1,2-trichloroethane consisted of purely products with no articles containing 1,1,2-trichloroethane reported. The embedded models within CEM 3.2 that were used for the 1,1,2-trichloroethane are listed in Table 11-1. Dermal exposure was modeled separately, only inhalation exposure was evaluated in CEM 3.2.

Table 11-1. CEM 3.2 Model Codes and Descriptions

Model Code	Description
E1	Emission from Product Applied to a Surface Indoors Incremental Source Model

Model Code	Description
E2	Emission from Product Applied to a Surface Indoors Double Exponential Model
P_INH2	Inhalation of Product Used in an Environment

Table 11-2 presents a crosswalk between COU subcategories with a predefined or generic scenario. Models were generated to reflect specific use conditions as well as physical and chemical properties of identified products. Table 11-1 provides data on emissions model and exposure pathways modeled for each exposure scenario. Emissions models were selected based upon the physical and chemical properties of the product and application use method for the products. Exposure pathways were selected to reflect the anticipated use of each product. For example, ingestion was deemed inappropriate for estimating exposure for the one identified COU because it is unlikely someone would do such activities and it would be unreasonable to model such a scenario as an exposure route. (P_INH2) was the most appropriate model for the products identified.

EPA identified two models within CEM that can model the inhalation concentrations of exposure to the user. The E1 and E2 scenarios within CEM were both used for the modeling of 1,1,2-trichloroethane inhalation exposure to consumer. The E1 scenario model represents a more conservative model than the E2 scenario because the E2 scenario model assumes only 25% of the mass applied is release because a substantial fraction of the mass becomes trapped in a cured substrate during the drying period ([U.S. EPA, 2017a](#)). Initial models were completed using the E1 model.

Table 11-2. Crosswalk of COU Subcategories, CEM 3.2 Scenarios, and Relevant CEM 3.2 Models Used for Consumer

Consumer COU	Subcategory COU	Product/Article	Emission Model and Exposure Pathway(s)
Adhesives and sealants	Adhesives and sealants	Epoxy plastic bonder, acrylic-based structural adhesive paste	E1, E2; P_INH2 (Zone 1)

Key parameters that control 1,1,2-trichloroethane emission rates from products in CEM 3.2 models are weight fraction of 1,1,2-trichloroethane in the formulation, duration of product use, mass of product used, and frequency of use. Any increase in these parameters results in higher exposure from product use. EPA performed low, medium and high intensity analysis that provides the distribution of MOEs with varying combinations of these parameters.

CEM 3.2 default values for key parameters for exposure modeling including product mass used, duration of use, and frequency of use were available for the products identified with 1,1,2-trichloroethane content but the CEM 3.2 defaults were not appropriate for the products modeled. The values for these parameters were based on professional judgment that incorporated information from product labels and technical specifications. EPA used CEM 3.2 default values for density within the inhalation modeling. SDS sheets were used primarily for identifying weight fraction of 1,1,2-trichloroethane in the products.

Mass of Product Used

The two products identified are primarily used for DIY home repair projects. The mass of product applied in each scenario was based on the reasonable assumption that the volume in which products are sold is adequate for the tasks they are intended. Mass of product used inputs was based on a survey of consumer available products fitting the COU description on manufacturer websites along with the information from the *Westat Survey* ([Westat Inc, 1987](#)). EPA identified a 25 mL epoxy plastic bonder

(resin) with a density of 1.037 g/cm³ which would be approximately 26 g of resin per container of product. The total mass delivered would be closer to 50g for an entire bottle of the product when accounting for the hardener. EPA modeled mass of product values at 50g for an entire bottle, 25g for half and 10 g for 20% of total product. These estimates were appropriate for both products that were identified since the other product is also found in the same density and quantities for consumer purchases.

Duration of Use

Duration of use inputs were based on a survey of consumer available products fitting the COU description on manufacturing websites along with a detailed review of the technical description for the identified products. For the products modeled, typical usage was for small scale repairs and less likely to be used over the span of hours. These products have what is considered a “working life” that ranged from 5 to 20 minutes. The working life of an adhesive amount of time a product remains at a viscosity low enough for application to a surface before curing begins. This means it would be very unlikely for the identified adhesive products to be used over an extended timeframe. The duration of use inputs for the modeled adhesive was 5, 10, and 20 minutes for the low, medium, and high use scenarios respectively.

Frequency of Use

The frequency of use input is used in the calculation of acute and chronic durations. Acute exposure frequency was modeled for 2 uses in a single day while the chronic frequency was 15 uses annually with the working life for each use being 5-20 mins. For the products and their patterns of use, it would not be appropriate to anticipate a weekly or daily use given the specific use of the identified products as structural adhesives used for fixing broken items in the house. *Westat Survey (1987)* provides reasonable use frequencies for products that fall under this COU. The median use of for similar products was 3.0 uses/year; however, the 90th percentile value was 15 uses/year which is more appropriate assumption since uses can occur more sporadically throughout the year and equate to approximately 1.25 uses/month. For the purposes of this analysis, EPA applied 2 uses/month as a reasonable estimate since 1.25 uses cannot be modeled. 15 uses/year was selected as the chronic frequency of use annually with 2 events per day being used as the acute value representing a scenario where the average monthly use occurred all in one day.

Environmental Parameters

The room of use selected for modeling affects the time occupants spend in the environment while products are actively emitting 1,1,2-trichloroethane, the total volume of air in the room, and ventilation rates. Default values are provided in CEM 3.2 for use environment and ventilation rates in each room, which may be modified by the user. As such, it is sometimes required to select an environment of use based on the activity pattern required and modify the environmental parameters to reflect conditions in the home area in which a product is expected to be used.

For the purposes of this assessment, the utility room environment was selected. This was chosen to reflect the fact that most repairs will take place in an area away from a room that is frequently occupied in the home. The CEM 3.2 default room volume and ventilation rates were used.

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Product	Exposure Scenario Level	Weight Fraction ^b	Duration of Use (min) ^d	Mass of Product Use (g) ^d	Density (g/cm ³)	Chronic Frequency of Use (year ⁻¹) ^c	Acute Frequency of Use (day ⁻¹) ^c	Use Environment; Volume (m ³) ^a	Air Exchange Rate Zone 1 and Zone 2 (h ⁻¹) ^a	Interzone Ventilation Rate (m ³ /h) ^a
Adhesives for small home repairs	L	0.0005	5	10	1.037	15	2	Utility Room; 20	0.45	108.978
	M	0.00025	10	25						
	H	0.005	20	50						
L,M, H*; low, medium, high exposure levels Weight Fractions are half of reported value on SDS due to the resin only being half of total mass of product delivered in 1:1 mix containing hardener ^a Consumer Exposure Model (CEM) default parameter ^b Parameter found from searching SDS of products containing 1,1,2-trichloroethane ^c Parmeter selected based on <i>Westat Survey</i> (Westat Inc, 1987) ^d Professional judgement based on manufacturer product specific use patterns instructions										

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Table 11-4. Low-, Medium-, and High-Intensity Analyses with Inputs

Weight Fraction	Frequency (Chronic)	Frequency (Acute)	Mass Used (Chronic)	Mass Used (Acute)
0.0005	15	2	10	10
0.0005	15	2	25	25
0.0005	15	2	50	50
0.0025	15	2	10	10
0.0025	15	2	25	25
0.0025	15	2	50	50
0.005	15	2	10	10
0.005	15	2	25	25
0.005	15	2	50	50
Low, medium, and high analysis completed for each duration of use listed in Table 11-3.				

11.1.4 Dermal Modeling Approach

This section summarizes the dermal absorption data related to 1,1,2-trichloroethane, the interpretation of the dermal absorption data, dermal absorption modeling, and uncertainties associated with dermal absorption estimation. The dermal modeling was done using the approach described below. Dermal data were sufficient to characterize consumer dermal exposures to liquid and paste products containing 1,1,2-trichloroethane. The fraction absorbed model for liquid products equation was derived from *Dermal Exposure Assessment: A Summary of EPA Approaches* ([U.S. EPA, 2007a](#)).

For dermal exposure, the acute daily dose and chronic average daily dose were calculated for age groups that are expected to be users of the products. Although, dermal exposures were modeled outside of CEM, EPA used the lifestages in CEM as a guide for life stage categorization and “inside both hands” surface area to body weight ratios. The life stages and expected users for products are defined in Table 11-5. High-end conservative values were used in Equation 11-1 as an initial screen in calculating dermal exposure doses.

Table 11-5. Dermal Lifestages and Ages

Lifestage Selected as User	Age (years)	Inside Both Hands SA/Body Weight Ratio ^a
Adult	≥21 years	6.2
Youth 2	16–20 years	5.8
Youth 1	11–15 years	6.5
^a Mean Surface Area to Body Weight Ratio (CEM default from appendices (U.S. EPA, 2023b)) Higher variance in Young Teen age group due to growth of children at these ages compared to later in the teenage years		

For the products containing 1,1,2-trichloroethane, EPA expects adults (21+ years), youth 2 (16–20 years) and youth 1 (11–15 years) to be potential users and thus the lifestages of concern with the products identified.

11.1.4.1 Modeling Inputs and Parameterization

EPA used the fractional absorption dermal model for liquid products. The fractional absorption dermal method was identified as the most appropriate for liquids as it is a finite splash-type exposure where

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there is instantaneous deposition onto the skin. The following equation (derived from *Dermal Exposure Assessment: A Summary of EPA Approaches* ([U.S. EPA, 2007a](#))) in the finite doses was used to calculate both acute and chronic doses for each applicable lifestage:

Equation 11-1. Fractional Absorption Dermal Model for Finite Doses

$$DD = \frac{Q_u \times WF \times SA \times f_{abs} \times FQ \times ED}{BW \times AT}$$

Where:

DD	=	Daily dose (mg/kg-day)
Q_u	=	Amount retained on skin (mg/cm ² -event)
WF	=	Weight fraction
f_{abs}	=	Fraction Absorbed
FQ	=	Frequency of Contact
	•	Acute: (events/day)
	•	Chronic: (events/year)
		ED = Exposure Duration
	•	Acute: (1 day)
	•	Chronic: (1 year)
		SA = Surface Area of Contact (cm ²)
		BW = Body Weight (kg)
		AT = Averaging Time
	•	Acute: (1 day)
	•	Chronic: (365 days)

To calculate Q_u :

Equation 11-2. Amount Retained on Skin Equation

$$Q_u = FT \times \rho \times (1 - \text{FracRemove}) \times CF_1$$

Where:

Q_u	=	Amount Retained on Skin (mg/cm ² -event)
FT	=	Film thickness (cm)
ρ	=	Density of formulation (g/cm ³)
FracRemove	=	Fraction of product removed by washing or wearing (unitless)
CF_1	=	Conversion factor (1,000 mg/g)

The Q_u is the amount of chemical retained on the skin. For consumer products, the Q_u is a conservative estimate as it assumes that the consumer is not wiping or removing any of the product when it encounters the skin. Therefore, the fraction removed is 0. The amount of product that is retained on the skin is the product of the film thickness of the liquid on the skin's surface and the density of the formulation.

The film thickness refers to the thickness of the layer of product remaining on the skin after use. Table B-3 of the *CEM User Guide Appendices* ([U.S. EPA, 2023b](#)) provides film thickness for various products. EPA selected the value of 0.00499 cm as the film thickness because this value represented a value identified as the appropriate film thickness for (glues and adhesives) corresponding to the products identified. For dermal modeling, the highest weight fraction was used in the model as a screening value.

The frequency of skin contact is dependent on the frequency of use of the product, and is the same value listed for inhalation in Table 11-3 as the frequency of use. The mean “inside both hands” value for surface area of skin contact with product was determined to represent a conservative estimate of impacted surface area to body weight for each lifestage modeled. EPA used this surface area to represent a conservative scenario for screening purposes to ensure potential high-end exposures are not missed.

The fraction absorbed value is from a high-quality guideline OECD 428 *in vitro* dermal absorption study utilizing human skin indicated a dermal absorption range of 0.5 to 1.0 % for 10 % 1,1,2- trichloroethane solution in 1,2-dichloroethane as the vehicle and neat 1,1,2-trichloroethane, respectively ([Labcorp Early Development, 2023](#)). EPA used 1.0 % for the fraction absorbed in the initial screening calculation to represent a conservative estimate.

Table 11-6. Dermal Inputs for Fractional Absorption Model

Product	Film Thickness (cm) ^a	Density (ρ) g/cm ³ ^b	Amount retained on skin (Qu) (mg/cm ² -event)	Weight Fraction ^b	Fraction Absorbed (f_{abs}) ^c
Adhesives for small home repairs	0.00499	1.037 g/cm ³	5.17	0.005	0.01
Weight Fractions are half of reported value on safety data sheet (SDS) because the resin only accounts for half of total mass of product delivered in 1:1 mix containing hardener					
^a Consumer Exposure Model (CEM) default parameter from appendices					
^b Parameter found from searching SDS of products containing 1,1,2-trichloroethane					
^c Parameter selected from systematic review (Labcorp Early Development, 2023)					

11.1.5 Evidence Integration for Consumer Exposure

EPA did not identify any monitoring data from systematic review that was relevant to modeling consumer products possibly emitting 1,1,2-trichloroethane from use. The modeling was based on the best available information found from product manufacturers and product reviews to help build the parameters included in the consumer exposure scenarios modeled.

11.2 Inhalation Exposure Assessment

This section summarizes 1-hour and 3-hour time-weighted average (TWA) concentrations calculated (Table 11-7) by CEM and used to estimate inhalation exposure to 1,1,2-trichloroethane in consumer products. Exposure via the inhalation route occurs during inhalation of vapor emissions of 1,1,2-trichloroethane. The lifestages (Adult: 21+ years, Youth 2:16-20 years, Youth 1:11-15 years) identified in Section 11.1.3 were assessed for resulting exposure concentrations from using products containing 1,1,2-trichloroethane. Supplemental file containing CEM Model Results ([U.S. EPA, 2026e](#)) summarizes in full the complete results from the low, medium, and high analyses completed at each duration of use for the lifestages of interest. EPA only modeled one product scenario in CEM with variability among weight fractions, duration of use, and mass of products used. The inhalation assessment conducted did not include bystander calculations but only user concentrations because by using exposure concentrations to the user as the deterministic value for risk, representing a health protective risk value to the bystander. The exact values for these parameters were discussed in Section 11.1.3.1.

The inhalation exposure from products containing 1,1,2-trichloroethane stays near constant for each lifestage across use duration with more variance within the duration of use, meaning the mass of product used and weight fraction were the driving forces behind increases in exposure concentrations rather than duration of use. The 1-hour TWA and 3-hour TWA concentrations from the use of epoxy plastic bonder and acrylic-base structural adhesive remains constant across duration of use for each lifestage modeled.

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The 1-hour and 3-hour TWA were used as more appropriate exposure concentrations because the hazard values were based on a 4-hour study ([WIL Research, 2001](#)). EPA did find preliminary concentrations that resulted in MOEs below the benchmark at the 1-hour and 3-hour TWA with the 3-hour TWA being a more reasonable estimate given the time needed to experience some effects of exposure ([WIL Research, 2001](#)). At each duration there were a total of 9 scenarios modeled to calculate a range of MOEs that could show the impacts of the weight fraction and mass of product used and how the exposure concentrations changed as a result. There was no chronic inhalation MOEs below benchmark with this scenario. There was no further refinement for the chronic values because the E1 model did not result in MOEs below the benchmark. There was further refinement done using the E2 model in CEM to determine whether the acute MOEs would be below the benchmark for the high intensity scenarios.

EPA further assessed inhalation exposures using the E2 model for the high intensity scenarios that resulted in acute exposure concentrations below the benchmark. It is reasonable to assume that this model would provide a more refined estimate of inhalation exposure concentrations due to the E2 model assuming only 25% of the mass applied is release because a substantial fraction of the mass becomes trapped in a cured substrate during the drying period ([U.S. EPA, 2017a](#)). Given the products identified containing 1,1,2-trichloroethane are adhesive products with quick curing time, it is appropriate to apply a second model for the high-end scenario to assess whether the MOEs would remain below the benchmark with this model. The concentrations modeled with the E2 model did not result in MOEs below the benchmark for the high intensity scenarios that were previously identified in the E1 model. Both modeled scenarios will be presented in the *Draft Risk Evaluation for 1,1,2-Trichloroethane* ([U.S. EPA, 2026r](#)), serving as the final refinement for chronic and acute inhalation concentrations respectively.

Table 11-7. 1-Hour TWA and 3-Hour TWA Exposure Concentrations

Scenario	Duration of Use (minutes)	Lifestage	1-Hour TWA Concentration Range (mg/m ³) ^a	3-Hour TWA Concentration Range (mg/m ³) ^a
Epoxy plastic bonder (adhesives and sealants small scale)	5	Adult (21+ years)	4.7E-02 to 2.4	1.9E-02 to 0.94
		Youth 2 (16–20 years)		
		Youth 1 (11–15 years)		
	10	Adult (21+ years)	4.7E-02 to 2.4	1.9E-02 to 0.93
		Youth 2 (16–20 years)		
		Youth 1 (11–15 years)		
	20	Adult (21+ years)	4.6E-02 to 2.3	1.9E-02 to 0.93
		Youth 2 (16–20 years)		
		Youth 1 (11–15 years)		
HEC = human equivalent concentration; TWA = time-weighted average All lifestages of interest exposure concentrations are the same Acute continuous HEC hazard value of 6.1 mg/m ³ Using Haber’s Rule, acute HEC at 1-hour timeframe would be 146.4 mg/m ³ and 48.8 mg/m ³ for 3-hr timeframe ^a Range provided to reflect parameter value changes for weight fraction and mass of product used at each duration. (9 scenarios modeled per duration of use value)				

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Table 11-8. E2 Model Inhalation Concentration for High Intensity Scenario^a

Scenario	Lifestage	Duration of Use	1-Hour TWA concentration (mg/m ³)	3-Hour TWA concentration (mg/m ³)
Epoxy plastic bonder (adhesives and sealants small scale)	Adult (21+)	5	6.0E-02	2.4E-02
		10	5.9E-02	2.3E-02
		20	5.8E-02	2.3E-02

Table 11-9. Chronic Non-Cancer Concentrations

Scenario	Duration of Use (minutes)	CEM Chronic ADC Range (mg/m ³) ^{a b}
Epoxy plastic bonder (adhesives and sealants small scale)	5	1.1E-08 to 5.8E-07
	10	2.3E-08 to 1.2E-06
	20	4.5E-08 to 2.3E-06
ADC = potential average daily concentration; CEM = Consumer Exposure Model; HEC = human equivalent concentration. All lifestages of interest exposure concentrations are the same Range provided to reflect parameter value changes for weight fraction and mass of product used at each duration. Nine scenarios modeled per duration ^a Used to calculate MOE given the chronic HEC chronic hazard value of 0.62 mg/m ³ ^b Calculated using 1-year as the chronic timeframe		

11.3 Dermal Exposure Assessment

This section summarizes dose estimates from dermal exposure to 1,1,2-trichloroethane in consumer products. Exposure via the dermal route occurs during direct contact with the adhesive during application. Dermal exposure calculations were all calculated outside of CEM for the same lifestages presented in Section 11.2. EPA did not identify any doses resulting in preliminary MOEs below the benchmark that would require further refinement.

Table 11-10. Dermal Acute and Chronic Dose

Scenario	Lifestage	Acute Dermal Dose Rate (mg/kg/day)	Chronic Dermal Dose Rate (mg/kg/day)
Epoxy plastic bonder (adhesives and sealants small scale)	Adult (21+ years)	3.2E-03	6.6E-05
	Youth 2 (16-20 years)	3.0E-03	6.2E-05

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Scenario	Lifestage	Acute Dermal Dose Rate (mg/kg/day)	Chronic Dermal Dose Rate (mg/kg/day)
	Youth 1 (11-15 years)	3.3E-03	6.7E-05

11.4 Oral Exposure Assessment

EPA did not assess oral ingestion for 1,1,2-trichloroethane. The patterns of use for the products identified to be 1,1,2-trichloroethane containing products do not support such a pathway. There was no reasonable pattern of use that would have suggested ingestion as a viable exposure pathway given the products.

11.5 Weight of Scientific Evidence Conclusions for Consumer Exposure Assessment

EPA evaluated all reasonably available information to assist with the parameterization of the inhalation and dermal models to assess consumer exposures from products containing 1,1,2-trichloroethane. This section describes the sources of uncertainty and variability, the strengths and weaknesses, and the overall confidence in the modeled consumer inhalation and dermal assessment. Variability refers to the inherent heterogeneity or diversity of data in an assessment. It is a description of the range or spread of a set of values. For this assessment the main sources of variability were the weight fractions and product patterns of use. Concentrations, weight fractions, of 1,1,2-trichloroethane from the product SDSs were reported as a range. There is also variability in the duration of use of a product. Variability cannot be reduced, however; it can be characterized. Uncertainty refers to lack of data or incomplete understanding of the context of the risk evaluation. Uncertainty can be reduced by collecting more and better data. Uncertainty is addressed qualitatively by including a discussion on factors such as data gaps and subjective decisions or instances where professional judgement was used.

The exposure assessment of chemicals from products or articles has inherent challenges due to many sources of uncertainty in the analysis, including variations in product formulation, patterns of consumer use, frequency of use, and duration of use. For this assessment, EPA was able to find relevant information needed on all parameters of interests thus limiting the uncertainty in the modeling completed. EPA has robust confidence in the modeling done for this consumer assessment. The supporting weight of scientific evidence outweighs the uncertainties to the point where it is unlikely that the uncertainties could have a significant effect on the exposure estimates. The low, medium, and high intensity analyses allows for a range of MOEs to show variances that could exist in use patterns. A summary of the strengths, limitations, and assumptions of the assessment are presented below.

11.5.1 Strengths, Limitations, Assumptions, and Key Sources of Uncertainty for the Consumer Exposure Assessment

EPA identified the adhesives/sealants as the only consumer COU relating to the products identified containing 1,1,2-trichloroethane. There were two products identified under this COU with the same function and pattern of use. Since the products were used in similar fashion and had the same weight fraction ranges, only one scenario was created in CEM to model this COU. Overall, EPA has robust confidence in the consumer exposure assessment.

Product Formulation and Composition

Variability in the formulation of consumer products, including changes in ingredients, concentrations, and chemical forms can introduce uncertainty in exposure assessments. EPA reduced uncertainty by using reported concentrations from product specific SDS. EPA obtained 1,1,2-trichloroethane weight

fractions in various products from material safety data sheets. EPA obtained multiple values for weight fractions for similar products. The identified products provided a range for the weight fraction, so the lowest value was used in the low exposure scenario, the highest value in the high exposure scenario, and the average of these two used in the medium exposure scenario. EPA decreased uncertainty in exposure and subsequent risk estimates in the high, medium, and low intensity exposure scenarios by capturing the weight fraction variability.

Product Use Patterns

Consumer use patterns such as frequency of use, duration of use, and methods of application are expected to differ. CEM Version 3.2 has prepopulated high, medium and low values for these parameters. In this assessment, the prepopulated values were not appropriate based on the use patterns identified for the products. EPA used the *Westat Survey* ([Westat Inc, 1987](#)) to provide better estimates for the frequency of use for consumers of the products given the COU these products were assigned. The duration of use was based manufacturer's product descriptions that identified the applicable "working life" of these products. EPA decreased uncertainty by selecting use patterns that represent product use descriptions and further captured the range of use patterns in the high, medium and low scenarios.

CEM

The modeling tool to assess inhalation exposure was CEM. CEM has been peer-reviewed and is publicly available. CEM has been applied in a manner intended by estimating exposures associated with uses of household products. The model also explicitly identifies the sources of default value such as building room volumes, interzonal ventilation rates, and air exchange rates. The environmental parameters chosen for the scenario were based on where the product is most likely to be used given its intended uses. Many of the parameters used in dermal modeling were identified given defaults from the *CEM Appendices* as inputs for the excel spreadsheet used to calculate dermal exposure. The fraction absorbed value used in the Equation 11-1 (Section 11.3) was obtained during systematic review from a high rated study ([Labcorp Early Development, 2023](#)). The weight fractions used were from the SDS of the products identified while all other parameters were CEM defaults appropriate for products that were identified under the adhesive and sealants product category.

EPA has robust confidence in the inhalation concentrations modeled can be used to determine risk to humans at various life stages. EPA acknowledges the refinement done using the E2 presents a more representative model for the high intensity scenarios to confirm whether the MOEs were below benchmark. This model more closely aligns with the products described due to their curing times. The E1 model is a more conservative model that can help with confirming whether an MOE is above benchmark but further refinement with the E2 model is more representative if there are MOEs below benchmark with the E1.

Similarly, all related dermal doses have moderate to robust confidence and can be used to determine dermal risk to humans at the lifestages of concern. EPA does acknowledge that the approaches used rely on conservative assumptions that represent an upper bound value for the high intensity use exposure scenario but still possible since the weight fractions and mass used are based solely on information obtained from the products. This ensures results are health protective and examines the most intense usage. EPA has robust confidence when using these estimated concentrations and doses to derive risk estimates and inform risk determination that the estimates are protective of consumers.

9610 **REFERENCES**

- 9611 Arnold, F; Engel, AJ. (2001). Evaporation of pure liquids from open surfaces. In JBHJ Linders (Ed.),
9612 Modelling of Environmental Chemical Exposure and Risk (pp. 61-71). The Netherlands: Kluwer
9613 Academic Publishers. https://dx.doi.org/10.1007/978-94-010-0884-6_6
- 9614 Arnot, J; Gobas, F. (2006). A review of bioconcentration factor (BCF) and bioaccumulation factor
9615 (BAF) assessments for organic chemicals in aquatic organisms. Environ Rev 14: 257-297.
9616 <https://dx.doi.org/10.1139/A06-005>
- 9617 Baldwin, PE; Maynard, AD. (1998). A survey of wind speed in indoor workplaces. Ann Occup Hyg 42:
9618 303-313. [https://dx.doi.org/10.1016/S0003-4878\(98\)00031-3](https://dx.doi.org/10.1016/S0003-4878(98)00031-3)
- 9619 Barsan, ME. (1991). Health Hazard Evaluation Report No. HETA-90-344-2159, A.W. Cash Valve
9620 Manufacturing Corporation, Decatur, Illinois. Cincinnati, OH: National Institute for
9621 Occupational Safety and Health.
- 9622 Bhattacharya, SK; Madura, RL; Dobbs, RA; Angara, RVR; Tabak, H. (1996). Fate of selected RCRA
9623 compounds in a pilot-scale activated sludge system. Water Environ Res 68: 260-269.
9624 <https://dx.doi.org/10.2175/106143096X127695>
- 9625 BLS. (2018). 2018 Standard Occupational Classification Definitions [Website].
9626 <https://www.bls.gov/soc/2018/home.htm>
- 9627 BLS. (2023). May 2023 Occupational Employment and Wage Estimates: National industry-specific
9628 estimates. Washington, DC. <https://www.bls.gov/oes/tables.htm>
- 9629 CEB. (1991). Chemical Engineering Branch manual for the preparation of engineering assessments:
9630 Volume I. CEB engineering manual. Washington, DC: Office of Pollution Prevention and
9631 Toxics, US Environmental Protection Agency.
9632 <https://nepis.epa.gov/Exe/ZyPURL.cgi?Dockey=P10000VS.txt>
- 9633 Chen, C; Puhakka, JA; Ferguson, JF. (1996). Transformations of 1,1,2,2-tetrachloroethane under
9634 methanogenic conditions. Environ Sci Technol 30: 542-547.
9635 <https://dx.doi.org/10.1021/es9502987>
- 9636 Christensen, TH; Kjeldsen, P; Bjerg, PL; Jensen, DL; Christensen, JB; Baun, A; Albrechtsen, HJ;
9637 Heron, G. (2001). Biogeochemistry of landfill leachate plumes. Appl Geochem 16: 659-718.
9638 [https://dx.doi.org/10.1016/S0883-2927\(00\)00082-2](https://dx.doi.org/10.1016/S0883-2927(00)00082-2)
- 9639 Chrostek, WJ, : Levine, M. S. (1981). Health hazard evaluation report no. HHE 30-153-881, Palmer
9640 Industrial Coatings Incorp., Williamsport, Pennsylvania. (HHE 30-153-881). Cincinnati, OH:
9641 National Institute for Occupational Safety and Health.
- 9642 Daniels, WJ; Orris, P; Kramkowski, R; Almaguer, D. (1988). Health Hazard Evaluation Report No.
9643 HETA-86-121-1923, Modern Plating Corporation, Freeport, Illinois. Cincinnati, OH: National
9644 Institute for Occupational Safety and Health.
- 9645 Descartes. (2018). Descartes Datamyne (Version 3.0). Miami, FL. Retrieved from
9646 <https://www.datamyne.com/>
- 9647 Descartes Datamyne. (2025). 1,1,2 Trichloroethane Import Query 2019–2025. Available online
- 9648 Dow Chemical. (1988). Mortality among Dow Chemical employees of a Texas operations per-tet
9649 manufacturing plant with cover letter dated 050389 [TSCA Submission]. (OTS0516752. 86-
9650 890000215. TSCATS/311616).
9651 <https://ntrl.ntis.gov/NTRL/dashboard/searchResults/titleDetail/OTS0516752.xhtml>
- 9652 Dreher, EL; Beutel, KK; Myers, JD; Lübbe, T; Krieger, S; Pottenger, LH. (2014). Chloroethanes and
9653 chloroethylenes. In B Elvers (Ed.), Ullmann's encyclopedia of industrial chemistry (6th ed., pp.
9654 1-81). Hoboken, NJ: Wiley-VCH Verlag GmbH & Co.
9655 https://dx.doi.org/10.1002/14356007.o06_o01.pub2
- 9656 Earthjustice. (2019). Comment submitted by Eve C. Gartner, Staff Attorney, Earthjustice regarding
9657 1,1,2-trichloroethane. EPA Docket ID: EPA-HQ-OPPT-2018-0421-0013. Gartner, E.C.
9658 <https://www.regulations.gov/document?D=EPA-HQ-OPPT-2018-0421-0013>

- Elsevier. (2019). Reaxys: physical-chemical property data for 1,1,2-trichloroethane. CAS Registry Number: 79-00-5. Available online
- Enzminger, JD. (1988) Anaerobic reductive dechlorination of C2 hydrocarbons in batch and fixed-film bioreactors. (Doctoral Dissertation). Rutgers University, New Brunswick, NJ.
- ETC. (2018). High Temperature Incineration. Available online at <http://etc.org/advanced-technologies/high-temperature-incineration.aspx>.
- Fehrenbacher, MC; Hummel, AA. (1996). Evaluation of the Mass Balance Model Used by the EPA for Estimating Inhalation Exposure to New Chemical Substances. Am Ind Hyg Assoc J 57: 526-536.
- Fishbein, L. (1979). Potential halogenated industrial carcinogenic and mutagenic chemicals. I. Halogenated unsaturated hydrocarbons [Review]. Sci Total Environ 11: 111-161. [https://dx.doi.org/10.1016/0048-9697\(79\)90025-1](https://dx.doi.org/10.1016/0048-9697(79)90025-1)
- Fitzsimmons, PN; Fernandez, JD; Hoffman, AD; Butterworth, BC; Nichols, JW. (2001). Branchial elimination of superhydrophobic organic compounds by rainbow trout (*Oncorhynchus mykiss*). Aquat Toxicol 55: 23-34. [https://dx.doi.org/10.1016/S0166-445X\(01\)00174-6](https://dx.doi.org/10.1016/S0166-445X(01)00174-6)
- Frasch, HF; Dotson, GS; Bunge, AL; Chen, C; Cherrie, JW; Kasting, GB; Kissel, JC; Sahmel, J; Semple, S; Wilkinson, S. (2014). Analysis of finite dose dermal absorption data: Implications for dermal exposure assessment. J Expo Sci Environ Epidemiol 24: 65-73. <https://dx.doi.org/10.1038/jes.2013.23>
- Gan, DR; Dupont, RR. (1989). Multiphase and multicomponent measurements of batch equilibrium distribution coefficients for six volatile organic compounds. Hazardous Waste and Hazardous Materials 6: 363-384. <https://dx.doi.org/10.1089/hwm.1989.6.363>
- Gilles, D; Anania, TL; Ilka, R. (1977). Health hazard evaluation report no. HHE 77-12-418, Airtex Products, Fairfield, Illinois. (HHE 77-12-418). Cincinnati, OH: National Institute for Occupational Safety and Health.
- Gorilla Glue Company. (2018). Safety data sheet-Gorilla Weld-Resing. rilla Glue Company; Gorilla Glue Company. <https://www.gorillatough.com/wp-content/uploads/Gorilla-Weld-Resin-v1.2.pdf>
- Gorilla Glue Company. (2020). GorillaWeld. Gorilla Glue Company. <https://www.gorillatough.com/product/gorillaweld/>
- Greenberg, M; Anderson, R; Keene, J; Kennedy, A; Page, GW; Schowgurow, S. (1982). Empirical test of the association between gross contamination of wells with toxic substances and surrounding land use. Environ Sci Technol 16: 14-19.
- Harkov, R; Gianti, SJ; Bozzelli, JW; Laregina, JE. (1985). Monitoring volatile organic compounds at hazardous and sanitary landfills in New Jersey. J Environ Sci Health A Environ Sci Eng 20: 491-502. <https://dx.doi.org/10.1080/10934528509375237>
- Heritage. (2018). Heritage website. Retrieved from <https://www.heritage-enviro.com/services/incineration/>
- Hunkeler, D; Aravena, R; Cox, E. (2002). Carbon isotopes as a tool to evaluate the origin and fate of vinyl chloride: Laboratory experiments and modeling of isotope evolution. Environ Sci Technol 36: 3378-3384. <https://dx.doi.org/10.1021/es011479d>
- Huntsman. (2018). Safety Data Sheet: Araldite 2021 A US. (SDS Number 400001010259). Huntsman Advanced Materials Americas LLC.
- Jeffers, PM; Ward, LM; Woytowitch, LM; Wolfe, NL. (1989). Homogeneous hydrolysis rate constants for selected chlorinated methanes, ethanes, ethenes, and propanes. Environ Sci Technol 23: 965-969. <https://dx.doi.org/10.1021/es00066a006>
- Kitto, JB; Stultz, SC. (1992). Steam: Its generation and use (40th ed.). Barberton, OH: Babcock & Wilcox.
- Labcorp Early Development. (2023). 1,1,2-Trichloroethane: Rates of penetration through human skin using a flow through *in vitro* system (Amended final report 1). (8479196). San Francisco, CA: Stantec ChemRisk, Vinyl Institute 1,1,2-Trichloroethane Test Order Consortium.

- Lewis, FA. (1980). Health hazard evaluation report no. HHE 80-87-708, Harowe Servo Contorls Inc., West Chester, Pennsylvania. (HHE 80-87-708). Cincinnati, OH: National Institute for Occupational Safety and Health.
- Liss, PS; Slater, PG. (1974). Flux of gases across the air-sea interface. *Nature* 247: 181-184.
<https://dx.doi.org/10.1038/247181a0>
- lsworth Adhesives; LLC, E. (2011). Safety Data Sheet: Electrón. Available online at <http://eximtradingusa.com/downloads/RefrigerationLubrications/electron.pdf>
- Mackay, D; Di Guardo, A; Paterson, S; Kicsi, G; Cowan, CE; Kane, DM. (1996). Assessment of chemical fate in the environment using evaluative, regional and local-scale models: Illustrative application to chlorobenzene and linear alkylbenzene sulfonates. *Environ Toxicol Chem* 15: 1638-1648.
- Matheson Tri-Gas. (2017). Safety Data Sheet: 1,1,2-Trichloroethane. Matheson Tri-Gas.
- Miller, B. (2019). Comment submitted by Bob Miller, Jr., Senior Director, Global Product Stewardship, Albemarle Corporation regarding 1-Bromopropane. Docket ID: EPA-HQ-OPPT-2019-0235-0029. (Docket ID: EPA-HQ-OPPT-2019-0235-0029). Miller, B.
<https://www.regulations.gov/document?D=EPA-HQ-OPPT-2019-0235-0029>
- Monsanto. (1987). Monsanto Pensacola plant ground water assessment feasibility study with 19 chemicals with attachments and cover letter dated 121887 [TSCA Submission] (pp. #86-880000091). (EPA/OTS Doc #86-880000091). St. Louis, MO.
<https://ntrl.ntis.gov/NTRL/dashboard/searchResults/titleDetail/OTS0513980.xhtml>
- Mueller, M; Klein, W. (1992). Comparative evaluation of methods predicting water solubility for organic compounds. *Chemosphere* 25: 769-782. [https://dx.doi.org/10.1016/0045-6535\(92\)90067-2](https://dx.doi.org/10.1016/0045-6535(92)90067-2)
- NCASI. (2008). NCASI Handbook of Environmental Regulations and Control, Volume I: Pulp and paper manufacturing. Cary, NC: National Council for Air and Stream Improvement.
- NCBI. (2020a). PubChem Compound Summary for CID 6574, 1,1,2-Trichloroethane.
- NCBI. (2020b). PubChem database: compound summary: 1,1,2-trichloroethane. Available online at https://pubchem.ncbi.nlm.nih.gov/compound/1_1_2-Trichloroethane
- NIOSH. (1973). Health Hazard Evaluation report no. HHE 72-84-31, Dunham-Bush, Incorporated, West Hartford, Connecticut, Part 2. (HHE 72-84-31). Washington, DC: U.S. Department of Health and Human Services.
- NIOSH. (1982). Health hazard evaluation report: HETA-82-040-1119. Synthes Ltd. (USA), Monument, Colorado (pp. 1-10). (NIOSH/00127593). Cincinnati, OH.
<https://www.cdc.gov/niosh/hhe/reports/pdfs/82-40-1119.pdf>
- NIOSH. (1984). Health hazard evaluation report no. HETA 82-075-1545, Pratt & Whitney Aircraft, West Palm Beach, Florida (pp. 1-49). (HETA 82-075-1545). Cincinnati, OH.
<https://www.cdc.gov/niosh/hhe/reports/pdfs/82-75-1545.pdf>
- NIOSH. (2002a). In-depth survey report: control of perchloroethylene (PCE) in vapor degreasing operations, site #1. (EPHB 256-19b). Cincinnati, Ohio: National Institute for Occupational Safety and Health (NIOSH).
- NIOSH. (2002b). In-depth survey report: Control of perchloroethylene (PCE) in vapor degreasing operations, site #2. (EPHB 256-16b). CDC. <https://www.cdc.gov/niosh/surveyreports/pdfs/256-16b.pdf>
- NIOSH. (2002c). In-depth survey report: control of perchloroethylene (PCE) in vapor degreasing operations, site #4. (EPHB 256-18b). Cincinnati, Ohio: National Institute for Occupational Safety and Health (NIOSH).
- NIOSH. (2002d). In-depth survey report: Control of perchloroethylene exposure (PCE) in vapor degreasing operations, site #3. (EPHB 256-17b). CDC.
<https://www.cdc.gov/niosh/surveyreports/pdfs/ECTB-256-17b.pdf>

- NIOSH. (2007). NIOSH pocket guide to chemical hazards. (DHHS Publication No. (NIOSH) 2005-149; CBRNIAC-CB-112149). Cincinnati, OH. <http://www.cdc.gov/niosh/docs/2005-149/>
- NIST. (2022). NIST Chemistry WebBook. Ethane, 1,1,2-trichloro- (79-00-5). Standard Reference Database No. 69. Washington, DC: US Sec Commerce. <https://webbook.nist.gov/cgi/cbook.cgi?ID=79-00-5&Units=SI&cTG=on&cIR=on&cTC=on&cTZ=on&cTP=on&cMS=on&cTR=on&cUV=on&cIE=on&cGC=on&cIC=on&cES=on&cDI=on&cSO=on>
- NLM. (2018). Hazardous substance data bank: 1,1,2-trichloroethane, 79-00-5. Bethesda, MD. <https://pubchem.ncbi.nlm.nih.gov/compound/6574#source=HSDB>
- O'Neil, MJ. (2013). 1,1,2-Trichloroethane. 79-00-5. In MJ O'Neil; PE Heckelman; PH Dobbelaar; KJ Roman; CM Kenney; LS Karaffa (Eds.), The Merck index (15th ed., pp. 1786). Cambridge, UK: Royal Society of Chemistry.
- OECD. (2000). SIDS initial assessment profile: 1,1,2-Trichloroethane, CAS No.: 79-00-5 [OECD SIDS]. Paris, France. <http://www.inchem.org/documents/sids/sids/79005.pdf>
- OECD. (2009a). Emission scenario document on adhesive formulation. (ENV/JM/MONO(2009)3; JT03263583). Paris, France. [http://www.oecd.org/officialdocuments/publicdisplaydocumentpdf/?cote=env/jm/mono\(2009\)3&doclanguage=en](http://www.oecd.org/officialdocuments/publicdisplaydocumentpdf/?cote=env/jm/mono(2009)3&doclanguage=en)
- OECD. (2009b). Emission scenario document on transport and storage of chemicals. Paris, France. [http://www.oecd.org/officialdocuments/publicdisplaydocumentpdf/?cote=env/jm/mono\(2009\)26&doclanguage=en](http://www.oecd.org/officialdocuments/publicdisplaydocumentpdf/?cote=env/jm/mono(2009)26&doclanguage=en)
- OECD. (2015). Emission scenario document on use of adhesives. (Number 34). Paris, France. [http://www.oecd.org/officialdocuments/publicdisplaydocumentpdf/?cote=ENV/JM/MONO\(2015\)4&doclanguage=en](http://www.oecd.org/officialdocuments/publicdisplaydocumentpdf/?cote=ENV/JM/MONO(2015)4&doclanguage=en)
- OECD. (2021). Emission scenario document on the use of vapour degreasers. (ENV/CBC/MONO(2021)40). Paris, France.
- OECD. (2022). No. 156: Guidance notes on dermal absorption studies (Second edition). (ENV/JM/MONO(2011)36/REV1). Paris, France: Organisation for Economic Co-operation and Development (OECD). [https://one.oecd.org/document/ENV/JM/MONO\(2011\)36/REV1/en/pdf](https://one.oecd.org/document/ENV/JM/MONO(2011)36/REV1/en/pdf)
- OEHHA. (2011). Appendix B: Chemical-specific summaries of the information used to derive unit risk and cancer potency values. California: California Environmental Protection Agency, Office of Environmental Health Hazard Assessment, Air Toxicology and Epidemiology Branch. <https://oehha.ca.gov/media/downloads/crn/appendixb.pdf>
- OSHA. (2013). 1-Bromopropane, Inspection/Case File Summary.
- OSHA. (2017). Chemical Exposure Health Data (CEHD) provided by OSHA to EPA. Washington, DC: Occupational Safety and Health Administration.
- OSHA. (2019). OSHA CEHD Monitoring Data provided by OSHA to EPA on 2/12/2019 (Version 1-BP sanitized OIS 1-24-2019.xlsx).
- Padilla, LE; Peters, DR; Mohr, EJ; Alvarez, RA. (2024). Ambient Measurements of Hazardous Air Pollutants in the United States Routinely Exceed Predictions from Screening-Level Exposure Models. Environ Sci Technol Lett 12. <https://dx.doi.org/10.1021/acs.estlett.4c00917>
- Page, GW. (1981). Comparison of groundwater and surface water for patterns and levels of contamination by toxic substances. Environ Sci Technol 15: 1475-1481. <https://dx.doi.org/10.1021/es00094a008>
- Partsmaster Inc. (2013). Safety Data Sheet: Dyna-Brake. Available online at <https://pass.partsmaster.com/MSDS/6228.pdf>
- PEI Associates. (1988). Releases during cleaning of equipment. Washington, DC: U.S. Environmental Protection Agency, Office of Pesticides and Toxic Substances.

https://ofmpub.epa.gov/apex/guideme_ext/guideme/file/releases%20during%20cleaning%20of%20equipment.pdf

- Phenova. (2018). Safety data sheet: 601 Purgable Halocarbons Mix. Version 1.0 Date of issue: 02/06/2018. Phenova.
- Poole, SK; Poole, CF. (1999). Chromatographic models for the sorption of neutral organic compounds by soil from water and air. J Chromatogr A 845: 381-400. [https://dx.doi.org/10.1016/S0021-9673\(98\)01085-1](https://dx.doi.org/10.1016/S0021-9673(98)01085-1)
- Rathbun, RE. (1998). Transport, behavior, and fate of volatile organic compounds in streams. Rathbun, RE.
- Reh, CM; Nemhauser, JB. (2001). Health Hazard Evaluation Report: HETA 2000-0233-2845, Trilithic, Inc. Indianapolis, Indiana. (NTIS/02937573_a). Organisation for Economic Cooperation and Development (OECD).
- RIVM. (2007). Ecotoxicologically based environmental risk limits for several volatile aliphatic hydrocarbons (pp. 217). (601782002/2007). Bilthoven, Netherlands: National Institute for Public Health and the Environment (RIVM). <https://www.rivm.nl/bibliotheek/rapporten/601782002.pdf>
- Rosensteel, RE; Lucas, JB. (1975). Health hazard evaluation report no. HHE 74-28-212, Westinghouse Air Brake Company, Wilmerding, Pennsylvania. (HHE 74-28-212). Cincinnati, OH: National Institute for Occupational Safety and Health.
- Ruhe, RL; Watanabe, A; Stein, G. (1981). Health hazard evaluation report no. HHE 80-49-808, Superior Tube Company, Collegeville, Pennsylvania. (HHE 80-49-808). Cincinnati, OH: National Institute for Occupational Safety and Health. <https://www.cdc.gov/niosh/hhe/reports/pdfs/80-49-808.pdf>
- Rumble, JR. (2018a). 1,1,2-Trichloroethane. In CRC handbook of chemistry and physics. Boca Raton, FL: CRC Press. Taylor & Francis Group.
- Rumble, JR. (2018b). Aqueous solubility and Henry's law constants of organic compounds. In CRC Handbook of Chemistry and Physics (99 ed.). Boca Raton, FL: CRC Press. Taylor & Francis Group. https://hcbp.chemnetbase.com/faces/documents/05_32/05_32_0001.xhtml
- Rumble, JR. (2018c). Flammability of chemical substances. In CRC Handbook of Chemistry and Physics (99 ed.). Boca Raton, FL: CRC Press. Taylor & Francis Group.
- Rumble, JR. (2021). CRC Handbook of Chemistry and Physics Online (Version 102nd Edition (Internet Version 2021)) [Database]. Boca Raton, FL: CRC Press/Taylor & Francis. Retrieved from https://hcbp.chemnetbase.com/faces/documents/02_07/02_07_0001.xhtml
- SAB. (2007). Science Advisory Board (SAB) review of the Estimation Programs Interface Suite (EPI Suite). (EPA-SAB-07-11). Washington, DC: U.S. Environmental Protection Agency.
- Sabel, GV; Clark, TP. (1984). Volatile organic compounds as indicators of municipal solid waste leachate contamination. Waste Manag Res 2: 119-130. [https://dx.doi.org/10.1016/0734-242X\(84\)90135-6](https://dx.doi.org/10.1016/0734-242X(84)90135-6)
- Santa Cruz Biotechnology. (2019). Safety Data Sheet (SDS): 1,1,2-Trichloroethane. Dallas, TX.
- Sathyanarayana, B; Ranjithkumar, B; Jyostna, TS; Satyanarayana, N. (2007). Densities and viscosities of binary liquid mixtures of N-methylacetamide with some chloroethanes and chloroethenes at T=308.15 K. J Chem Thermodyn 39: 16-21. <https://dx.doi.org/10.1016/j.jct.2006.06.009>
- SC&A. (2025). The HEM User's Guide Version 5.0: Instructions for using the Human Exposure Model for single and multiple facility exposure and risk modeling. Research Triangle Park, NC: Air Toxics Assessment Group, U.S. Environmental Protection Agency. <https://www.epa.gov/system/files/documents/2025-05/hem5.0-users-guide.pdf>
- Seip, H; Alstad, J; Carlberg, G; Martinsen, K; Skaane, R. (1986). Measurement of mobility of organic compounds in soils. Sci Total Environ 50: 87-101. [https://dx.doi.org/10.1016/0048-9697\(86\)90353-0](https://dx.doi.org/10.1016/0048-9697(86)90353-0)

- Seitz, T; Driscoll, R. (1989). Health Hazard Evaluation Report No. HETA-88-082-1971, Jostens Incorporated, Princeton, Illinois. Cincinnati, OH: National Institute for Occupational Safety and Health. <https://www.cdc.gov/niosh/hhe/reports/pdfs/1988-0082-1971.pdf>
- Sigma-Aldrich Inc. (2020). 1,1,2-Trichloroethane. Available online at <https://www.sigmaaldrich.com/catalog/search?term=79-00-5&interface=CAS%20No.&N=0+&mode=partialmax&lang=en&region=US&focus=product>
- Snedecor, G; Hickman, JC; Mertens, JA. (2004). Chloroethylenes. In Kirk-Othmer encyclopedia of chemical technology. Hoboken, NJ: John Wiley & Sons. <https://dx.doi.org/10.1002/0471238961.1520080519140504.a01.pub2>
- Spectrum Chemical. (2019). Safety Data Sheet: 1,1,2-Trichloroethane. Available online at https://www.spectrumchemical.com/MSDS/T2199_AGHS.pdf
- SPEX CertiPrep LLC. (2019). SDS - Volatile Organics Mix. SPEX CertiPrep LLC.
- Stantec ChemRisk. (2024a). Final study report: Inhalation monitoring of 1,1,2-trichloroethane (CASRN 79-00-5). Washington, DC: Vinyl Institute Consortium. <https://www.regulations.gov/document/EPA-HQ-OPPT-2018-0421-0034>
- Stantec ChemRisk. (2024b). Final study report: Inhalation monitoring of 1,2-dichloroethane (CASRN 107-06-2) with cover letter. Washington, DC: Vinyl Institute Consortium.
- ThermoFisher Scientific. (2018). Safety data sheet: 1,1,2-Trichloroethane. Revision no. 3. Revision date 1/18/2018. ThermoFisher Scientific. <https://www.fishersci.com/store/msds?partNumber=AC139430010&productDescription=1%2C1%2C2-TRICHLOROETHANE%2C+9+1LT&vendorId=VN00032119&countryCode=US&language=en>
- Tomer, A; Kane, J. (2015). The great port mismatch: U.S. goods trade and international transportation. Brookings and JPMorgan Chase. <https://www.brookings.edu/wp-content/uploads/2015/06/brgkssrvygcifreightnetworks.pdf>
- U.S. BLS. (2014). Employee Tenure News Release. Available online at http://www.bls.gov/news.release/archives/tenure_09182014.htm
- U.S. BLS. (2016). May 2016 Occupational Employment and Wage Estimates: National industry-specific estimates. Available online at <http://www.bls.gov/oes/tables.htm>
- U.S. BLS. (2023). May 2023 Occupational Employment and Wage Estimates: National industry-specific estimates. Washington, DC. <https://www.bls.gov/oes/tables.htm>
- U.S. Census Bureau. (2017). 2017 SUSB Annual Data Tables by Establishment Industry: U.S. & states, 6-digit NAICS. Suitland-Silver Hill, MD. <https://www.census.gov/data/tables/2017/econ/susb/2017-susb-annual.html>
- U.S. Census Bureau. (2019a). Survey of Income and Program Participation data. Available online at <https://www.census.gov/programs-surveys/sipp/data/datasets/2008-panel/wave-1.html> (accessed May 16, 2019).
- U.S. Census Bureau. (2019b). Survey of Income and Program Participation: SIPP introduction and history. Washington, DC. <https://www.census.gov/programs-surveys/sipp/about/sipp-introduction-history.html>
- U.S. Census Bureau. (2022). 2022 North American Industry Classification System (NAICS). Suitland-Silver Hill, MD. <https://www.census.gov/naics/?58967?yearbck=2022>
- U.S. EPA. (1981). Chapter 4.6: Solvent degreasing. Compilation of air pollutant emission factors. Volume I: Stationary point and area sources, fifth edition, AP-42. Washington, DC. <http://www3.epa.gov/ttn/chief/ap42/ch04/final/c4s06.pdf>
- U.S. EPA. (1982). Fate of priority pollutants in publicly owned treatment works, Volume i. (EPA 440/1-82/303). Washington, DC: Effluent Guidelines Division. <http://nepis.epa.gov/exe/ZyPURL.cgi?Dockey=000012HL.txt>

- 9902 U.S. EPA. (1989). Risk assessment guidance for superfund, volume I: Human health evaluation manual
9903 (Part A). Interim final. (EPA/540/1-89/002). Washington, DC.
9904 https://www.epa.gov/sites/production/files/2015-09/documents/rags_a.pdf
- 9905 U.S. EPA. (1992a). Dermal exposure assessment: Principles and applications (interim report) [EPA
9906 Report]. (EPA/600/8-91/011B). Washington, DC: Office of Health and Environmental
9907 Assessment. <http://cfpub.epa.gov/ncea/cfm/recorddisplay.cfm?deid=12188>
- 9908 U.S. EPA. (1992b). Guidelines for exposure assessment. Federal Register 57(104):22888-22938 [EPA
9909 Report]. In Risk Assessment Forum. (EPA/600/Z-92/001). Washington, DC.
9910 <http://cfpub.epa.gov/ncea/cfm/recorddisplay.cfm?deid=15263>
- 9911 U.S. EPA. (1992c). A laboratory method to determine the retention of liquids on the surface of hands
9912 [EPA Report]. (EPA/747/R-92/003). Washington, DC.
- 9913 U.S. EPA. (1993). Standards for the use or disposal of sewage sludge, 40 CFR Parts 257, 403, and 503
9914 [EPA Report]. (EPA/822/Z-93/001). Fed. Regist. 58(32):9248-9415.
9915 <http://nepis.epa.gov/EPA/html/Pubs/pubtitleOW.htm>
- 9916 U.S. EPA. (1994). Guidelines for Statistical Analysis of Occupational Exposure Data: Final. United
9917 States Environmental Protection Agency :: U.S. EPA.
- 9918 U.S. EPA. (1996). Technical support document for the Round Two Sewage Sludge Pollutants. (EPA-
9919 822-R-96-003). Washington, DC: Office of Water.
9920 <https://nepis.epa.gov/Exe/ZyPDF.cgi/20003N5O.PDF?Dockkey=20003N5O.PDF>
- 9921 U.S. EPA. (2000). Methodology for deriving ambient water quality criteria for the protection of human
9922 health (2000). (EPA/822/B-00/004). Washington, DC: U.S. Environmental Protection Agency,
9923 Office of Water. [https://www.nj.gov/drbc/library/documents/EPA_human-health-](https://www.nj.gov/drbc/library/documents/EPA_human-health-criteria2000.pdf)
9924 [criteria2000.pdf](https://www.nj.gov/drbc/library/documents/EPA_human-health-criteria2000.pdf)
- 9925 U.S. EPA. (2004). Risk Assessment Guidance for Superfund (RAGS), volume I: Human health
9926 evaluation manual, (part E: Supplemental guidance for dermal risk assessment).
9927 (EPA/540/R/99/005). Washington, DC: U.S. Environmental Protection Agency, Risk
9928 Assessment Forum. <https://www.epa.gov/risk/risk-assessment-guidance-superfund-rags-part-e>
- 9929 U.S. EPA. (2005). Compilation of air pollutant emission factors (AP-42). Available online at
9930 [https://www.epa.gov/air-emissions-factors-and-quantification/ap-42-compilation-air-emission-](https://www.epa.gov/air-emissions-factors-and-quantification/ap-42-compilation-air-emission-factors)
9931 [factors](https://www.epa.gov/air-emissions-factors-and-quantification/ap-42-compilation-air-emission-factors) (accessed January 22, 2018).
- 9932 U.S. EPA. (2006a). Risk assessment for the halogenated solvent cleaning source category [EPA Report].
9933 (EPA Contract No. 68-D-01-052). Research Triangle Park, NC: U.S. Environmental Protection
9934 Agency, Office of Air Quality Planning and Standards.
9935 <https://www.regulations.gov/document?D=EPA-HQ-OAR-2002-0009-0022>
- 9936 U.S. EPA. (2006b). Significant new alternatives policy (SNAP) - Risk screen on substitutes for ozone
9937 depleting substances for adhesive, aerosol solvent, and solvent cleaning applications. Proposed
9938 substitute: n-Propyl bromide. In Office of Air and Radiation, Stratospheric Protection Division.
9939 Washington DC.
- 9940 U.S. EPA. (2007a). Dermal exposure assessment: A summary of EPA approaches [EPA Report].
9941 (EPA/600/R-07/040F). Washington, DC.
9942 <http://cfpub.epa.gov/ncea/cfm/recorddisplay.cfm?deid=183584>
- 9943 U.S. EPA. (2007b). Exposure and Fate Assessment Screening Tool (E-FAST), Version 2.0 [Computer
9944 Program]. Washington, DC.
- 9945 U.S. EPA. (2009). Water treatment technology feasibility support document for chemical contaminants
9946 for the second six-year review of national primary drinking water regulations. (EPA 815-B-09-
9947 007). Washington, DC: U.S. Environmental Protection Agency, Office of Water.
9948 <https://nepis.epa.gov/Exe/ZyPDF.cgi/P1007BBH.PDF?Dockkey=P1007BBH.PDF>
- 9949 U.S. EPA. (2011). Exposure factors handbook: 2011 edition [EPA Report]. (EPA/600/R-090/052F).
9950 Washington, DC: U.S. Environmental Protection Agency, Office of Research and Development,

National Center for Environmental Assessment.

<https://nepis.epa.gov/Exe/ZyPURL.cgi?Dockey=P100F2OS.txt>

U.S. EPA. (2012). Estimation Programs Interface Suite™ for Microsoft® Windows, v 4.11 [Computer Program]. Washington, DC. Retrieved from <https://www.epa.gov/tsca-screening-tools/epi-suite-estimation-program-interface>

U.S. EPA. (2013). Updating CEB's method for screening-level estimates of dermal exposure. Chemical Engineering Branch.

U.S. EPA. (2014a). Estimated fish consumption rates for the U.S. population and selected subpopulations (NHANES 2003-2010) [EPA Report]. (EPA-820-R-14-002). Washington, DC. <https://www.epa.gov/sites/production/files/2015-01/documents/fish-consumption-rates-2014.pdf>

U.S. EPA. (2014b). Formulation of waterborne coatings - Generic scenario for estimating occupational exposures and environmental releases -Draft. Washington, DC. <https://www.epa.gov/tsca-screening-tools/using-predictive-methods-assess-exposure-and-fate-under-tsca>

U.S. EPA. (2015a). ChemSTEER user guide - Chemical screening tool for exposures and environmental releases. Washington, D.C. https://www.epa.gov/sites/production/files/2015-05/documents/user_guide.pdf

U.S. EPA. (2015b). Evaluation of Swimmer Exposures Using the SWIMODEL Algorithms and Assumptions. Available online at https://www.epa.gov/sites/production/files/2016-11/documents/swimodel_final.pdf

U.S. EPA. (2016). Instructions for reporting 2016 TSCA chemical data reporting. (EPA/600/R-09/052F). Washington, DC: U.S. Environmental Protection Agency, Office of Pollution Prevention and Toxics. <https://www.epa.gov/chemical-data-reporting/instructions-reporting-2016-tsca-chemical-data-reporting>

U.S. EPA. (2017a). Consumer Exposure Model (CEM) version 2.0: User guide. U.S. Environmental Protection Agency, Office of Pollution Prevention and Toxics. https://www.epa.gov/sites/production/files/2017-06/documents/cem_2.0_user_guide.pdf

U.S. EPA. (2017b). Estimation Programs Interface Suite™ v.4.11. Washington, DC: U.S. Environmental Protection Agency, Office of Pollution Prevention Toxics. Retrieved from <https://www.epa.gov/tsca-screening-tools/download-epi-suite-estimation-program-interface-v411>

U.S. EPA. (2018). Hazardous Waste Management Facilities and Units. Available online at <https://www.epa.gov/hwpermitting/hazardous-waste-management-facilities-and-units>

U.S. EPA. (2019a). Chemical data reporting (2012 and 2016 public CDR database). Washington, DC: U.S. Environmental Protection Agency, Office of Pollution Prevention and Toxics. Retrieved from <https://www.epa.gov/chemical-data-reporting>

U.S. EPA. (2019b). Chemistry Dashboard Information for 1,1,2-Trichloroethane. 79-00-5. Available online at <https://comptox.epa.gov/dashboard/dsstoxdb/results?search=DTXSID5021380>

U.S. EPA. (2019c). Exposure factors handbook chapter 3 (update): Ingestion of water and other select liquids [EPA Report]. (EPA/600/R-18/259F). Washington, DC. <https://cfpub.epa.gov/ncea/efp/recordisplay.cfm?deid=343661>

U.S. EPA. (2019d). Point Source Calculator: A Model for Estimating Chemical Concentration in Water Bodies. Washington, DC: U.S. Environmental Protection Agency, Office of Chemical Safety and Pollution Prevention.

U.S. EPA. (2019e). User's Guide: Integrated Indoor-Outdoor Air Calculator (IIOAC). Washington, DC: U.S. EPA.

U.S. EPA. (2020a). 2017 National Emissions Inventory (NEI) data (April 2020 version) (Version April 2020). Washington, DC: US Environmental Protection Agency. Retrieved from <https://www.epa.gov/air-emissions-inventories/2017-national-emissions-inventory-nei-data>

- 9999 U.S. EPA. (2020b). Chemical Data Reporting (CDR): Reporting year 2020 [Database]. Washington, DC: U.S. Environmental Protection Agency, Office of Pollution Prevention and Toxics. Retrieved from <https://www.epa.gov/chemical-data-reporting/access-cdr-data>
- 10000
- 10001
- 10002 U.S. EPA. (2020c). Final scope of the risk evaluation for 1,1,2-trichloroethane; CASRN 79-00-5. (EPA 740-R-20-003). Washington, DC: Office of Chemical Safety and Pollution Prevention. https://www.epa.gov/sites/default/files/2020-09/documents/casrn_79-00-5_112-trichloroethane_finalscope.pdf
- 10003
- 10004
- 10005
- 10006 U.S. EPA. (2021a). About the Exposure Factors Handbook. Available online at <https://www.epa.gov/expobox/about-exposure-factors-handbook>
- 10007
- 10008 U.S. EPA. (2021b). Draft systematic review protocol supporting TSCA risk evaluations for chemical substances, Version 1.0: A generic TSCA systematic review protocol with chemical-specific methodologies. (EPA Document #EPA-D-20-031). Washington, DC: Office of Chemical Safety and Pollution Prevention. <https://www.regulations.gov/document/EPA-HQ-OPPT-2021-0414-0005>
- 10009
- 10010
- 10011
- 10012
- 10013 U.S. EPA. (2022a). Access chemical data reporting data: 2020 CDR data (up-to-date as of April 2022) [Database]. Washington, DC: U.S. Environmental Protection Agency, Office of Pollution Prevention and Toxics. Retrieved from <https://www.epa.gov/chemical-data-reporting/access-cdr-data>
- 10014
- 10015
- 10016
- 10017 U.S. EPA. (2022b). Ambient Monitoring Technology Information Center (AMTIC) - Ambient Monitoring Archive for HAPs [Database]. Washington, DC. Retrieved from <https://www.epa.gov/amtic/amtic-ambient-monitoring-archive-haps>
- 10018
- 10019
- 10020 U.S. EPA. (2022c). Chemical repackaging - Generic scenario for estimating occupational exposures and environmental releases (revised draft) [EPA Report]. Washington, DC.
- 10021
- 10022 U.S. EPA. (2022d). Discharge Monitoring Report (DMR) data for 1,4-dioxane, 2013-2019. Washington, DC. Retrieved from <https://echo.epa.gov/trends/loading-tool/water-pollution-search>
- 10023
- 10024 U.S. EPA. (2022e). Safe Drinking Water Information System (SDWIS) Fed Data Warehouse: Sensitive drinking water-related information, 2022Q2. Washington, DC. Retrieved from <https://www.epa.gov/ground-water-and-drinking-water/safe-drinking-water-information-system-sdwis-federal-reporting>
- 10025
- 10026
- 10027
- 10028 U.S. EPA. (2022f). Toxics Release Inventory (TRI) data for 1,4-dioxane, 2013-2019. Washington, DC. Retrieved from <https://www.epa.gov/toxics-release-inventory-tri-program/tri-data-and-tools>
- 10029
- 10030 U.S. EPA. (2023a). 2020 National Emissions Inventory (NEI) Data (August 2023 version) (Version August 2023). Washington, DC: US Environmental Protection Agency. Retrieved from <https://www.epa.gov/air-emissions-inventories/2020-national-emissions-inventory-nei-data>
- 10031
- 10032
- 10033 U.S. EPA. (2023b). Consumer Exposure Model (CEM) Version 3.2 User's Guide. Washington, DC. <https://www.epa.gov/tsc-screening-tools/consumer-exposure-model-cem-version-32-users-guide>
- 10034
- 10035
- 10036 U.S. EPA. (2023c). Methodology for estimating environmental releases from sampling waste (revised draft). Washington, DC: Office of Pollution Prevention and Toxics, Chemical Engineering Branch.
- 10037
- 10038
- 10039 U.S. EPA. (2023d). [REFER TO CORRECTED COPY] Use of laboratory chemicals - Generic scenario for estimating occupational exposures and environmental releases (Revised draft generic scenario) [EPA Report]. Washington, DC: U.S. Environmental Protection Agency, Office of Pollution Prevention and Toxics, Existing Chemicals Risk Assessment Division. <https://www.epa.gov/tsc-screening-tools/chemsteer-chemical-screening-tool-exposures-and-environmental-releases#genericscenarios>
- 10040
- 10041
- 10042
- 10043
- 10044
- 10045 U.S. EPA. (2024a). Analysis of regulated contaminant occurrence data from public water systems in support of the Fourth Six-Year Review of national primary drinking water regulations: Chemical phase and radionuclides rules. (EPA- 815-R-24-014). Washington, DC: Office of Water.
- 10046
- 10047

<https://www.epa.gov/dwsixyearreview/support-documents-epas-fourth-review-existing-drinking-water-standards>

- U.S. EPA. (2024b). Draft Risk Evaluation for 1,1-Dichloroethane. Washington, DC: Office of Pollution Prevention and Toxics, Office of Chemical Safety and Pollution Prevention.
<https://www.regulations.gov/document/EPA-HQ-OPPT-2024-0114-0006>
- U.S. EPA. (2025). Summary of and Response to External Peer Review and Public Comments on the Risk Evaluation for 1,1-Dichloroethane and Human Health Hazard Technical Support Document for 1,2-Dichloroethane. Washington, DC: Office of Pollution Prevention and Toxics, Office of Chemical Safety and Pollution Prevention. <https://www.epa.gov/assessing-and-managing-chemicals-under-tsca/risk-evaluation-11-dichloroethane>
- U.S. EPA. (2026a). Byproducts Assessment for 1,2-Dichloroethane. Washington, DC: Office of Pollution Prevention and Toxics, Office of Chemical Safety and Pollution Prevention.
- U.S. EPA. (2026b). Chemical Data Reporting (CDR): Reporting year 2024. Washington, DC.
- U.S. EPA. (2026c). Draft Air Releases for 1,1,2-Trichloroethane. Washington, DC: Office of Pollution Prevention and Toxics, Office of Chemical Safety and Pollution Prevention.
- U.S. EPA. (2026d). Draft AMTIC Monitoring Data for 1,1,2-Trichloroethane. Washington, DC: Office of Pollution Prevention and Toxics, Office of Chemical Safety and Pollution Prevention.
- U.S. EPA. (2026e). Draft CEM Outputs for 1,1,2-Trichloroethane. Washington, DC: Office of Pollution Prevention and Toxics, Office of Chemical Safety and Pollution Prevention.
- U.S. EPA. (2026f). Draft Chemistry, Fate, Release, and Exposure Assessment for 1,1,2-Trichloroethane. Washington, DC: Office of Pollution Prevention and Toxics, Office of Chemical Safety and Pollution Prevention.
- U.S. EPA. (2026g). Draft Data Quality Evaluation and Data Extraction Information for Environmental Fate and Transport for 1,1,2-Trichloroethane. Washington, DC: Office of Pollution Prevention and Toxics, Office of Chemical Safety and Pollution Prevention.
- U.S. EPA. (2026h). Draft Data Quality Evaluation and Data Extraction Information for Physical and Chemical Properties for 1,1,2-Trichloroethane. Washington, DC: Office of Pollution Prevention and Toxics, Office of Chemical Safety and Pollution Prevention.
- U.S. EPA. (2026i). Draft Estimates of Number of Workers and ONUs for 1,1,2-Trichloroethane. Washington, DC: Office of Pollution Prevention and Toxics, Office of Chemical Safety and Pollution Prevention.
- U.S. EPA. (2026j). Draft Formulation of Adhesives and Sealants Environmental Release Model for 1,1,2-Trichloroethane. Washington, DC: Office of Pollution Prevention and Toxics, Office of Chemical Safety and Pollution Prevention.
- U.S. EPA. (2026k). Draft General Population Surface Water Pathway Exposure Estimates for 1,1,2-Trichloroethane. Washington, DC: Office of Pollution Prevention and Toxics, Office of Chemical Safety and Pollution Prevention.
- U.S. EPA. (2026l). Draft Human Health and Environmental Hazard Assessment for 1,1,2-Trichloroethane. Washington, DC: Office of Pollution Prevention and Toxics, Office of Chemical Safety and Pollution Prevention.
- U.S. EPA. (2026m). Draft Land Releases for 1,1,2-Trichloroethane. Washington, DC: Office of Pollution Prevention and Toxics, Office of Chemical Safety and Pollution Prevention.
- U.S. EPA. (2026n). Draft Number of Sites for 1,1,2-Trichloroethane. Washington, DC: Office of Pollution Prevention and Toxics, Office of Chemical Safety and Pollution Prevention.
- U.S. EPA. (2026o). Draft Occupational Risk Calculator for 1,1,2-Trichloroethane. Washington, DC: Office of Pollution Prevention and Toxics, Office of Chemical Safety and Pollution Prevention.
- U.S. EPA. (2026p). Draft Open-Top Vapor Degreasing Environmental Release Model for 1,1,2-Trichloroethane. Washington, DC: Office of Pollution Prevention and Toxics, Office of Chemical Safety and Pollution Prevention.

10097 U.S. EPA. (2026q). Draft Repackaging Environmental Release and Occupational Exposure Model for
10098 1,1,2-Trichloroethane. Washington, DC: Office of Pollution Prevention and Toxics, Office of
10099 Chemical Safety and Pollution Prevention.

10100 U.S. EPA. (2026r). Draft Risk Evaluation for 1,1,2-Trichloroethane. Washington, DC: Office of
10101 Pollution Prevention and Toxics, Office of Chemical Safety and Pollution Prevention.

10102 U.S. EPA. (2026s). Draft Surface Water and Sediment Monitoring Data for 1,1,2-Trichloroethane.
10103 Washington, DC: Office of Pollution Prevention and Toxics, Office of Chemical Safety and
10104 Pollution Prevention.

10105 U.S. EPA. (2026t). Draft Surface Water Concentration Modeling and Environmental Exposure for 1,1,2-
10106 Trichloroethane. Washington, DC: Office of Pollution Prevention and Toxics, Office of
10107 Chemical Safety and Pollution Prevention.

10108 U.S. EPA. (2026u). Draft Systematic Review Protocol for 1,1,2-Trichloroethane. Washington, DC:
10109 Office of Pollution Prevention and Toxics, Office of Chemical Safety and Pollution Prevention.

10110 U.S. EPA. (2026v). Draft Tier 1 Ambient Air Analysis - Results and Risk Calcs for 1,1,2-
10111 Trichloroethane. Washington, DC: Office of Pollution Prevention and Toxics, Office of
10112 Chemical Safety and Pollution Prevention.

10113 U.S. EPA. (2026w). Draft Tier 1 Ambient Air Analysis Model Files for 1,1,2-Trichloroethane.
10114 Washington, DC: Office of Pollution Prevention and Toxics, Office of Chemical Safety and
10115 Pollution Prevention.

10116 U.S. EPA. (2026x). Draft Tier 2 Ambient Air Analysis - Results and Risk Calcs by Industry Sector for
10117 1,1,2-Trichloroethane. Washington, DC: Office of Pollution Prevention and Toxics, Office of
10118 Chemical Safety and Pollution Prevention.

10119 U.S. EPA. (2026y). Draft Tier 2 Ambient Air Analysis Model Files for 1,1,2-Trichloroethane.
10120 Washington, DC: Office of Pollution Prevention and Toxics, Office of Chemical Safety and
10121 Pollution Prevention.

10122 U.S. EPA. (2026z). Draft Tier 3 Ambient Air Analysis - TRI Dataset ReadMe File for 1,1,2-
10123 Trichloroethane. Washington, DC: Office of Pollution Prevention and Toxics, Office of
10124 Chemical Safety and Pollution Prevention.

10125 U.S. EPA. (2026aa). Draft Tier 3 Ambient Air Analysis - TRI Dataset Release Summary by OES for
10126 1,1,2-Trichloroethane. Washington, DC: Office of Pollution Prevention and Toxics, Office of
10127 Chemical Safety and Pollution Prevention.

10128 U.S. EPA. (2026ab). Draft Tier 3 Ambient Air Analysis - TRI Dataset Results Summary for 1,1,2-
10129 Trichloroethane. Washington, DC: Office of Pollution Prevention and Toxics, Office of
10130 Chemical Safety and Pollution Prevention.

10131 U.S. EPA. (2026ac). Draft Tier 3 Ambient Air Analysis Model Files for 1,1,2-Trichloroethane.
10132 Washington, DC: Office of Pollution Prevention and Toxics, Office of Chemical Safety and
10133 Pollution Prevention.

10134 U.S. EPA. (2026ad). Draft Tier 3 Ambient Air Max Cancer Results by OES and Dataset for 1,1,2-
10135 Trichloroethane. Washington, DC: Office of Pollution Prevention and Toxics, Office of
10136 Chemical Safety and Pollution Prevention.

10137 U.S. EPA. (2026ae). Draft Use of Adhesives and Sealants Environmental Release Model for 1,1,2-
10138 Trichloroethane. Washington, DC: Office of Pollution Prevention and Toxics, Office of
10139 Chemical Safety and Pollution Prevention.

10140 U.S. EPA. (2026af). Draft Use of Laboratory Chemicals Environmental Release Model for 1,1,2-
10141 Trichloroethane. Washington, DC: Office of Pollution Prevention and Toxics, Office of
10142 Chemical Safety and Pollution Prevention.

10143 U.S. EPA. (2026ag). Draft Water Releases for 1,1,2-Trichloroethane. Washington, DC: Office of
10144 Pollution Prevention and Toxics, Office of Chemical Safety and Pollution Prevention.

- U.S. EPA. (2026ah). ICIS-NPDES permit limit and Discharge Monitoring Report (DMR) datasets. <https://echo.epa.gov/tools/data-downloads/icis-npdes-dmr-and-limit-data-set>
- U.S. EPA. (2026ai). Safety Data Sheets and Technical Information for Products Containing 1,1,2-Trichloroethane. Washington, DC: Office of Pollution Prevention and Toxics, Office of Chemical Safety and Pollution Prevention.
- U.S. EPA; U.S.G.S. (2016). National hydrography dataset plus - NHDPlus edition 2.10: U.S. Environmental Protection Agency. Retrieved from <https://www.epa.gov/waterdata/nhdplus-national-hydrography-dataset-plus>
- UT Austin. (1987). Analysis and interpretation of batch equilibrium and column studies of the partitioning of chlorinated hydrocarbons to soil materials from the PPG Lake Charles site [TSCA Submission]. (EPA/OTS Doc #86-870002008). PPG Industries. <https://ntrl.ntis.gov/NTRL/dashboard/searchResults/titleDetail/OTS0517097.xhtml>
- Valsaraj, KT; Kommalapati, RR; Robertson, ED; Constant, WD. (1999). Partition constants and adsorption-desorption hysteresis for volatile organic compounds on soil from a Louisiana Superfund site. Environ Monit Assess 58: 225-241. <https://dx.doi.org/10.1023/A:1006006528573>
- Vinyl Institute. (2020). Comment submitted by Vinyl Institute regarding EDC impurities. Available online
- Vulcan Chemicals. (1994). EXECUTIVE SUMMARY, COLD CLEANING FIELD TESTS OF PERCHLOROETHYLENE/ALCOHOL BLENDS WITH COVER LETTER DATED 032494. (OTS: OTS0556807; 8EHQ Num: NA; DCN: NA; TSCATS RefID: 442277; CIS: NA).
- Wegmann, F; Cavin, L; Macleod, M; Scheringer, M; Hungerbuhler, K. (2009). The OECD software tool for screening chemicals for persistence and long-range transport potential. Environ Modell Softw 24: 228-237. <https://dx.doi.org/10.1016/j.envsoft.2008.06.014>
- Westat Inc. (1987). National Usage Survey of Household Cleaning Products. Westat Inc. http://www.epa.gov/oppt/exposure/presentations/efast/westat_1987a_household_cleaning_products.pdf
- Westlake Vinyls. (2015). Safety data sheet: EDC Intermediate Feedstock. Preparation date: 7/29/2015. Westlake Vinyls Company, L.P. <https://www.westlake.com/sites/default/files/EDC%20Intermediate%20Feedstock%20150728.pdf>
- WIL Research. (2001). Acute inhalation toxicity (with histopathology) study of 1,1,2-trichloroethane (1,1,2-TCE) in rats [TSCA Submission]. In TSCA chemical testing; receipt of test data action: Notice (67 FR 17429) w/final rpt of acute inhalation toxicity of 1,1,2-trichloroethane in rats, w/attachmnt & cvr ltr dtd 103101. (WIL-417001. OTS0574376. 42198C E-001 44654. TSCATS/454711). <https://ntrl.ntis.gov/NTRL/dashboard/searchResults/titleDetail/OTS0574376.xhtml>
- Wilson, JT; Enfield, CG; Dunlap, WJ; Cosby, RL; Foster, DA; Baskin, LB. (1981). Transport and fate of selected organic pollutants in a sandy soil. J Environ Qual 10: 501-506. <https://dx.doi.org/10.2134/jeq1981.00472425001000040016x>

APPENDICES

Appendix A ENVIRONMENTAL RELEASE AND OCCUPATIONAL EXPOSURE MODEL APPROACHES AND PARAMETERS

This appendix presents the modeling approach and model equations used in estimating environmental releases and occupational exposures for each of the applicable OESs. The models were developed through review of the literature and consideration of existing EPA/OPPT models, ESDs, and/or GSs. An individual model input parameter could either have a discrete value or a distribution of values. The Agency assigned statistical distributions based on reasonably available literature data. A Monte Carlo simulation (a type of stochastic simulation) was conducted to capture variability in the model input parameters. The simulation was conducted using the Latin hypercube sampling method in @Risk Industrial Edition, Version 8.0.0. The Latin hypercube sampling method generates a sample of possible values from a multi-dimensional distribution and is considered a stratified method, meaning the generated samples are representative of the probability density function (variability) defined in the model. EPA performed the model at 100,000 iterations to capture a broad range of possible input values, including values with low probability of occurrence.

EPA used the 95th and 50th percentile Monte Carlo simulation model result values for assessment. The 95th percentile value represents the high-end release amount or exposure level, whereas the 50th percentile value represents the typical release amount or exposure level. The following subsections detail the model design equations and parameters for each of the OESs.

A.1 EPA/OPPT Standard Models

This section discusses the standard models used by EPA to estimate environmental releases and occupational exposure of chemicals. All the models presented in this section are models that were previously developed by the Agency and are not the result of any new model development work for this risk evaluation. Therefore, this appendix does not provide the details of the derivation of the model equations that have been provided in other documents such as the ChemSTEER User Guide ([U.S. EPA, 2015a](#)), Chemical Engineering Branch Manual for the Preparation of Engineering Assessments, Volume 1 ([CEB, 1991](#)), Evaporation of pure liquids from open surfaces ([Arnold and Engel, 2001](#)), Evaluation of the Mass Balance Model Used by the References Environmental Protection Agency for Estimating Inhalation Exposure to New Chemical Substances ([Fehrenbacher and Hummel, 1996](#)) and Releases During Cleaning of Equipment ([PEI Associates, 1988](#)). The models address loss fraction as well as estimating chemical vapor generation rates used in subsequent model equations to estimate the volatile releases to air and occupational inhalation exposure concentrations. The parameters in the equations of this appendix section are specific to calculating environmental releases of 1,1,2-trichloroethane.

The EPA/OPPT Penetration Model estimates releases to air from evaporation of a chemical from an open, exposed liquid surface. This model is appropriate for determining volatile releases from activities that are performed indoors or when air velocities are expected to be less than or equal to 100 feet per minute. The EPA/OPPT Penetration Model calculates the average vapor generation rate of the chemical from the exposed liquid surface using the following equation:

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Equation_Apx A-1. $G_{activity}$

$$= \frac{(8.24 \times 10^{-8}) * (MW_{1,1,2-TCA}^{0.835}) * F_{correction\_factor} * VP * \sqrt{Rate_{air\_speed}} * (0.25\pi D_{opening}^2)^4 \sqrt{\frac{1}{29} + \frac{1}{MW_{1,1,2-TCA}}}}{T^{0.05} * \sqrt{D_{opening}} * \sqrt{P}}$$

Where:

$G_{activity}$	=	Vapor generation rate for activity [g/s]
$MW_{1,1,2-TCA}$	=	1,1,2-Trichloroethane molecular weight [g/mol]
$F_{correction\_factor}$	=	Vapor pressure correction factor [unitless]
VP	=	1,1,2-Trichloroethane vapor pressure [torr]
$Rate_{air\_speed}$	=	Air speed [cm/s]
$D_{opening}$	=	Diameter of opening [cm]
T	=	Temperature [K]
P	=	Pressure [torr]

The EPA/OPPT Mass Transfer Coefficient Model estimates releases to air from the evaporation of a chemical from an open, exposed liquid surface. This model is appropriate for determining this type of volatile release from activities that are performed outdoors or when air velocities are expected to be greater than 100 feet per minute. The EPA/OPPT Mass Transfer Coefficient Model calculates the average vapor generation rate of the chemical from the exposed liquid surface using the following equation:

Equation_Apx A-2. $G_{activity}$

$$= \frac{(1.93 \times 10^{-7}) * (MW_{1,1,2-TCA}^{0.78}) * F_{correction\_factor} * VP * Rate_{air\_speed}^{0.78} * (0.25\pi D_{opening}^2)^3 \sqrt{\frac{1}{29} + \frac{1}{MW_{1,1,2-TCA}}}}{T^{0.4} D_{opening}^{0.11} (\sqrt{T} - 5.87)^{2/3}}$$

Where:

$G_{activity}$	=	Vapor generation rate for activity [g/s]
$MW_{1,1,2-TCA}$	=	1,1,2-Trichloroethane molecular weight [g/mol]
$F_{correction\_factor}$	=	Vapor pressure correction factor [unitless]
VP	=	1,1,2-Trichloroethane vapor pressure [torr]
$Rate_{air\_speed}$	=	Air speed [cm/s]
$D_{opening}$	=	Diameter of opening [cm]
T	=	Temperature [K]

The EPA's Office of Air Quality Planning and Standards (OAQPS) AP-42 Loading Model estimates releases to air from the displacement of air containing chemical vapor as a container/vessel is filled with a liquid. This model assumes that the rate of evaporation is negligible compared to the vapor loss from the displacement and is used as the default for estimating volatile air releases during both loading activities and unloading activities. It is used for unloading activities because it is assumed while one vessel is being unloaded another is assumed to be loaded. The EPA/OAQPS AP-42 Loading Model calculates the average vapor generation rate from loading or unloading using the following equation:

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Equation_Apx A-3. $G_{activity}$

$$= \frac{F_{saturation\_factor} * MW_{1,1,2-TCA} * V_{container} * 3785.4 \frac{cm^3}{gal} * F_{correction\_factor} * VP * \frac{RATE_{fill} \frac{s}{hr}}{3600}}{R * T}$$

Where:

$G_{activity}$	=	Vapor generation rate for activity [g/s]
$F_{saturation\_factor}$	=	Saturation factor [unitless]
$MW_{1,1,2-TCA}$	=	1,1,2-Trichloroethane molecular weight [g/mol]
$V_{container}$	=	Volume of container [gal/container]
$F_{correction\_factor}$	=	Vapor pressure correction factor [unitless]
VP	=	1,1,2-Trichloroethane vapor pressure [torr]
$RATE_{fill}$	=	Fill rate of container [containers/hr]
R	=	Universal gas constant [L*torr/mol-K]
T	=	Temperature [K]

For each of the vapor generation rate models, the vapor pressure correction factor ($F_{correction\_factor}$) can be estimated using Raoult's Law and the mole fraction of 1,1,2-trichloroethane in the liquid of interest.

If calculating an environmental release, the vapor generation rate calculated from one of the above models (Equation_Apx A-1, Equation_Apx A-2, Equation_Apx A-3) is then used along with an operating time to calculate the release amount:

Equation_Apx A-4.

$$Release\_Year_{activity} = Time_{activity} * G_{activity} * 3600 \frac{s}{hr} * 0.001 \frac{kg}{g}$$

Where:

$Release\_Year_{activity}$	=	1,1,2-Trichloroethane released for activity per site-year [kg/site-yr]
$Time_{activity}$	=	Operating time for activity [hr/site-yr]
$G_{activity}$	=	Vapor generation rate for activity [g/s]

In addition to the vapor generation rate models, EPA uses various loss fraction models to calculate environmental releases, including the following:

- EPA/OPPT Small Container Residual Model
- EPA/OPPT Drum Residual Model
- EPA/OPPT Bulk Transport Residual Model
- EPA/OPPT Multiple Process Vessel Residual Model
- EPA/OPPT Single Process Vessel Residual Model
- March 2023 Methodology for Estimating Environmental Releases from Sampling Waste

The loss fraction models apply a given loss fraction to the overall throughput of 1,1,2-trichloroethane for the given process. The loss fraction value or distribution of values differs for each model; however, the models each follow the same general equation:

Equation_Apx A-5.

$$Release\_Year_{activity} = PV * F_{activity\_loss}$$

Where:

$Release\_Year_{activity}$	=	1,1,2-Trichloroethane released for activity per site-year [kg/site-yr]
PV	=	Production volume throughput of 1,1,2-trichloroethane [kg/site-yr]
$F_{activity\_loss}$	=	Loss fraction for activity [unitless]

The EPA/OPPT Mass Balance Inhalation Model estimates a worker inhalation exposure to an estimated concentration of chemical vapors within the worker's breathing zone using a one box model. The model estimates the amount of chemical inhaled by a worker during an activity in which the chemical has volatilized and the airborne concentration of the chemical vapor is estimated as a function of the source vapor generation rate or the saturation level of the chemical in air. First, the applicable vapor generation rate model (Equation_Apx A-1, Equation_Apx A-2, Equation_Apx A-3) is used to calculate the vapor generation rate for the given activity. With this vapor generation rate, the EPA/OPPT Mass Balance Inhalation Model calculates the volumetric concentration of 1,1,2-trichloroethane using the following equation:

Equation_Apx A-6.

$$Cv_{activity} = Minimum: \left\{ \frac{\left[\frac{170,000 \times T \times G_{activity}}{MW_{1,1,2-TCA} \times Q \times k} \right]}{\left[\frac{1,000,000 \text{ ppm} \times F_{correction\_factor} \times VP}{P} \right]} \right\}$$

Where:

$Cv_{activity}$	=	Exposure activity volumetric concentration [ppm]
$G_{activity}$	=	Exposure activity vapor generation rate [g/s]
$MW_{1,1,2-TCA}$	=	1,1,2-Trichloroethane molecular weight [g/mol]
Q	=	Ventilation rate [ft ³ /min]
k	=	Mixing factor [unitless]
T	=	Temperature [K]
$F_{correction\_factor}$	=	Vapor pressure correction factor [unitless]
VP	=	1,1,2-Trichloroethane vapor pressure [torr]
P	=	Pressure [torr]

Mass concentration can be estimated by multiplying the volumetric concentration by the molecular weight of 1,1,2-trichloroethane and dividing by molar volume at standard temperature and pressure.

A.2 Equations for Calculation Acute, Intermediate, and Chronic (Non-cancer and Cancer) Inhalation and Dermal Exposures

A.2.1 Equations for Calculating Inhalation Exposures

Full-shift (8-hour) time weighted average exposure concentrations are utilized to calculate acute exposure concentrations (AC), intermediate average daily concentrations (ADC_{intermediate}), average daily concentrations (ADC) for chronic, non-cancer risks, lifetime average daily concentrations (LADC) for chronic, cancer risks.

AC is used to estimate workplace inhalation exposures for acute risks (*i.e.*, risks occurring as a result of exposure for <1 day), per **Equation_Apx A-7**.

Equation_Apx A-7.

$$AC = \frac{C \times ED \times BR}{AT_{acute}}$$

Where:

AC = Acute exposure concentration (ppm)
 C = Contaminant concentration in air (TWA) (ppm)
 ED = Exposure duration (h/day)
 BR = Breathing rate ratio (unitless)
 AT_{acute} = Acute averaging time (hour)

$ADC_{intermediate}$ is used to estimate workplace exposures for intermediate risks and is estimated as follows:

Equation_Apx A-8.

$$ADC_{intermediate} = \frac{C \times ED \times EF_{intermediate} \times BR}{AT_{intermediate}}$$

Equation_Apx A-9.

$$AT_{intermediate} = D_{intermediate} \times 24 \frac{h}{day}$$

Where:

$ADC_{intermediate}$ = Intermediate average daily concentration (ppm)
 $EF_{intermediate}$ = Intermediate exposure frequency (ppm)
 $AT_{intermediate}$ = Averaging time (hours) for intermediate exposure
 $D_{intermediate}$ = Days for intermediate duration (day)

ADC and LADC are used to estimate workplace exposures for non-cancer and cancer risks, respectively. These exposures are estimated as follows:

Equation_Apx A-10.

$$ADC \text{ or } LADC = \frac{C \times ED \times EF \times WY \times BR}{AT \text{ or } AT_c}$$

Equation_Apx A-11.

$$AT = WY \times 365 \frac{day}{yr} \times 24 \frac{hr}{day}$$

Equation_Apx A-12.

$$AT_c = LT \times 365 \frac{day}{yr} \times 24 \frac{hr}{day}$$

Where:

ADC = Average daily concentration used for chronic non-cancer risk calculations (ppm)
 $LADC$ = Lifetime average daily concentration used for chronic cancer risk calculations

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(ppm)		
<i>ED</i>	=	Exposure duration (h/day)
<i>EF</i>	=	Exposure frequency (day/yr)
<i>WY</i>	=	Working years/lifetime (yr)
<i>AT</i>	=	Averaging time (hours) for chronic, non-cancer risk
<i>AT_C</i>	=	Averaging time (hours) for cancer risk
<i>LT</i>	=	Lifetime years (yr) for cancer risk

A.2.2 Equations for Calculating Dermal Exposures

EPA estimated occupational dermal exposures as a dermal acute absorbed dose rate (AADR), as described in Appendix B.8. The AADRs were used to calculate acute absorbed doses (AAD), intermediate absorbed doses (IAD), chronic absorbed doses (CADD) for chronic noncancer risks, and lifetime chronic absorbed doses (LCAD) for chronic cancer risks, as described below:

AAD is used to estimate workplace dermal exposures for acute risks and are calculated using **Equation_Apx A-13.**

Equation_Apx A-13,

$$AAD = \frac{AADR}{BW}$$

Where:

<i>AAD</i>	=	Acute absorbed dose (mg/kg-day)
<i>AADR</i>	=	Acute absorbed dose rate (mg/day)
<i>BW</i>	=	Body weight (kg)

IAD is used to estimate workplace dermal exposures for intermediate risks and is estimated using **Equation_Apx A-14.**

Equation_Apx A-14.

$$IAD = \frac{AADR \times EF_{intermediate}}{BW \times D_{intermediate}}$$

Where:

<i>IAD</i>	=	Intermediate absorbed dose (mg/kg-day)

CAD and LCAD are used to estimate workplace dermal exposures for non-cancer and cancer risks and are calculated using **Equation_Apx A-15.**

Equation_Apx A-15.

$$CAD \text{ or } LCAD = \frac{AADR \times EF \times WY}{BW \times 365 \frac{days}{yr} \times (WY \text{ or } LT)}$$

Where WY and LT are used in the denominator for CAD and LCAD, respectively.

A.2.3 Acute, Intermediate, and Chronic Equation Inputs

The input parameter values in Table_Apx A-1 are used to calculate each of the above acute, intermediate, and chronic exposure estimates. Where exposure is calculated using probabilistic modeling, the calculations are integrated into the Monte Carlo simulation. Where multiple values are provided for ED, it indicates that EPA may have used different values for different conditions of use. The EF used for each OES can differ and the values used are described in the appropriate sections of this report. The maximum values used in the equations as well as a general summary for these differences are described below in this section.

Table_Apx A-1. Parameter Values for Calculating Inhalation Exposure Estimates

Parameter Name	Symbol	Value	Unit
Full-shift exposure duration	<i>ED</i>	8	hr/day
Breathing rate ratio	<i>BR</i>	2.04 ^a	m ³ /hr
Exposure frequency	<i>EF</i>	174- 250 ^b	days/yr
Exposure Frequency, Intermediate Duration	<i>EF_{int}</i>	22 ^c	days
Exposure Days, Intermediate Duration	<i>D_{intermediate}</i>	30	days
Working years ^b	<i>WY</i>	31 (50th percentile) 40 (95th percentile)	years
Lifetime years, cancer	<i>LT</i>	78	years
Averaging Time, intermediate	<i>AT_{int}</i>	720	hours
Averaging Time, non-cancer	<i>AT</i>	271,560 (central tendency) ^d 350,400 (high-end) ^e	hours
Averaging Time, Cancer	<i>AT_c</i>	683,280	hours
^a EPA uses a breathing rate ratio, which is the ratio between the worker breathing rate and resting breathing rate, to account for the amount of air a worker breathes during exposure. The typical worker breathes about 10 m ³ of air in 8 hours, or 1.25 m ³ /h while the resting breathing rate is 0.6125 m ³ /h (CEB, 1991). The ratio of these two values is equivalent to 2.04. ^b Depending on OES; maximum number of exposure days was assumed to be 250 days per year. ^c Estimated maximum working days in a 30-day period. ^d Calculated using the central tendency value for working years. ^e Calculated using the high-end value for working years.			

A.2.3.1 Exposure Duration (ED)

EPA user an exposure duration of eighthours per day to estimate full-shift exposure.

A.2.3.2 Breathing Rate Ratio (BR)

EPA uses a breathing rate ratio, which is the ratio between the worker breathing rate and resting breathing rate, to account for the amount of air a worker breathes during exposure. The typical worker breathes about 10 m^3 of air in 8 hours, or $1.25 \text{ m}^3/\text{hr}$ ([CEB, 1991](#)) while the resting breathing rate is $0.6125 \text{ m}^3/\text{hr}$ ([CEB, 1991](#)). The ratio of these two values is equivalent to 2.04.

A.2.3.3 Exposure Frequency (EF)

EPA generally uses a maximum exposure frequency of 250 days per year based on an assumed shift duration of 8-hours/day.

A.2.3.4 Intermediate Exposure Frequency ($EF_{\text{intermediate}}$)

For 1,1,2-trichloroethane, the $D_{\text{intermediate}}$ was set at 30 days. EPA estimated the maximum number of working days within the $D_{\text{intermediate}}$, using the following equation and assuming 5 working days/wk:

Equation_Apx A-16.

$$EF_{intermediate}(max) = 5 \frac{\text{working days}}{wk} \times \frac{30 \text{ total days}}{7 \frac{\text{total days}}{wk}} = 21.4 \text{ days, rounded up to 22 days}$$

A.2.3.5 Intermediate Duration ($D_{intermediate}$)

EPA assessed an intermediate duration of 30 days based on the available health data.

A.2.3.6 Working Years (WY)

EPA has developed a triangular distribution for working years. EPA has defined the parameters of the triangular distribution as follows:

- Minimum value: BLS CPS tenure data with current employer as a low-end estimate of the number of lifetime working years: 10.4 years;
- Mode value: The 50th percentile tenure data with all employers from SIPP as a mode value for the number of lifetime working years: 36 years; and
- Maximum value: The maximum average tenure data with all employers from SIPP as a high-end estimate on the number of lifetime working years: 44 years.

This triangular distribution has a 50th percentile value of 31 years and a 95th percentile value of 40 years. EPA uses these values for central tendency and high-end ADC and LADC calculations, respectively. Additionally, EPA utilized industry specific estimates for working years for select OES where such information was available (Manufacturing as a byproduct).

The BLS ([U.S. BLS, 2014](#)) provides information on employee tenure with *current employer* obtained from the Current Population Survey (CPS). CPS is a monthly sample survey of about 60,000 households that provides information on the labor force status of the civilian non-institutional population age 16 and over; CPS data are released every 2 years. The data are available by demographics and by generic industry sectors but are not available by NAICS codes.

The U.S. Census' ([U.S. Census Bureau, 2019a](#)) Survey of Income and Program Participation (SIPP) provides information on *lifetime tenure with all employers*. SIPP is a household survey that collects data on income, labor force participation, social program participation and eligibility, and general demographic characteristics through a continuous series of national panel surveys of between 14,000 and 52,000 households ([U.S. Census Bureau, 2019a](#)). EPA analyzed the 2008 SIPP Panel Wave 1, a panel that began in 2008 and covers the interview months of September 2008 through December 2008 ([U.S. Census Bureau, 2019a, b](#)). For this panel, lifetime tenure data are available by Census Industry Codes, which can be cross-walked with NAICS codes.

SIPP data include fields for the industry in which each surveyed, employed individual works (TJBIND1), worker age (TAGE), and years of work experience *with all employers* over the surveyed individual's lifetime.¹⁴ Census household surveys use different industry codes than the NAICS codes used in its firm surveys, so these were converted to NAICS using a published crosswalk. EPA calculated

¹⁴ To calculate the number of years of work experience EPA took the difference between the year first worked (TMAKMNYR) and the current data year (*i.e.*, 2008). EPA then subtracted any intervening months when not working (ETIMEOFF).

the average tenure for the following age groups: (1) workers age 50 and older; (2) workers age 60 and older; and (3) workers of all ages employed at time of survey. EPA used tenure data for age group “50 and older” to determine the high-end lifetime working years, because the sample size in this age group is often substantially higher than the sample size for age group “60 and older”. For some industries, the number of workers surveyed, or the *sample size*, was too small to provide a reliable representation of the worker tenure in that industry. Therefore, EPA excluded data where the sample size is less than five from our analysis.

Table_Apx A-2 summarizes the average tenure for workers age 50 and older from SIPP data. Although the tenure may differ for any given industry sector, there is no significant variability between the 50th and 95th percentile values of average tenure across manufacturing and non-manufacturing sectors.

Table_Apx A-2. Overview of Average Worker Tenure from U.S. Census SIPP (Age Group 50+)

Industry Sectors	Working Years			
	Average	50th Percentile	95th Percentile	Maximum
All industry sectors relevant to the 10 chemicals undergoing risk evaluation	35.9	36	39	44
Manufacturing sectors (NAICS 31–33)	35.7	36	39	40
Non-manufacturing sectors (NAICS 42–81)	36.1	36	39	44
Source: (U.S. Census Bureau, 2019a)				
Note: Industries where sample size is less than five are excluded from this analysis.				

BLS CPS data provides the median years of tenure that wage and salary workers had been with their current employer. Table_Apx A-3 presents CPS data for all demographics (men and women) by age group from 2008 to 2012. To estimate the low-end value on number of working years, EPA uses the most recent (2014) CPS data for workers aged 55 to 64 years, which indicates a median tenure of 10.4 years with their current employer. The use of this low-end value represents a scenario where workers are only exposed to the chemical of interest for a portion of their lifetime working years, as they may change jobs or move from one industry to another throughout their career.

Table_Apx A-3. Median Years of Tenure with Current Employer by Age Group

Age	January 2008	January 2010	January 2012	January 2014
16 years and over	4.1	4.4	4.6	4.6
16 to 17 years	0.7	0.7	0.7	0.7
18 to 19 years	0.8	1.0	0.8	0.8
20 to 24 years	1.3	1.5	1.3	1.3
25 years and over	5.1	5.2	5.4	5.5
25 to 34 years	2.7	3.1	3.2	3.0

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Age	January 2008	January 2010	January 2012	January 2014
35 to 44 years	4.9	5.1	5.3	5.2
45 to 54 years	7.6	7.8	7.8	7.9
55 to 64 years	9.9	10.0	10.3	10.4
65 years and over	10.2	9.9	10.3	10.3
Source: BLS, 2014b.				

A.2.3.7 Lifetime Years (LT)

EPA assumes a lifetime of 78 years for all worker demographics.

A.3 Repackaging Model Approaches and Parameters

This appendix presents the modeling approach and equations used to estimate environmental releases and occupational exposures for 1,1,2-trichloroethane during the Repackaging OES. This approach utilizes the ESD for Transport and Storage of Chemicals and the Repackaging Generic Scenario ([U.S. EPA, 2022c](#); [OECD, 2009b](#)) combined with Monte Carlo simulation (a type of stochastic simulation).

Based on the ESD, EPA identified the following release sources from repackaging operations:

- Release Source 1: Transfer operation losses to air from unloading 1,1,2-trichloroethane
- Release Source 2: Product sampling wastes disposed of to incineration or landfill
- Release Source 3: Open surface losses to air during product sampling
- Release Source 4: Import container residue released to incineration or landfill
- Release Source 5: Open surface losses to air during container cleaning
- Release Source 6: Equipment cleaning releases to incineration or landfill
- Release Source 7: Open surface losses to air during equipment cleaning
- Release Source 8: Transfer operation losses to air from packaging 1,1,2- trichloroethane into containers

Based on the ESD, EPA also identified the following release sources from repackaging operations:

- Exposure Point A: Inhalation exposure from unloading transport containers
- Exposure Point B: Inhalation exposure from product sampling
- Exposure Point C: Inhalation exposure from container cleaning
- Exposure Point D: Inhalation exposure from equipment cleaning
- Exposure Point E: Inhalation exposure from loading of transport containers

Environmental releases and occupational exposures for 1,1,2-trichloroethane during repackaging are a function of 1,1,2-trichloroethane's physical properties, container size, mass fractions, and other model parameters. Although physical properties are fixed, some model parameters are expected to vary. EPA used a Monte Carlo simulation to capture variability in the following model input parameters for environmental releases: container loss fraction, saturation factor, container volume, and air speed. For occupational exposure, additional model parameters were ventilation rate, mixing factor, air speed,

saturation factor, loss factor, and container sizes. The Agency used the outputs from a Monte Carlo simulation with 100,000 iterations and the Latin Hypercube sampling method in @Risk to calculate release amounts and exposure concentrations for this OES.

A.3.1 Model Equations

Table_Apx A-4 provides the models and associated variables used to calculate environmental releases for each release source within each iteration of the Monte Carlo simulation. EPA used these environmental releases to develop a distribution of release outputs for the repackaging OES. The variables used to calculate each of the following values include deterministic or variable input parameters, known constants, physical properties, conversion factors, and other parameters. The values for these variables are provided in Appendix Section A.3.2. The Monte Carlo simulation calculated the total 1,1,2-trichloroethane release (by environmental media) across all release sources during each iteration of the simulation. EPA then selected 50th and 95th percentile values to estimate the central tendency and high-end releases, respectively.

Table_Apx A-4. Models and Variables Applied for Release Sources in the Repackaging OES

Release Source	Model(s) Applied	Variables Used
Release Source 1: Transfer operation losses to air from unloading 1,1,2-trichloroethane	EPA/OAQPS AP-42 Loading Model (Appendix A.1)	Vapor Generation Rate: $F_{saturation\_factor}$; MW_{112TCA} ; V_{tote} ; $RATE_{fill\_tote}$; $F_{chem\_product}$; VP_{112TCA} ; T_K Operating Time: $RATE_{fill\_tote}$
Release Source 2: Product sampling wastes disposed of to incineration or landfill	EPA/OPPT 2023 Methodology for Estimating Environmental Releases from Sampling Waste (Appendix A.1)	PV_{site} ; $F_{sampling\_RS2}$
Release Source 3: Open surface losses to air during product sampling	EPA/OPPT Penetration Model or EPA/OPPT Mass Transfer Coefficient Model, based on air speed (Appendix A.1)	Vapor Generation Rate: $F_{chem\_product}$; MW_{112TCA} ; VP_{112TCA} ; $RATE_{air\_speed}$; $D_{sampling\_RS3}$; T_K ; P_{Torr}
Release Source 4: Import container residue released to incineration or landfill	EPA/OPPT Bulk Transport Residual Model (Appendix A.1)	PV_{site} ; $F_{residue\_RS4}$
Release Source 5: Open surface losses to air during container cleaning	EPA/OPPT Penetration Model or EPA/OPPT Mass Transfer Coefficient Model, based on air speed (Appendix A.1)	Vapor Generation Rate: $F_{chem\_product}$; MW_{112TCA} ; VP_{112TCA} ; $RATE_{air\_speed}$; $D_{cleaning\_RS5}$; T_K ; P_{Torr}
Release Source 6: Equipment cleaning releases to incineration or landfill	EPA/OPPT Multiple Process Vessels Residual Model (Appendix A.1)	PV_{site} ; $F_{equip\_cleaning\_RS6}$
Release Source 7: Open surface losses to air during equipment cleaning	EPA/OPPT Penetration Model or EPA/OPPT Mass Transfer Coefficient Model, based on air speed (Appendix A.1)	Vapor Generation Rate: $F_{chem\_product}$; MW_{112TCA} ; VP_{112TCA} ; $RATE_{air\_speed}$; $D_{equipment\_RS7}$; T_K ; P_{Torr}
Release Source 8: Transfer operation losses to air from packaging 1,1,2-trichloroethane into containers	EPA/OAQPS AP-42 Loading Model (Appendix A.1)	Vapor Generation Rate: $F_{saturation\_factor}$; MW_{112TCA} ; $V_{prod\_container}$; $RATE_{fill\_prod\_container}$; $F_{chem\_product}$; VP_{112TCA} ; T_K Operating Time: $RATE_{fill\_prod\_container}$

Table_Apx A-5 provides the models and associated variables used to calculate occupational exposures for each exposure point within each iteration of the Monte Carlo simulation. EPA used these occupational exposures to develop a distribution of exposure outputs for the repackaging OES. EPA assumed that the same worker performed each exposure activity resulting in a total exposure duration of either 8, 10, or 12 hours per day. The variables used to calculate each of the following exposure concentrations and durations include deterministic or variable input parameters, known constants, physical properties, conversion factors, and other parameters.

The values for these variables are provided in Appendix A.3.2. The Monte Carlo simulation calculated a full shift (8, 10, or 12 hours per day) TWA exposure concentration for each iteration using the exposure concentration and duration associated with each activity and assuming exposures outside the exposure activities were zero. EPA then selected 50th percentile and 95th percentile values to estimate the central tendency and high-end exposure concentrations, respectively.

Table_Apx A-5. Models and Variables Applied for Exposure Points in the Repackaging OES

Exposure Point	Model(s) Applied	Variables Used
Exposure Point A: Inhalation exposure from unloading transport containers	EPA/OPPT Mass Balance Inhalation Model (Appendix A.1)	G_{RS1} ; Q_{vent} ; f_{mix} ; V_{molar} ; T_K ; VP ; F_{112TCA_prod}
Exposure Point B: Inhalation exposure from product sampling	EPA/OPPT Mass Balance Inhalation Model (Appendix A.1)	G_{RS3} ; Q_{vent} ; f_{mix} ; V_{molar} ; T_K ; VP ; F_{112TCA_prod}
Exposure Point C: Inhalation exposure from container cleaning	EPA/OPPT Mass Balance Inhalation Model (Appendix A.1)	G_{RS5} ; Q_{vent} ; f_{mix} ; V_{molar} ; T_K ; VP ; F_{112TCA_prod}
Exposure Point D: Inhalation exposure from equipment cleaning	EPA/OPPT Mass Balance Inhalation Model (Appendix A.1)	G_{RS7} ; Q_{vent} ; f_{mix} ; V_{molar} ; T_K ; VP ; F_{112TCA_prod}
Exposure Point E: Inhalation exposure from loading of transport containers	EPA/OPPT Mass Balance Inhalation Model (Appendix A.1)	G_{RS8} ; Q_{vent} ; f_{mix} ; V_{molar} ; T_K ; VP ; F_{112TCA_prod}

A.3.2 Model Input Parameters

Table_Apx A-6 and Table_Apx A-7 summarizes the model parameters and their values for the Repackaging Monte Carlo release and exposure simulations. Additional explanations of EPA's selection of the distributions for each parameter are provided following this table.

Table Apx A-6. Summary of Parameter Values and Distributions Used in the Repackaging Release Model

Input Parameter	Symbol	Unit	Deterministic Values	Uncertainty Analysis Distribution Parameters				Rationale/Basis
			Value	Lower Bound	Upper Bound	Mode	Distribution Type	
Operating Days	OP _{days}	days/yr	260	174	260	–	Discrete	2,080 hours/year divided by shift lengths (8 hr/day, 10 hr/day, and 12 hr/day)
Facility Annual Product Throughput	PV _{product}	Kg product/site-yr	7,000	1	315,479	–	Discrete	Search of PMN submission data related to repackaging from 2010-2020. 21 cases were identified, with repackaging rates ranging from 1 kg chemical/site-yr to 315,479 kg chem/site-yr and a 50th percentile of 7,000 kg chem/site-yr.
Waste Sampling Loss Fraction	F _{sampling_RS2}	unitless	0.00008-0.002	0.00000112-0.00000365	0.000552-0.0667	0.00008-0.002	Triangular	EPA/OPPT 2023 Methodology for Estimating Environmental Releases from Sampling Waste
Bulk Transport Container Residue Loss Fraction	F _{residue_RS4}	unitless	0.0007	0.0002	0.002	0.0007	Triangular	Repackaging GS
Air Speed	RATE _{air_speed}	cm/s	10	1.3	202.2	–	Lognormal	EPA's air speed model
Tote Size	V _{tote}	gal	550	100	1,000	550	Triangular	1991 CEB Manual for the Preparation of Engineering Assessments
Product Container Size	V _{prod_container}	gal/container	0.066	0.00026	0.66	0.066	Triangular	Based on 1,1,2-trichloroethane Laboratory Product Information
Saturation Factor During Loading/Unloading	F _{saturation_factor}	dimensionless	0.5	0.5	1.45	0.5	Triangular	AP-42 provided values

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Input Parameter	Symbol	Unit	Deterministic Values	Uncertainty Analysis Distribution Parameters				Rationale/Basis
			Value	Lower Bound	Upper Bound	Mode	Distribution Type	
Total Production Volume Assessed	PV	kg/yr	34,019.4	–	–	–	–	Based on CDR reporting thresholds
Mass Fraction of 1,1,2-trichloroethane in Product	F _{112TCA_product}	kg/kg	–	0.001	1	–	Discrete	Based on 1,1,2-trichloroethane Laboratory Product Information
Unloading Rate of Received Container	RATE _{unload}	containers/hr	20	–	–	–	–	ChemSTEER User Guide
Small Container Loading Rate	RATE _{fill_cont}	Container s/hr	60	–	–	–	–	ChemSTEER User Guide
Molecular Weight of 1,1,2-trichloroethane	MW _{112TCA}	g/mol	133.41	–	–	–	–	Chemical-Specific Parameter
Vapor Pressure of 1,1,2-trichloroethane	VP _{112TCA}	Torr	23	–	–	–	–	Chemical-Specific Parameter
Diameter of Sampling Opening	D _{sampling_RS3}	cm	5.08	–	–	–	–	ChemSTEER User Guide
Temperature	T _K	Kelvin	298	–	–	–	–	Assumed Standard Temperature
Pressure	P _{Torr}	Torr	760	–	–	–	–	Assumed Standard Pressure
Sampling Duration	OH _{RS3}	Hours/site-day	1	–	–	–	–	ChemSTEER User Guide
Diameter of Container Opening	D _{cleaning_RS5}	cm	5.08	–	–	–	–	ChemSTEER User Guide
Equipment Cleaning Loss Fraction	F _{equip_cleaning_RS6}	unitless	0.02	–	–	–	–	ChemSTEER User Guide
Equipment Cleaning Frequency	Freq _{cleaning}	days/yr	260	174	260	–	Discrete	Equal to Operating Days
Diameter of Equipment Opening	D _{equipment_RS7}	cm	92	–	–	–	–	Repackaging GS
Equipment Cleaning Duration	OH _{RS7}	hr/site-day	4	–	–	–	–	ChemSTEER User Guide

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Table_Apx A-7. Summary of Parameter Values and Distributions Used in the Repackaging Exposure Model

Input Parameter	Symbol	Unit	Deterministic Values	Uncertainty Analysis Distribution Parameters				Rationale/Basis
			Value	Lower Bound	Upper Bound	Mode	Distribution Type	
Ventilation Rate	Q_{vent}	ft ³ /min	3,000	500	3,000	3,000	Triangular	Triangular distribution ranging from 500 ft ³ /min to 3,000 ft ³ /min, with a mode of 3,000 ft ³ /min based on the EPA/OPPT Mass Balance Inhalation Model.
Mixing Factor	f_{mix}	unitless	0.5	0.5	1.45	0.5	Triangular	ChemSTEER User Guide
Working Years	WY	years	36	10.4	44	36	Triangular	Based on data from U.S. BLS Current Population Survey (CPS) and the U.S. Census Bureau Survey of Income and Program Participation (SIPP).
Full-Shift Exposure Duration	ED _{FS}	hrs/day	10	8	12	–	Uniform, Discrete	Discrete distribution using three potential shift times (8, 10, 12 hours). Based on the operating days parameter from the release assessment for consistency.
Exposure Frequency	EF	days/yr	200	167	250	–	Uniform, Discrete	Discrete distribution based on potential shift times (167, 200, 250 days). Based on the operating days parameter from the release assessment for consistency.
Molar Volume	V_{molar}	L/mol	24.45	–	–	–	–	Based on assumed standard conditions.
Lifetime Years	LT	years	78	–	–	–	–	Average lifetime years.

Input Parameter	Symbol	Unit	Deterministic Values	Uncertainty Analysis Distribution Parameters				Rationale/Basis
			Value	Lower Bound	Upper Bound	Mode	Distribution Type	
Intermediate Averaging Time	AT _{int}	hours	720	—	—	—	—	Equivalent of the total number of hours in a 30-day month.
Chronic Averaging Time	AT _c	hours	683,280	—	—	—	—	Equivalent of Lifetime Years (LT) converted to hours.
Breathing Ratio	BR	m ³ /hr	2.04	—	—	—	—	The ratio of the working breathing rate (1.25 m ³ /hr) to the resting breathing rate (0.6125 m ³ /hr) and is applied to the subsequent exposure outputs.

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A.3.3 Throughput Parameters

EPA estimated the annual facility throughput using the Chemical Repackaging GS ([U.S. EPA, 2022c](#)). The GS estimates chemicals are repackaged at rates ranging from 1 to 315,479 kg/site-year, with a 50th percentile value of 7,000 kg/site-year. EPA estimated the annual facility throughput using a triangular distribution of 1 to 315,479 kg/site-year with a mode of 7,000 kg/site-year.

The daily throughput of 1,1,2-trichloroethane is calculated using Equation_Apx A-17 by dividing the annual facility throughput by the number of operating days. The number of operating days is determined according to Section A.3.7.

Equation_Apx A-17.

$$PV_{site} = PV_{product} \times F_{chem\_product}$$

Where:

PV_{site}	=	Facility throughput of 1,1,2-trichloroethane [kg/site-day]
$PV_{product}$	=	Annual facility throughput of products [kg/site-yr]
$F_{chem\_product}$	=	Concentration of 1,1,2-trichloroethane in repackaged products [kg/kg]

A.3.4 Number of Sites

The number of sites is calculated using the following equation:

Equation_Apx A-18.

$$N_{sites} = \frac{PV}{PV_{site}}$$

Where:

N_{sites}	=	Number of sites [sites]
PV	=	Production Volume of 1,1,2-trichloroethane [kg/yr]
PV_{site}	=	Annual facility throughput of 1,1,2-trichloroethane [kg/site-yr]

A.3.5 Number of Containers per Year

The number of totes unloaded and repackaged into product containers per site per year is calculated using the following equation:

Equation_Apx A-19.

$$N_{cont\_unload\_site\_yr} = \frac{PV_{site}}{RHO_{product} \times \left(3.79 \frac{L}{gal}\right) \times V_{tote} \times 0.001 \frac{m^3}{L} \times F_{chem\_product}}$$

Where:

$N_{cont\_unload\_site\_yr}$	=	Annual number of totes unloaded [tote/site-year]
PV_{site}	=	Annual facility throughput of 1,1,2-trichloroethane [kg/site-yr]
$RHO_{product}$	=	Laboratory chemical product density [kg/m ³]
V_{tote}	=	Tote container volume [gal/container]
$F_{chem\_product}$	=	Concentration of 1,1,2-trichloroethane in product [kg/kg]

The number of product containers of repackaged 1,1,2-trichloroethane laboratory chemicals loaded per

site per year is calculated using the following equation:

Equation_Apx A-20.

$$N_{cont\_load\_site\_yr} = \frac{PV_{site}}{RHO_{product} \times \left(3.79 \frac{L}{gal}\right) \times V_{product\_container} \times 0.001 \frac{m^3}{L} * F_{chem\_product}}$$

Where:

$N_{cont\_load\_site\_yr}$	=	Annual number of product containers loaded [drum/site-year]
PV_{site}	=	Annual facility throughput of 1,1,2-trichloroethane [kg/site-yr]
$RHO_{product}$	=	Laboratory chemical product density [kg/m ³]
$V_{prod\_container}$	=	Product container volume [gal/container]
$F_{chem\_product}$	=	Concentration of 1,1,2-trichloroethane in product [kg/kg]

A.3.6 Operating Hours and Exposure Durations

EPA estimated operating hours or hours of duration using data provided from the ChemSTEER User Guide ([U.S. EPA, 2015a](#)) and/or through calculation from other parameters.

For unloading and container cleaning (release sources 1 and 5), the operating hours are calculated based on the number of totes unloaded at the site and the unloading rate using the following equation:

Equation_Apx A-21.

$$OH_{RS1/RS5} = \frac{N_{cont\_unload\_site\_yr}}{RATE_{fill\_tote} \times OD}$$

Where:

$OH_{RS1/RS5}$	=	Operating time for release sources 1 and 5 [hrs/site-day]
$N_{cont\_unload\_site\_yr}$	=	Annual number of totes unloaded [tote/site-year]
$RATE_{unload}$	=	Unload rate of totes [containers/hr]
OP_{days}	=	Operating days [days/site-year]

For loading into transport containers (release source 8), the operating hours are calculated based on the number of product containers filled per year. The operating hours are calculated using the following equation:

Equation_Apx A-22.

$$OH_{RS8} = \frac{N_{cont\_load\_site\_yr}}{RATE_{fill\_drum} \times OD}$$

Where:

OH_{RS8}	=	Operating time for release source 8 [hrs/site-day]
$N_{cont\_load\_site\_yr}$	=	Annual number of product containers loaded [containers/site-year]
$RATE_{fill\_cont}$	=	Fill rate of small containers [containers/hr]
OP_{days}	=	Operating days [days/site-year]

A.3.7 Operating Days

EPA assessed the number of operating days associated with repackaging using employment data obtained through the U.S. BLS Occupational Employment Statistics ([U.S. BLS, 2016](#)). Per the U.S. BLS website, operating duration for each NAICS code is assumed as a 'year-round, full-time' hours figure of 2,080 hours ([U.S. BLS, 2016](#)). Therefore, dividing this time by an assumed working duration of 8 to 12 hours/day yields a number of operating days between 174 to 260 days/year. In order to account for differences in operating days, EPA assumed three types of shift durations with corresponding operating days per year: 8-hour, 10-hour, and 12-hour shifts. These shift durations correspond to 260, 208, and 174 operating days per year, respectively. Therefore, EPA used a discrete distribution with equal probability for each shift length/operating days combination to model this parameter.

A.3.8 Repackaged 1,1,2-Trichloroethane Concentration

Based on a review of Datamyne data from 2019-2025, EPA identified 2 import instances of 1,1,2-trichloroethane in 2022 and 2024 to a laboratory. Based on the Consignee names, this was an import by Sigma-Aldrich, a laboratory chemical distributor. EPA assumed that 1,1,2-trichloroethane-containing laboratory chemicals are repackaged into smaller product containers for downstream use, therefore, the concentrations of 1,1,2-trichloroethane-containing laboratory chemicals were used in the Monte Carlo model.

A.3.9 Air Speed

Baldwin and Maynard measured indoor air speeds across a variety of occupational settings in the United Kingdom ([Baldwin and Maynard, 1998](#)). Fifty-five work areas were surveyed across a variety of workplaces. EPA analyzed the air speed data from Baldwin and Maynard and categorized the air speed surveys into settings representative of industrial facilities and representative of commercial facilities. EPA fit separate distributions for these industrial and commercial settings and used the industrial distribution for this OES.

EPA fit a lognormal distribution for the data set as consistent with the authors' observations that the air speed measurements within a surveyed location were lognormally distributed and the population of the mean air speeds among all surveys were lognormally distributed ([Baldwin and Maynard, 1998](#)). Since lognormal distributions are bound by zero and positive infinity, EPA truncated the distribution at the largest observed value among all of the survey mean air speeds.

EPA fit the air speed surveys representative of industrial facilities to a lognormal distribution with the following parameter values: mean of 22.414 cm/s and standard deviation of 19.958 cm/s. In the model, the lognormal distribution is truncated at a minimum allowed value of 1.3 cm/s and a maximum allowed value of 202.2 cm/s (largest surveyed mean air speed observed in Baldwin and Maynard) to prevent the model from sampling values that approach infinity or are otherwise unrealistically small or large ([Baldwin and Maynard, 1998](#)).

Baldwin and Maynard only presented the mean air speed of each survey. The authors did not present the individual measurements within each survey. Therefore, these distributions represent a distribution of mean air speeds and not a distribution of spatially variable air speeds within a single workplace setting. However, a mean air speed (averaged over a work area) is the required input for the model. EPA converted the units to ft/min prior to use within the model equations.

A.3.10 Bulk Container Residue Fraction

EPA paired the data from the PEI Associates Inc. study ([PEI Associates, 1988](#)) such that the residuals data for emptying tanks by gravity-draining was aligned with the default central tendency and high-end values from the EPA/OPPT Bulk Transport Residual Model. For unloading tanks by gravity-draining in the PEI Associates Inc. study, EPA found that the average percent residual from the pilot-scale experiments showed a range of 0.02 to 0.19 % and an average of 0.06 % ([PEI Associates, 1988](#)). The EPA/OPPT Bulk Transport Residual Model from the ChemSTEER User Guide ([U.S. EPA, 2015a](#)) recommends a default central tendency loss fraction of 0.07 % and a high-end loss fraction of 0.2 %.

The underlying distribution of the loss fraction parameter for bulk containers is not known; therefore, EPA assigned a triangular distribution, since triangular distributions require least assumptions and are completely defined by range and mode of a parameter. EPA assigned the mode and maximum values for the loss fraction probability distribution using the central tendency and high-end values, respectively, prescribed by the EPA/OPPT Bulk Transport Residual Model in the ChemSTEER User Guide ([U.S. EPA, 2015a](#)). EPA assigned the minimum value for the triangular distribution using the minimum average percent residual measured in the PEI Associates, Inc. study for emptying tanks by gravity-draining ([PEI Associates, 1988](#)).

A.3.11 Sampling Loss Fraction

Sampling loss fractions were estimated using the March 2023 Methodology for Estimating Environmental Releases from Sampling Wastes ([U.S. EPA, 2023c](#)). In this methodology, EPA completed a search of over 300 IRERs completed in the years 2021 and 2022 for sampling release data, including a similar proportion of both PMNs and LVE). Of the searched IRERs, 60 data points for sampling release loss fractions, primarily for sampling releases from submitter-controlled sites (~75% of IRERs), were obtained. The data points were analyzed as a function of the chemical daily throughput and industry type. This analysis showed that the sampling loss fraction generally decreased as the chemical daily throughput increased. Therefore, the methodology provides guidance for selecting a loss fraction based on chemical daily throughput. Table_Apx A-8 presents a summary of the chemical daily throughputs and corresponding loss fractions.

Table_Apx A-8. Sampling Loss Fraction Data from the March 2023 Methodology for Estimating Environmental Releases from Sampling Waste

Chemical Daily Throughput (kg/site-day) (PV _{site})	Number of Data Points	Sampled Quantity (kg chemical/day)		Sampling Loss Fraction (LF _{sampling})	
		50 th Percentile	95 th Percentile	50 th Percentile	95 th Percentile
<50	13	0.03	0.20	0.002	0.02
50 to <200	10	0.10	0.64	0.0006	0.005
200 to <5,000	25	0.37	3.80	0.0005	0.004
≥5,000	10	1.36	6.00	0.00008	0.0004
All	58	0.20	5.15	0.0005	0.008

For each range of daily throughputs, EPA estimated sampling loss fractions using a triangular distribution of the 50th percentile value as the lower bound, and the 95th percentile value as the upper

bound and mode. The sampling loss fraction distribution was chosen based on the calculation of daily throughput, as shown in Section A.3.3.

A.3.12 Diameter of Opening

The ChemSTEER User Guide indicates diameters for the openings for various vessels that may hold liquids in order to calculate vapor generation rates during different activities ([U.S. EPA, 2015a](#)). In the simulation developed for the repackaging OES based on the ESD for Transport and Storage of Chemicals ([OECD, 2009b](#)), EPA used the default diameters of vessels from the ChemSTEER User Guide for product sampling, container cleaning, and equipment cleaning.

For container cleaning activities, the ChemSTEER User Guide indicates a single default value of 5.08 cm ([U.S. EPA, 2015a](#)). Therefore, EPA could not develop a distribution of values for this parameter and used the single value 5.08 cm from that user guide. EPA also utilized this value for product sampling activities as it is expected that products are sampled from the containers received on site.

For equipment cleaning activities, the ChemSTEER User Guide indicates a single default value of 92 cm ([U.S. EPA, 2015a](#)). Therefore, EPA could not develop a distribution of values for this parameter and used the single value 92 cm from that user guide.

A.3.13 Equipment Cleaning Loss Fraction

EPA used the EPA/OPPT Multiple Process Residual Model to estimate the releases from equipment cleaning. The EPA/OPPT Multiple Process Residual Model, as detailed in the ChemSTEER User Guide ([U.S. EPA, 2015a](#)) provides an overall loss fraction of two % from equipment cleaning.

A.3.14 Saturation Factor

The Chemical Engineering Branch Manual for the Preparation of Engineering Assessments, Volume 1 [CEB Manual] indicates that during splash filling, the saturation concentration was reached or exceeded by misting with a maximum saturation factor of 1.45 ([CEB, 1991](#)). The CEB Manual indicates that saturation concentration for bottom filling was expected to be about 0.5 ([CEB, 1991](#)). The underlying distribution of this parameter is not known; therefore, EPA assigned a triangular distribution based on the lower bound, upper bound, and mode of the parameter. Because a mode was not provided for this parameter, EPA also assigned a mode value of 0.5 for bottom filling as bottom filling minimizes volatilization ([CEB, 1991](#)). This value also corresponds to the typical value provided in the ChemSTEER User Guide for the EPA/OAQPS AP-42 Loading Model ([U.S. EPA, 2015a](#)).

A.3.15 Container Size

The ChemSTEER User Guide ([U.S. EPA, 2015a](#)) indicates a range of 100 to less than 1,000 gallons for the volume capacity of totes modeled in container-related activities with 550 gallons as the default volume size. The underlying distribution import tote sizes is not known; therefore, EPA assigned a lower bound of 100 gallons, an upper bound of 1,000 gallons, and a mode of 550 gallons for the import container volume distribution.

For the product container sizes, EPA assigned a lower bound of 0.00026 gallons, an upper bound of 0.66 gallons, and a mode of 0.066 gallons based on available 1,1,2-trichloroethane containing laboratory chemical product data.

A.3.16 Container Fill Rates

The ChemSTEER User Guide ([U.S. EPA, 2015a](#)) provides a typical fill rate of 20 containers per hour for containers with 100 to 1,000 gallons of liquid and a typical fill rate of 60 containers per hour for

containers with less than 20 gallons of liquid.

A.3.17 Ventilation Rate

The CEB Manual ([CEB, 1991](#)) indicates general ventilation rates in industry range from 500 to 10,000 ft³/min, with a typical value of 3,000 ft³/min. The underlying distribution of this parameter is not known; therefore, EPA assigned a triangular distribution based on an estimated lower bound, upper bound, and mode of the parameter. EPA assumed the lower and upper bound using the industry range of 500 to 10,000 ft³/min and the mode using the 3,000 ft³/min typical value ([CEB, 1991](#)).

A.3.18 Mixing Factor

The CEB Manual ([CEB, 1991](#)) indicates mixing factors may range from 0.1 to 1, with 1 representing ideal mixing. The CEB Manual references the 1988 ACGIH Ventilation Handbook, which suggests the following factors and descriptions: 0.67 to 1 for best mixing; 0.5 to 0.67 for good mixing; 0.2 to 0.5 for fair mixing; and 0.1 to 0.2 for poor mixing ([CEB, 1991](#)). The underlying distribution of this parameter is not known; therefore, EPA assigned a triangular distribution based on the defined lower and upper bound and estimated mode of the parameter. The mode for this distribution was not provided; therefore, EPA assigned a mode value of 0.5 based on the typical value provided in the ChemSTEER User Guide for the EPA/OPPT Mass Balance Inhalation Model ([U.S. EPA, 2015a](#)).

A.4 Formulation of Adhesives and Sealants Model Approaches and Parameters

This appendix presents the modeling approach and equations used to estimate environmental releases for 1,1,2-trichloroethane during the incorporation into formulation, mixture, or reaction product – incorporation into adhesives and sealants OES. This approach utilizes the Emission Scenario Document on Adhesive Formulation ([OECD, 2009a](#)) combined with Monte Carlo simulation (a type of stochastic simulation).

Based on the ESD, EPA identified the following release sources from incorporation into adhesives and sealants:

- Release source 1: Transfer Operation Losses to Air from Unloading Adhesive Component.
- Release source 2: Dust Generation from Transfer Operations.
- Release source 3: Adhesive Component Container Residue Losses.
- Release source 4: Open Surface Losses to Air During Container Cleaning.
- Release source 5: Vented Losses During Dispersion and Blending/Process Operations.
- Release source 6: Product Sampling Wastes.
- Release source 7: Open Surface Losses to Air During Product Sampling.
- Release source 8: Equipment Cleaning Wastes.
- Release source 9: Open Surface Losses to Air During Equipment Cleaning.
- Release source 10: Transfer Operations Losses to Air for Packaging Adhesive/Sealant into Transport Containers.
- Release source 11: Off-Specification and Other Waste Adhesive.

Environmental releases for 1,1,2-trichloroethane during incorporation into adhesives and sealants are a function of 1,1,2-trichloroethanes physical properties, container size, mass fractions, and other model parameters. While physical properties are fixed, some model parameters are expected to vary. EPA used a Monte Carlo simulation to capture variability in the following model input parameters: production volume, 1,1,2-trichloroethane concentrations, air speed, saturation factor, container size, loss fractions,

diameters of openings, and operating durations. EPA used the outputs from a Monte Carlo simulation with 100,000 iterations and the Latin Hypercube sampling method in @Risk to calculate release amounts for this OES.

A.4.1 Model Equations

Table_Apx A-9 provides the models and associated variables used to calculate environmental releases for each release source within each iteration of the Monte Carlo simulation. EPA used these environmental releases to develop a distribution of release outputs for the formulation of adhesives and sealants OES. The variables used to calculate each of the following values include deterministic or variable input parameters, known constants, physical properties, conversion factors, and other parameters. The values for these variables are provided in Appendix A.4.2. The Monte Carlo simulation calculated the total 1,1,2-trichloroethane release (by environmental media) across all release sources during each iteration of the simulation. EPA then selected 50th percentile and 95th percentile values to estimate the central tendency and high-end releases, respectively.

Table_Apx A-9. Models and Variables Applied for Release Sources in the Formulation of Adhesives and Sealants OES

Release Source	Model(s) Applied	Variables Used
Release source 1: Transfer Operation Losses to Air from Unloading the Adhesive Component	EPA/OAQPS AP-42 Loading Model (Appendix A.1)	f_{sat} ; MW_{112TCA} ; $V_{received\_cont}$; $RATE_{fill}$; $F_{112TCA\_received}$; VP_{112TCA} ; T_K Operating Time: $N_{cont\_unload\_site\_yr}$; $RATE_{unload}$; OP_{days}
Release source 2: Dust Generation from Transfer Operations.	Not assessed for liquid 1,1,2-trichloroethane.	N/A
Release source 3: Adhesive Component Container Residue.	EPA/OPPT Drum Residual Model (Appendix A.1)	PV_{site} ; LF_{RS3} ; $V_{cont\_received}$; RHO_{112TCA} ; $F_{112TCA\_received}$; $N_{cont\_unload\_site\_yr}$
Release source 4: Open Surface Losses to Air During Container Cleaning.	EPA/OPPT Penetration Model or EPA/OPPT Mass Transfer Coefficient Model, based on air speed (Appendix A.1)	Vapor Generation Rate: $F_{112TCA\_received}$; MW_{112TCA} ; VP_{112TCA} ; $RATE_{air\_speed}$; D_{cont_RS4} ; T_K ; P_{Torr} ; OP_{days} Operating Time: $N_{cont\_unload\_site\_yr}$; $RATE_{unload}$; OP_{days}
Release source 5: Vented Losses to Air During Dispersion and Blending.	EPA/OPPT Penetration Model or EPA/OPPT Mass Transfer Coefficient Model, based on air speed (Appendix A.1)	Vapor Generation Rate: $F_{112TCA\_received}$; MW_{112TCA} ; VP_{112TCA} ; $RATE_{air\_speed}$; D_{RS5} ; T_K ; P_{Torr} Operating Time: N_{batch} ; OH_{batch} ; OP_{days}
Release source 6: Product Sampling Wastes.	March 2023 Methodology for Estimating Environmental Releases from Sampling Waste (Appendix A.1)	PV_{site} ; LF_{RS6}
Release source 7: Open Surface Losses to Air During Product Sampling.	EPA/OPPT Penetration Model or EPA/OPPT Mass Transfer Coefficient Model, based on air speed (Appendix A.1)	Vapor Generation Rate: F_{112TCA_prod} ; MW_{112TCA} ; VP_{112TCA} ; $RATE_{air\_speed}$; D_{RS7} ; T_K ; P_{Torr} Operating Time: OH_{RS7}

Release Source	Model(s) Applied	Variables Used
Release source 8: Equipment Cleaning Wastes.	EPA/OPPT Multiple Process Vessel Residual Model (Appendix A.1)	$PV_{site}; LF_{RS8}$
Release source 9: Open Surface Losses to Air During Equipment Cleaning.	EPA/OPPT Penetration Model or EPA/OPPT Mass Transfer Coefficient Model, based on air speed (Appendix A.1)	Vapor Generation Rate: $F_{112TCA_{prod}}; MW_{112TCA}; VP_{112TCA}; RATE_{air\_speed}; D_{RS9}; T_K; P_{Torr}$ Operating Time: OH_{RS9}
Release source 10: Transfer Operation Losses to Air from Packaging Adhesive/ Sealant into Transport Containers.	EPA/OAQPS AP-42 Loading Model (Appendix A.1)	$F_{112TCA_{prod}}; VP_{112TCA}; f_{sat}; MW_{112TCA}; T_K; V_{prod\_cont}; RATE_{fill}$ Operating Time: $N_{cont\_load\_site\_yr}; RATE_{fill}; OP_{days}$
Release source 11: Off-Spec and Other Waste Adhesive.	See Equation_Apx A-23	$PV_{site}; LF_{RS11}$

Release source 11 daily release (Off-Spec and Other Waste Adhesive) is calculated using the following equation:

Equation_Apx A-23.

$$Release\_perDay_{RP11} = PV_{site} \times LF_{RS11}$$

Where:

$Release\_perDay_{RS11}$	=	1,1,2-Trichloroethane released for release source 11 [kg/site-day]
PV_{site}	=	Facility throughput of 1,1,2-trichloroethane [kg/site-day]
LF_{RS11}	=	Loss fraction for off-spec and waste adhesive [unitless]

A.4.2 Model Input Parameters

Table_Apx A-10 summarizes the model parameters and their values for the Formulation of Adhesives and Sealants Monte Carlo simulation. Additional explanations of EPA's selection of the distributions for each parameter are provided after this table.

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Table_Apx A-10. Summary of Parameter Values and Distributions Used in the Formulation of Adhesives and Sealants Model

Input Parameter	Symbol	Unit	Deterministic Values	Uncertainty Analysis Distribution Parameters				Rationale / Basis
			Value	Lower Bound	Upper Bound	Mode	Distribution Type	
Facility Adhesive Production Rate	Q _{adhesive_site_yr}	kg/site-yr	2,190,000	380,000	4,000,000	—	Uniform	ESD on Adhesive Formulation (OECD, 2009a)
PV of 1,1,2-Trichloroethane Assessed	PV _{kg}	kg/year	34,019	—	—	—	—	See Section A.4.4
1,1,2- Trichloroethane Concentration Received	F _{112TCA_received}	kg/kg	0.155	0.010	0.30	—	Uniform	See Section A.4.8
1,1,2- Trichloroethane Concentration in Product	F _{112TCA_prod}	kg/kg	0.3	0.010	0.05	—	Uniform	See Section A.4.9
Air Speed	RATE _{air_speed}	ft/min	19.7	2.56	398	—	Lognormal	See Section A.4.10
Saturation Factor	f _{sat}	dimensionless	0.5	0.5	1.45	0.5	Triangular	See Section A.4.11
Feed Container Size	V _{received_cont}	gal	55	20	100	55	Triangular	See Section A.4.12
Product Container Size	V _{prod_cont}	gal	—	0.013	0.1	—	Discrete	See Section A.4.12
Container Residual Loss Fraction	LF _{RS3}	kg/kg	0.025	0.017	0.03	0.025	Triangular	See Section A.4.13
Fraction of 1,1,2-Trichloroethane Lost During Sampling – 1 (PV _{site} < 50 kg/site-day)	LF _{RS6_<50kg}	kg/kg	2.0E–02	2.0E–03	2.0E–02	2.0E–02	Triangular	See Section A.4.14
Fraction of 1,1,2-Trichloroethane Lost During Sampling – 2 (PV _{site} 50–200 kg/site-day)	LF _{RS6_50-200kg}	kg/kg	5.0E–03	6.0E–04	5.0E–03	5.0E–03	Triangular	See Section A.4.14
Fraction of 1,1,2- Trichloroethane Lost During Sampling - 3 (PV _{site} 200–5,000 kg/site-day)	LF _{RS6_200-500kg}	kg/kg	4.0E–03	5.0E–04	4.0E–03	4.0E–03	Triangular	See Section A.4.14
Fraction of 1,1,2- Trichloroethane Lost During Sampling – 4 (PV _{site} > 5,000 kg/site-day)	LF _{RS6_>5000kg}	kg/kg	4.0E–04	8.0E-5	4.0E–04	4.0E–04	Triangular	See Section A.4.14
Diameter of Opening – Container Cleaning	D _{cont_RS4}	cm	5.08	—	—	—	—	See Section A.4.15
Diameter of Opening – Blending	D _{RS5}	cm	10	—	—	—	—	See Section A.4.15
Diameter of Opening – Sampling	D _{RS7}	cm	2.5	2.5	10	—	Uniform	See Section A.4.15
Diameter of Opening – Equipment	D _{RS9}	cm	92	—	—	—	—	See Section A.4.15

Input Parameter	Symbol	Unit	Deterministic Values	Uncertainty Analysis Distribution Parameters				Rationale / Basis
			Value	Lower Bound	Upper Bound	Mode	Distribution Type	
Cleaning								
Hours per Batch for Equipment Cleaning	OH _{RS9}	hours/batch	3	1	4	3	Triangular	See Section A.4.19
Vapor Pressure at 25 °C	VP	Torr	23	–	–	–	–	Physical property
Molecular Weight	MW	g/mol	133.41	–	–	–	–	Physical property
Density of 1,1,2- Trichloroethane	RHO _{112TCA}	kg/m ³	1,432	–	–	–	–	Physical property
Density of Adhesive Product	RHO _{prod}	kg/m ³	1,030	–	–	–	–	Product-specific property
Temperature	T _K	K	298	–	–	–	–	Process parameter
Pressure	P _{Torr}	Torr	760	–	–	–	–	Process parameter
Batch Size	V _{batch}	kg/batch	1,000	300	5,000	1,000	Triangular	See Section A.4.17
Operating Hours per Batch	OH _{batch}	Hr/batch	8	8	24	8	Triangular	See Section A.4.7
Container Unload Rate	RATE _{unload}	containers/hr	20	–	–	–	–	See Section A.4.18
Small Container Fill Rate	RATE _{fill}	containers/hr	60	–	–	–	–	See Section A.4.18
Sampling Duration	OH _{RS7}	hr/day	1	–	–	–	–	See Section A.4.7
Equipment Cleaning Loss Fraction	LF _{RS8}	kg/kg	2.0E–02	–	–	–	–	See Section A.4.19
Off-Spec and Waste Loss Fraction	LF _{RS11}	kg/kg	1.0E–02	–	–	–	–	See Section A.4.20

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A.4.3 Number of Sites

The number of sites is calculated using the following equation:

Equation_Apx A-24.

$$N_{cont\_unload\_site\_yr} = \frac{PV_{site}}{Q_{adhesive\_site\_yr} \times F_{112TCA\_prod}}$$

Where:

N_{sites}	=	Number of sites [sites]
PV_{site}	=	Annual facility throughput of 1,1,2-trichloroethane (see Section A.4.4) [kg/site-yr]
$Q_{adhesive\_site\_yr}$	=	Annual facility adhesive throughput [kg adhesive/site-yr] (see Section A.4.2)
F_{112TCA_prod}	=	Concentration of 1,1,2-trichloroethane in product [kg/kg]

A.4.4 Throughput Parameters

The annual throughput of 1,1,2-trichloroethane is calculated using Equation_Apx A-25 by multiplying the facility adhesive production rate by the concentration of 1,1,2-trichloroethane in adhesive products.

Equation_Apx A-25.

$$PV_{site} = Q_{adhesive\_site\_yr} \times F_{112TCA\_prod}$$

Where:

PV_{site}	=	Facility throughput of 1,1,2-trichloroethane [kg/site-yr]
$Q_{adhesive\_site\_yr}$	=	Facility annual throughput of adhesives [kg adhesive/site-yr]
F_{112TCA_prod}	=	Concentration of 1,1,2-trichloroethane in products [kg/kg]

A.4.5 Number of Batches

The annual number of adhesive batches produced by a site is calculated using the following equation:

Equation_Apx A-26.

$$N_{batch} = \frac{Q_{adhesive\_site\_yr}}{\left(V_{batch} \times RHO_{prod} \times 0.00379 \frac{m^3}{gal} \right)}$$

Where:

N_{batch}	=	Annual number of adhesive batches produced [batches/site-year]
$Q_{adhesive\_site\_yr}$	=	Annual facility throughput of adhesive (see Section A.4.4) [kg adhesive/site-yr]
V_{batch}	=	Volume of adhesive batches [gal/batch]
RHO_{prod}	=	Density of adhesive products [kg/m ³]

A.4.6 Numbers of Containers per Year

The number of 1,1,2-trichloroethane raw material containers received and unloaded by a site per year is calculated using the following equation:

Equation_Apx A-27.

$$N_{cont\_unload\_site\_yr} = \frac{PV_{site}}{V_{received\_cont} \times F_{112TCA\_received} \times \left(3.79 \frac{L}{gal}\right) \times RHO_{112TCA} \times (0.001 \frac{m^3}{L})}$$

Where:

$N_{cont\_unload\_site\_yr}$	=	Annual number of containers unloaded [container/site-year]
PV_{site}	=	Annual facility throughput of 1,1,2-trichloroethane (see Section A.4.4) [kg/site-yr]
$V_{received\_cont}$	=	Received container volume (see Section A.4.12) [gal/container]
$F_{112TCA\_received}$	=	Concentration of 1,1,2-trichloroethane received on site [kg/kg]
RHO_{112TCA}	=	Density of 1,1,2-trichloroethane [kg/m ³]

The number of product containers loaded by a site per year is calculated using the following equation:

Equation_Apx A-28.

$$N_{cont\_load\_site\_yr} = \frac{PV_{site}}{RHO_{product} \times \left(3.79 \frac{L}{gal}\right) \times V_{prod\_cont} \times 0.001 \frac{m^3}{L} \times F_{112TCA\_product}}$$

Where:

$N_{cont\_load\_site\_yr}$	=	Annual number of product containers loaded [drum/site-year]
PV_{site}	=	Annual facility throughput of 1,1,2-trichloroethane (see Section A.4.4) [kg/site-yr]
RHO_{prod}	=	Laboratory chemical product density [kg/m ³]
V_{prod_cont}	=	Product container volume (see Section A.4.12) [gal/container]
$F_{112TCA\_product}$	=	Concentration of 1,1,2-trichloroethane in product [kg/kg]

A.4.7 Operating Hours

EPA estimated operating hours or hours of duration using data provided from the ESD for Adhesive Formulation ([OECD, 2009a](#)), ChemSTEER User Guide ([U.S. EPA, 2015a](#)), and/or through calculation from other parameters. Release points with operating hours provided from these sources include unloading, container cleaning, blending/process operations, product sampling, equipment cleaning, and loading into transport containers.

For unloading and container cleaning (release points 1 and 4), the operating hours are calculated based on the number of containers unloaded at the site and the unloading rate using the following equation:

Equation_Apx A-29.

$$OH_{RS1/RS4} = \frac{N_{cont\_unload\_site\_yr}}{RATE_{unload} \times OP_{days}}$$

Where:

$OH_{RS1/RS4}$	=	Operating time for release points 1 and 4 [hrs/site-day]
$N_{cont\_unload\_site\_yr}$	=	Annual number of containers unloaded (see Section A.4.6)

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[container/site-year]

 $RATE_{fill\_drum\_tote}$ = Unload rate of containers (see Section A.4.18) [containers/hr]

 OP_{days} = Operating days (see Section A.4.16) [days/site-year]

For blending/process operations (release point 5), the ESD for Adhesive Formulation ([OECD, 2009a](#)) recommends using the following equation:

Equation_Apx A-30.

$$OH_{RS5} = \left(\frac{N_{batch} \times OH_{batch}}{OP_{days}} \right)$$

Where:

 OH_{RS5} = Operating time for release point 5 [hrs/site-day]

 N_{batch} = Facility annual throughput of (see Section A.4.5) [kg/site-yr]

 OH_{batch} = Operating hours per batch (see Section A.4.7) [hr/batch]

 OP_{days} = Operating days (see Section A.4.16) [days/site-year]

For product sampling (release point 7), the ChemSTEER User Guide ([U.S. EPA, 2015a](#)) indicates a value of 1 hour/day.

For equipment cleaning (release point 9), the ESD for Adhesive Formulation ([OECD, 2009a](#)) provides an estimate of four hours per batch based on the value for cleaning multiple vessels from the ChemSTEER User Guide ([U.S. EPA, 2015a](#)). The ESD for Adhesive Formulation also states that a case study conducted by the Pollution Prevention Assistance Division indicated a range of equipment cleaning times between one and three hours per batch. The underlying distribution of this parameter is not known; therefore, EPA assigned a triangular distribution based on a lower bound, upper bound, and mode for equipment cleaning operating hours. EPA assigned the lower bound as one hour based on the lower end cleaning time observed in the case study ([OECD, 2009a](#)) and the upper bound as four hours based on the ChemSTEER User Guide default value for this worker activity. For the mode, EPA assigned three hours based on the ESD for Adhesive Formulation ([OECD, 2009a](#)).

For loading into transport containers (release point 10), the operating hours are calculated based on number of product containers filled per year unless the operating hours per day exceeds 24 hours. If the total operating hours exceeds 24 hours, the duration for loading containers is capped at 24 hours per day. The operating hours are calculated using the following equation:

Equation_Apx A-31.

$$OH_{RS10} = \frac{N_{cont\_load\_site\_yr}}{RATE_{fill} \times OP_{days}}$$

Where:

 OH_{RS10} = Operating time for release point 10 [hrs/site-day]

 $RATE_{fill}$ = Fill rate of containers (see Section A.4.18) [containers/hr]

 $N_{cont\_load\_site\_yr}$ = Annual number of containers loaded (see Section A.4.6) [container/site-year]

 OP_{days} = Operating days (see Section A.4.16) [days/site-year]

A.4.8 Feed 1,1,2-Trichloroethane Concentration

EPA used the manufactured concentration range reported in CDR ([U.S. EPA, 2020b](#)) of 1 to 30 % to create a uniform distribution.

A.4.9 Final 1,1,2-Trichloroethane Concentration

EPA modeled final, post-formulation, 1,1,2-trichloroethane concentration in adhesives and sealants using a uniform distribution with a lower bound of 1 % and an upper bound of 5 %. The assessed range is based on SDS information for one adhesive and sealant product containing 1,1,2-trichloroethane. From the compiled data, the minimum concentration was 1 percent and the maximum was 5 % ([Huntsman, 2018](#)).

A.4.10 Air Speed

Baldwin and Maynard measured indoor air speeds across a variety of occupational settings in the United Kingdom ([Baldwin and Maynard, 1998](#)). Fifty-five work areas were surveyed across a variety of workplaces. EPA analyzed the air speed data from Baldwin and Maynard and categorized the air speed surveys into settings representative of industrial facilities and representative of commercial facilities. EPA fit separate distributions for these industrial and commercial settings and used the industrial distribution for this OES.

EPA fit a lognormal distribution for the data set as consistent with the authors' observations that the air speed measurements within a surveyed location were lognormally distributed and the population of the mean air speeds among all surveys were lognormally distributed ([Baldwin and Maynard, 1998](#)). Since lognormal distributions are bound by zero and positive infinity, EPA truncated the distribution at the largest observed value among all of the survey mean air speeds.

EPA fit the air speed surveys representative of industrial facilities to a lognormal distribution with the following parameter values: mean of 22.414 cm/s and standard deviation of 19.958 cm/s. In the model, the lognormal distribution is truncated at a minimum allowed value of 1.3 cm/s and a maximum allowed value of 202.2 cm/s (largest surveyed mean air speed observed in Baldwin and Maynard) to prevent the model from sampling values that approach infinity or are otherwise unrealistically small or large ([Baldwin and Maynard, 1998](#)).

Baldwin and Maynard only presented the mean air speed of each survey. The authors did not present the individual measurements within each survey. Therefore, these distributions represent a distribution of mean air speeds and not a distribution of spatially variable air speeds within a single workplace setting. However, a mean air speed (averaged over a work area) is the required input for the model. EPA converted the units to ft/min prior to use within the model equations.

A.4.11 Saturation Factor

The CEB Manual indicates that during splash filling, the saturation concentration was reached or exceeded by misting with a maximum saturation factor of 1.45 ([CEB, 1991](#)). The CEB Manual indicates that saturation concentration for bottom filling was expected to be about 0.5 ([CEB, 1991](#)). The underlying distribution of this parameter is not known; therefore, EPA assigned a triangular distribution based on the lower bound, upper bound, and mode of the parameter. Because a mode was not provided for this parameter, EPA assigned a mode value of 0.5 for bottom filling as bottom filling minimizes volatilization ([CEB, 1991](#)). This value also corresponds to the typical value provided in the ChemSTEER User Guide for the EPA/OAQPS AP-42 Loading Model ([CEB, 1991](#)).

A.4.12 Container Size

EPA assumed that adhesive and sealant manufacturing sites would receive 1,1,2-trichloroethane in drums. According to the ESD for Adhesive Formulation ([OECD, 2009a](#)), 55-gallon drums are expected to be the default container size for adhesives and sealant components. According to the ChemSTEER User Guide, drums are defined as containing between 20 and 100 gallons of liquid, and the default drum size is 55 gallons ([U.S. EPA, 2015a](#)). Therefore, EPA modeled the incoming container size using a triangular distribution with a lower bound of 20 gallons, an upper bound of 100 gallons, and a mode of 55 gallons.

For packaging of adhesives and sealants after formulation, EPA identified one product in bottles as small as 0.013 or 0.1 gallons. Based on the available product information, modeled finished adhesive container size using a discrete distribution with an equal chance of 0.013 gallon and 0.1 gallon containers.

A.4.13 Drum Residue Loss Fraction

For drums, EPA paired the data from the PEI Associates Inc. study ([PEI Associates, 1988](#)) such that the residuals data for emptying drums by pouring was aligned with the default central tendency and high-end values from the EPA/OPPT Drum Residual Model. For unloading drums by pumping in the PEI Associates Inc. study ([PEI Associates, 1988](#)), EPA found that the average percent residual from the pilot-scale experiments showed a range of 0.017 to 0.03 % and an average of 0.025 %. The EPA/OPPT Drum Residual Model from the ChemSTEER User Guide ([U.S. EPA, 2015a](#)) recommends a default central tendency loss fraction of 0.025 % and a high-end loss fraction of 0.03 %.

The underlying distribution of the loss fraction parameter for drums is not known; therefore, EPA assigned a triangular distribution, since triangular distributions require least assumptions and are completely defined by range and mode of a parameter. EPA assigned the mode and maximum values for the loss fraction probability distribution using the central tendency and high-end values, respectively, prescribed by the EPA/OPPT Drum Residual Model in the ChemSTEER User Guide ([U.S. EPA, 2015a](#)). EPA assigned the minimum value for the triangular distribution using the minimum average percent residual measured in the PEI Associates, Inc. study ([PEI Associates, 1988](#)) for emptying drums by pumping.

A.4.14 Sampling Loss Fraction

Sampling loss fractions were estimated using the March 2023 Methodology for Estimating Environmental Releases from Sampling Wastes ([U.S. EPA, 2023c](#)). In this methodology, EPA completed a search of over 300 IRERs completed in the years 2021 and 2022 for sampling release data, including a similar proportion of both PMNs and LVEs. Of the searched IRERs, 60 data points for sampling release loss fractions, primarily for sampling releases from submitter-controlled sites (~75% of IRERs), were obtained. The data points were analyzed as a function of the chemical daily throughput and industry type. This analysis showed that the sampling loss fraction generally decreased as the chemical daily throughput increased. Therefore, the methodology provides guidance for selecting a loss fraction based on chemical daily throughput. Table_Apx A-11 presents a summary of the chemical daily throughputs and corresponding loss fractions.

Table_Apx A-11. Sampling Loss Fraction Data from March 2023 Methodology for Estimating Environmental Releases from Sampling Waste

Chemical Daily Throughput (kg/site-day) ($Q_{chem\_site\_day}$)	Number of Data Points	Sampled Quantity (kg chemical/day)		Sampling Loss Fraction ($LF_{sampling}$)	
		50 th Percentile	95 th Percentile	50 th Percentile	95 th Percentile
<50	13	0.03	0.20	0.002	0.02
50 to <200	10	0.10	0.64	0.0006	0.005
200 to <5,000	25	0.37	3.80	0.0005	0.004
≥5,000	10	1.36	6.00	0.00008	0.0004
All	58	0.20	5.15	0.0005	0.008

For each range of daily throughputs, EPA estimated sampling loss fractions using a triangular distribution of the 50th percentile value as the lower bound, and the 95th percentile value as the upper bound and mode. The sampling loss fraction distribution was chosen based on the calculation of daily throughput, as shown in Section A.4.4.

A.4.15 Diameters of Opening

The ChemSTEER User Guide indicates diameters for the openings for various vessels that may hold liquids in order to calculate vapor generation rates during different activities ([U.S. EPA, 2015a](#)).

For container cleaning activities, the ChemSTEER User Guide indicates a single default value of 5.08 cm for containers less than 5,000 gallons ([U.S. EPA, 2015a](#)).

For blending operations, the ESD for Adhesive Formulation ([OECD, 2009a](#)) and GS for Formulation of Waterborne Coatings ([U.S. EPA, 2014b](#)) assumes a closed vessel with a 4-inch diameter process vent, corresponding to 10 cm in diameter. EPA assigned the ESD default value of 10 cm for the opening diameter as closed vessels are expected during process operations.

For sampling liquid product, sampling liquid raw material, or general liquid sampling, the ChemSTEER User Guide indicates that the typical diameter of opening for vaporization of the liquid is 2.5 cm ([U.S. EPA, 2015a](#)). Additionally, the ChemSTEER User Guide provides 10 cm as a high-end value for the diameter of opening during sampling ([U.S. EPA, 2015a](#)). The underlying distribution of this parameter is not known; therefore, EPA assigned a uniform distribution based on the estimated lower and upper bound of the parameter. EPA assigned the value of 2.5 cm as a lower bound for the parameter and 10 cm as the upper bound based on the values provided in the ChemSTEER User Guide ([U.S. EPA, 2015a](#)).

For equipment cleaning operations, the ChemSTEER User Guide indicates a single default value of 92 cm ([U.S. EPA, 2015a](#)).

A.4.16 Operating Days

EPA was unable to identify 1,1,2-trichloroethane-specific information for operating days in the production of adhesives and sealants. EPA calculated the number of annual operating days using the annual number of batches produced and operating hours per batch and capped the number of operating days at 365 days per year. The operating days are calculated using the following equation:

Equation_Apx A-32.

$$OP_{days} = \frac{N_{batch} * OH_{batch}}{24 \frac{hours}{day}}$$

Where:

OP_{days}	=	Operating days [days/site-year]
N_{batch}	=	Annual number of adhesive batches produced [batches/yr]
OH_{batch}	=	Operating hours per batch (see Section A.4.7) [hr/batch]

A.4.17 Batch Size

The ESD for Adhesive Formulation ([OECD, 2009a](#)) cites a default batch size of 4,000 kg adhesive per batch with an approximate batch volume of 1,000 gallons. The ESD for Adhesive Formulation also states that data from a single formulator shows batch sizes ranging from 300 to 5,000 gallons. The underlying distribution of this parameter is unknown; therefore, EPA assigned a triangular distribution with a lower bound of 300 gallons, an upper bound of 5,000 gallons, and a mode of 1,000 gallons.

A.4.18 Container Fill Rates

The ChemSTEER User Guide ([U.S. EPA, 2015a](#)) provides a typical fill rate of 20 containers per hour for containers with 20 to 100 gallons of liquid and a typical fill rate of 60 containers per hour for containers with less than 20 gallons of liquid.

To account for situations where operating times for container unloading and loading exceeded a 24-hour period in the simulation, EPA applied an equation to determine a corrected fill rate that would replace the deterministic values provided in the ChemSTEER User Guide. The equation for the corrected fill rate in cases where operating time for unloading and loading is greater than 24 hours is included below. EPA only used the corrected fill rate for loading product containers (release point 10).

Equation_Apx A-33.

$$\text{if } OH_{RP10} = 24, RATE_{fill\_recalc} = \frac{N_{cont\_load\_site\_yr}}{OH_{RS10} * OP_{days}}$$

Where:

$RATE_{fill\_recalc}$	=	Corrected fill rate for product containers [containers/hr]
OH_{RS10}	=	Operating time for release point 10 [hrs/site-day]
OP_{days}	=	Operating days [days/site-year]

A.4.19 Equipment Cleaning Loss Fraction

EPA used the EPA/OPPT Multiple Process Residual Model to estimate the releases from equipment cleaning. The EPA/OPPT Multiple Process Residual Model, as detailed in the ChemSTEER User Guide ([U.S. EPA, 2015a](#)) provides an overall loss fraction of two % from equipment cleaning.

A.4.20 Off-Spec Loss Fraction

The ESD for Adhesive Formulation ([OECD, 2009a](#)) and GS for Formulation of Waterborne Coatings ([U.S. EPA, 2014b](#)) provides a loss fraction of one % of throughput disposed from off-specification material during manufacturing. The one % default loss fraction was provided as an estimate from a Source Reduction Research Partnership (SRRP) study referenced in the ESD for Adhesive Formulation ([OECD, 2009a](#)).

A.5 Use of Adhesives Model Approaches and Parameters

This appendix presents the modeling approach and equations used to estimate environmental releases for 1,1,2-trichloroethane during the use of adhesives and sealants OES. This approach utilizes the Emission Scenario Document on Use of Adhesives ([OECD, 2015](#)) combined with Monte Carlo simulation (a type of stochastic simulation).

Based on the ESD, EPA identified the following release sources from the application of adhesives and sealants:

- Release source 1: Container Cleaning Wastes.
- Release source 2: Open Surface Losses to Air During Container Cleaning (not assessed).
- Release source 3: Transfer Operation Losses from Unloading Adhesive Formulation.
- Release source 4: Equipment Cleaning Wastes.
- Release source 5: Open Surface Losses to Air During Equipment Cleaning.
- Release source 6: Process Releases During Adhesive Application (not assessed).
- Release source 7: Open Surface Losses to Air During Curing/Drying.
- Release source 8: Trimming Wastes (not assessed).

Environmental releases for 1,1,2-trichloroethane during use of adhesives and sealants are a function of the chemical's physical properties, container size, mass fractions, and other model parameters. While physical properties are fixed, some model parameters are expected to vary. EPA used a Monte Carlo simulation to capture variability in the following model input parameters: production volume, product throughput, 1,1,2-trichloroethane concentrations, air speed, saturation factor, container size, loss fractions, and operating days. EPA used the outputs from a Monte Carlo simulation with 100,000 iterations and the Latin Hypercube sampling method in @Risk to calculate release amounts for this OES.

A.5.1 Model Equations

Table_Apx A-12 provides the models and associated variables used to calculate environmental releases for each release source within each iteration of the Monte Carlo simulation. EPA used these environmental releases to develop a distribution of release outputs for the use of adhesives and sealants OES. The variables used to calculate each of the following values include deterministic or variable input parameters, known constants, physical properties, conversion factors, and other parameters. The values for these variables are provided in Section A.5.2. The Monte Carlo simulation calculated the total 1,1,2-trichloroethane release (by environmental media) across all release sources during each iteration of the simulation. EPA then selected 50th percentile and 95th percentile values to estimate the central tendency and high-end releases, respectively.

Table_Apx A-12. Models and Variables Applied for Release Sources in the Use of Adhesives and Sealants OES

Release Source	Model(s) Applied	Variables Used
Release source 1: Container Cleaning Wastes.	EPA/OPPT Small Container Residual Model (Appendix A.1)	PV_{site} ; LF_{RS1} ; OP_{days}
Release source 2: Open Surface Losses to Air During Container Cleaning.	Not assessed; release is not expected as 1,1,2-trichloroethane-containing	Not applicable

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Release Source	Model(s) Applied	Variables Used
	adhesives and sealants are expected to be received in syringes which are disposed of following use.	
Release source 3: Transfer Operation Losses from Unloading Adhesive Formulation.	EPA/OAQPS AP-42 Loading Model (Appendix A.1)	Vapor Generation Rate: $F_{chem\_product}$; VP_{112TCA} ; f_{sat} ; MW_{112TCA} ; T_K ; $RATE_{prod\_cont}$; V_{prod_cont} Operating Time: $RATE_{prod\_cont}$; $N_{cont\_unload\_site\_day}$
Release source 4: Equipment Cleaning Wastes.	EPA/OPPT Multiple Process Vessel Residual Model (Appendix A.1)	PV_{site} ; LF_{RS4}
Release source 5: Open Surface Losses to Air During Equipment Cleaning.	EPA/OPPT Penetration Model or EPA/OPPT Mass Transfer Coefficient Model, based on air speed (Appendix A.1)	Vapor Generation Rate: $F_{chem\_product}$; MW_{112TCA} ; VP_{112TCA} ; $RATE_{air\_speed}$; D_{RS5} ; T_K ; P_{Torr} Operating Time: $N_{batch\_site\_day}$; OH_{batch}
Release source 6: Process Releases During Adhesive Application.	Not assessed; volatile releases are assumed to occur to completion during curing/drying.	Not applicable
Release source 7: Open Surface Losses to Air During Curing/Drying.	No model applicable; remaining chemical not released from the previous release sources is released here.	Not applicable
Release source 8: Trimming Wastes.	Not assessed; it is assumed that all 1,1,2-trichloroethane evaporated during adhesive curing/drying so releases from trimming wastes are not assessed.	Not applicable

A.5.2 Model Input Parameters

Table_Apx A-13 summarizes the model parameters and their values for the Application of Adhesives and Sealants Monte Carlo simulation. Additional explanations of EPA's selection of the distributions for each parameter are provided after this table.

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Table_Apx A-13. Summary of Parameter Values and Distributions Used in the Use of Adhesives and Sealants Model

Input Parameter	Symbol	Unit	Deterministic Values	Uncertainty Analysis Distribution Parameters				Rationale / Basis
			Value	Lower Bound	Upper Bound	Mode	Distribution Type	
Adhesive/ Sealant 1,1,2-Trichloroethane Concentration	F _{chem_prod}	kg/kg	3E-02	1E-02	5E-02	—	Uniform	See Section A.5.7
Small Container Residual Loss Fraction	LF _{RS1}	kg/kg	3.0E-03	3.0E-04	6.0E-03	3.0E-03	Triangular	See Section A.5.13
Equipment Cleaning Loss Fraction	LF _{RS4}	kg/kg	2.0E-03	7E-04	1E-02	2E-03	Triangular	See Section A.5.16
Diameter of Equipment Cleaning Opening	D _{RS5}	cm	2.5	2.5	10	2.5	Triangular	See Section A.5.15
Air Speed	RATE _{air_speed}	ft/min	19.7	2.56	398	—	Lognormal	See Section A.5.10
Saturation Factor	f _{sat}	dimensionless	0.5	0.5	1.45	0.5	Triangular	See Section B.5.11
Small Container Volume	V _{prod_cont}	gal	—	1.3E-02	0.1	—	Discrete	See Section A.5.12
Density of Adhesive/Sealant	RHO _{prod}	kg/m ³	1,030	—	—	—	—	See Section A.5.8
Production Volume	PV	kg/yr	34,019	—	—	—	—	See Section A.5.4
Molecular Weight	MW _{112TCA}	g/mol	133.41	—	—	—	—	Physical property
Temperature	T _K	K	298	—	—	—	—	Process parameter
Density of 1,1,2-trichloroethane	RHO _{112TCA}	kg/m ³	1,432.16	—	—	—	—	Physical property
Vapor Pressure at 25C	VP _{112TCA}	Torr	23	—	—	—	—	Physical property
Pressure	P _{Torr}	Torr	760	—	—	—	—	Process parameter
Small Container Fill Rate	RATE _{small_cont}	containers/hr	60	—	—	—	—	See Section A.5.14

Input Parameter	Symbol	Unit	Deterministic Values	Uncertainty Analysis Distribution Parameters				Rationale / Basis
			Value	Lower Bound	Upper Bound	Mode	Distribution Type	
Number of Adhesive Batches used per Site-Day	N _{batch_site-day}	Batches/site-day	1	—	—	—	—	See Section A.5.4
Annual Facility Throughput of Adhesive/ Sealant	Q _{app_use_rate}	kg/year	13,500	—	—	—	—	See Section A.5.4
Operating Days	OP _{days}	days/year	260	—	—	—	—	See Section A.5.9
Operating Hours for Equipment Cleaning per Batch	OH _{batch}	hr/day	1	—	—	—	—	See Section A.5.6

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A.5.3 Number of Sites

The number of sites is calculated using the following equation.:

Equation_Apx A-34.

$$N_{sites} = \frac{PV}{Q_{app\_use\_rate} \times F_{chem\_product}}$$

Where:

N_{sites}	=	Number of sites [sites]
PV	=	Production volume [kg/year]
$Q_{app\_use\_rate}$	=	Facility annual throughput of adhesive [kg/site-yr]
$F_{chem\_product}$	=	1,1,2-Trichloroethane concentration in adhesive/sealant (see [kg/site-yr])

A.5.4 Throughput Parameters

EPA estimated the total production volume for application of adhesives and sealants as a deterministic value of 34,019 kg/year based on CDR reporting thresholds. The annual throughput of adhesive and sealant product is set at a deterministic value of 13,500 kg/site-year. This is based on the Emission Scenario Document on Use of Adhesives ([OECD, 2015](#)). The ESD provides default adhesive use rates based on end-use category. EPA chose the most relevant end-use category from the ESD based on the sole 1,1,2-trichloroethane product for this OES, Araldite 2021, which is used in rapid assembly automotive applications. The relevant end-use category chosen from the ESD was the general assembly, motor and non-motor vehicle, vehicle parts, and tire manufacturing (except retreading) category.

The annual throughput of 1,1,2-trichloroethane in adhesives/sealants is calculated Equation_Apx A-35 by multiplying the annual throughput of all adhesives and sealants by the concentration of 1,1,2-trichloroethane in the adhesives/sealants.

Equation_Apx A-35.

$$PV_{site} = Q_{app\_use\_rate} \times F_{chem\_product}$$

Where:

PV_{site}	=	Facility annual throughput of 1,1,2-trichloroethane [kg/site-yr]
$Q_{app\_use\_rate}$	=	Facility annual throughput of all adhesives/ sealants [kg/site-yr]
$F_{chem\_product}$	=	Concentration of 1,1,2-trichloroethane in adhesive/ sealant [kg/kg]

The daily throughput of 1,1,2-trichloroethane is calculated using Equation_Apx A-36 by dividing the annual production volume by the number of operating days. The number of operating days is determined according to Section 10.2.5.

Equation_Apx A-36.

$$PV_{site\_daily} = \frac{PV_{site}}{OP_{days}}$$

Where:

PV_{site_daily}	=	Facility daily throughput of 1,1,2-trichloroethane [kg/site-day]
PV_{site}	=	Facility annual throughput of 1,1,2-trichloroethane [kg/site-yr]
OP_{days}	=	Operating days [days/year]

A.5.5 Number of Containers Per Year

The number of 1,1,2-trichloroethane raw material containers received and unloaded by a site per year is calculated using the following equation:

Equation_Apx A-37.

$$N_{cont\_unload\_site\_yr} = \frac{PV_{site}}{V_{prod\_cont} \times RHO_{prod} \times \left(0.00379 \frac{m^3}{gal}\right)}$$

Where:

$N_{cont\_unload\_site\_yr}$	=	Annual number of containers unloaded [container/site-year]
PV_{site}	=	Facility annual throughput of 1,1,2-trichloroethane [kg/site-yr]
RHO_{prod}	=	Product density [kg/L]
V_{prod_cont}	=	Product container volume [gal/container]

A.5.6 Operating Hours

EPA estimated operating hours or hours of duration using data provided from the Emission Scenario Document on Use of Adhesives ([OECD, 2015](#)), ChemSTEER User Guide ([U.S. EPA, 2015a](#)), and/or through calculation from other parameters. Release points with operating hours provided from these sources include container cleaning, container unloading, and equipment cleaning.

For container unloading (release point 3), the operating hours are calculated based on the number of containers unloaded at the site and the unloading rate using the following equation:

Equation_Apx A-38.

$$OH_{RP3} = \frac{N_{cont\_unload\_site\_day}}{RATE_{fill}}$$

Where:

OH_{RP3}	=	Operating time for release point 3 [hrs/site-day]
$N_{cont\_unload\_site\_day}$	=	Daily number of containers unloaded [container/site-year]
$RATE_{fill}$	=	Container fill rate [containers/hr]

For equipment cleaning (release point 5), the Emission Scenario Document on Use of Adhesives ([OECD, 2015](#)) states that the default operating hours for equipment cleaning is one hour/batch multiplied by the number of batches per day for multiple vessels. Per the Emission Scenario Document on Use of Adhesives ([OECD, 2015](#)), the default number of batches per day is one. Therefore, EPA assumes that equipment cleaning occurs for one hour/day.

A.5.7 Adhesive/Sealant 1,1,2-Trichloroethane Concentration

EPA modeled 1,1,2-trichloroethane concentration in adhesives and sealants using a uniform distribution with a lower bound of 1 % and an upper bound of 5 %. The lower bound and upper bound are based on SDS information for the sole adhesive and sealant product containing 1,1,2-trichloroethane ([Huntsman, 2018](#)).

11309 A.5.8 Adhesives/Sealant Density

11310 EPA utilized the density of the sole 1,1,2-trichloroethane adhesive product, Araldite 2021 . The density
11311 of the product was obtained from the product safety data sheet, which provided a density of 1,030 kg/m³
11312 ([Huntsman, 2018](#)).

11313 A.5.9 Operating Days

11314 EPA used the default operating days per year for the Motor and Non-Motor Vehicle, Vehicle Parts, and
11315 Tire Manufacturing (Except Retreading) sector from the Emission Scenario Document on Use of
11316 Adhesives ([OECD, 2015](#)). The emission scenario document provides the default operating days for this
11317 sector to be 260 days per year.

11318 A.5.10 Air Speed

11319 Baldwin and Maynard measured indoor air speeds across a variety of occupational settings in the United
11320 Kingdom ([Baldwin and Maynard, 1998](#)). Fifty-five work areas were surveyed across a variety of
11321 workplaces. EPA analyzed the air speed data from Baldwin and Maynard and categorized the air speed
11322 surveys into settings representative of industrial facilities and representative of commercial facilities.
11323 EPA fit separate distributions for these industrial and commercial settings and used the industrial
11324 distribution for this OES.

11325
11326 EPA fit a lognormal distribution for the data set as consistent with the authors' observations that the air
11327 speed measurements within a surveyed location were lognormally distributed and the population of the
11328 mean air speeds among all surveys were lognormally distributed ([Baldwin and Maynard, 1998](#)). Since
11329 lognormal distributions are bound by zero and positive infinity, EPA truncated the distribution at the
11330 largest observed value among all of the survey mean air speeds.

11331
11332 EPA fit the air speed surveys representative of industrial facilities to a lognormal distribution with the
11333 following parameter values: mean of 22.414 cm/s and standard deviation of 19.958 cm/s. In the model,
11334 the lognormal distribution is truncated at a minimum allowed value of 1.3 cm/s and a maximum allowed
11335 value of 202.2 cm/s (largest surveyed mean air speed observed in Baldwin and Maynard) to prevent the
11336 model from sampling values that approach infinity or are otherwise unrealistically small or large
11337 ([Baldwin and Maynard, 1998](#)).

11338
11339 Baldwin and Maynard only presented the mean air speed of each survey. The authors did not present the
11340 individual measurements within each survey. Therefore, these distributions represent a distribution of
11341 mean air speeds and not a distribution of spatially variable air speeds within a single workplace setting.
11342 However, a mean air speed (averaged over a work area) is the required input for the model. EPA
11343 converted the units to ft/min prior to use within the model equations.

11344 A.5.11 Saturation Factor

11345 The CEB Manual indicates that during splash filling, the saturation concentration was reached or
11346 exceeded by misting with a maximum saturation factor of 1.45 ([CEB, 1991](#)). The CEB Manual indicates
11347 that saturation concentration for bottom filling was expected to be about 0.5 ([CEB, 1991](#)). The
11348 underlying distribution of this parameter is not known; therefore, EPA assigned a triangular distribution
11349 based on the lower bound, upper bound, and mode of the parameter. Because a mode was not provided
11350 for this parameter, EPA assigned a mode value of 0.5 for bottom filling as bottom filling minimizes
11351 volatilization ([CEB, 1991](#)). This value also corresponds to the typical value provided in the
11352 ChemSTEER User Guide for the EPA/OAQPS AP-42 Loading Model ([U.S. EPA, 2015a](#)).

A.5.12 Container Size

EPA utilized available container size information for the sole 1,1,2-trichloroethane-containing adhesive product for the container size distribution. The product, Araldite 2021, is available in 50 (0.013 gallon) or 400mL (0.1 gallon) bottles. Therefore, EPA modeled container size using a discrete distribution using a lower bound of 0.013 gallons and an upper bound of 0.1 gallons ([Huntsman, 2018](#)).

A.5.13 Small Container Residue Loss Fraction

EPA used data from the PEI Associates Inc. study ([PEI Associates, 1988](#)) and the EPA/OPPT Small Container Residual Model. For unloading drums by pouring in the PEI Associates Inc. study ([PEI Associates, 1988](#)), EPA found that the average % residual from the pilot-scale experiments showed a range of 0.03 to 0.79 % and an average of 0.32 %. The EPA/OPPT Small Container Residual Model from the ChemSTEER User Guide ([U.S. EPA, 2015a](#)) recommends a default central tendency loss fraction of 0.3 % and a high-end loss fraction of 0.6 %.

The underlying distribution of the loss fraction parameter for small containers is not known; therefore, EPA assigned a triangular distribution, since triangular distributions require least assumptions and are completely defined by range and mode of a parameter. EPA assigned the mode and maximum values for the loss fraction probability distribution using the central tendency and high-end values, respectively, prescribed by the EPA/OPPT Small Container Residual Model in the ChemSTEER User Guide ([U.S. EPA, 2015a](#)). EPA assigned the minimum value for the triangular distribution using the minimum average % residual measured in the PEI Associates, Inc. study ([PEI Associates, 1988](#)) for emptying drums by pouring.

A.5.14 Container Unloading Rates

The ChemSTEER User Guide ([U.S. EPA, 2015a](#)) provides a typical fill rate of 60 containers per hour for containers with less than 20 gallons of liquid.

A.5.15 Diameters of Opening

The ChemSTEER User Guide indicates diameters for the openings for various vessels that may hold liquids in order to calculate vapor generation rates during different activities ([U.S. EPA, 2015a](#)). For equipment cleaning operations, the ChemSTEER User Guide indicates a single default value of 92 cm ([U.S. EPA, 2015a](#)).

A.5.16 Equipment Cleaning Loss Fraction

EPA used the EPA/OPPT Single Process Vessel Residual Model to estimate the releases from equipment cleaning. The EPA/OPPT Single Process Vessel Residual Model, as detailed in the ChemSTEER User Guide ([U.S. EPA, 2015a](#)), recommends a central tendency loss fraction of 0.0007, a conservative loss fraction of 0.01, and a default loss fraction of 0.002. The underlying distribution of this parameter is not known; therefore, EPA assigned a triangular distribution based on the lower bound, upper bound, and mode of the parameter. EPA utilized a triangular distribution with 0.0007 as the low-end, 0.01 as the high-end, and 0.002 as the mode for the equipment cleaning loss fraction.

A.6 Vapor Degreasing Model Approaches and Parameters

This appendix presents the modeling approach and equations used to estimate environmental releases and occupational exposures for 1,1,2-trichloroethane during the Use of Cleaning and Degreasing Solvents OES. The release approach utilizes the ESD on the Use of Vapour Degreasers ([OECD, 2021](#)) combined with Monte Carlo simulation (a type of stochastic simulation).

Based on the ESD, EPA identified the following release sources from vapor degreasing operations:

- Release source 1: Transfer operation losses to fugitive or stack air from unloading transport containers (not assessed)
- Release source 2: Container residue releases to wastewater treatment, incineration, or landfill
- Release source 3: Vapor degreasing operations to fugitive or stack air
- Release source 4: Release to air from equipment cleaning (not assessed)
- Release source 5: Equipment cleaning and waste solvent disposal to incineration
- Release source 6: Vapor degreasing wastewater to wastewater treatment

An individual model input parameter could either have a discrete value or a distribution of values. EPA assigned statistical distributions based on available literature data. A Monte Carlo simulation (a type of stochastic simulation) was conducted to capture variability in the model input parameters. The simulation was conducted using the Latin hypercube sampling method in @Risk Industrial Edition, Version 8.0.0. The Latin hypercube sampling method is a statistical method for generating a sample of possible values from a multi-dimensional distribution. Latin hypercube sampling is a stratified method, meaning it guarantees that its generated samples are representative of the probability density function (variability) defined in the model. EPA performed the model at 100,000 iterations to capture the range of possible input values (*i.e.*, including values with low probability of occurrence).

Model results from the Monte Carlo simulation are presented as 95th and 50th percentile values. The statistics were calculated directly in @Risk. The 95th percentile value was selected to represent high-end release and exposure levels, whereas the 50th percentile value was selected to represent typical release and exposure levels. The following subsections detail the model design equations and parameters for the Vapor degreasing OES.

A.6.1 Model Equations

Table_Apx A-14 provides the models and associated variables used to calculate environmental releases for each release source within each iteration of the Monte Carlo simulation. EPA used these environmental releases to develop a distribution of release outputs for the Vapor degreasing OES. The variables used to calculate each of the following values include deterministic or variable input parameters. The values for these variables are provided in Appendix A.6.2. The Monte Carlo simulation calculated the total 1,1,2-trichloroethane release (by environmental media) across all release sources during each iteration of the simulation. EPA then selected 50th and 95th percentile values to estimate the central tendency and high-end releases, respectively.

Table_Apx A-14. Models and Variables Applied for Release Sources in the Vapor Degreasing OES

Release source	Model(s) Applied	Variables Used
Release source 1: Release to Air from Unloading Transport Containers.	Not assessed; release is expected to be covered by incorporated NEI release data in release source 3.	Not applicable
Release source 2: Release to Incineration or Landfill from Cleaning of Transport Containers.	EPA/OPPT Drum Residual Model (Appendix A.1)	$V_{container}$; RHO ; $F_{chem\_product}$; $F_{container\_disp}$; $Q_{chem\_site\_day}$
Release source 3: Release to Air During Vapor Degreasing Operations.	Equation_Apx A-40	$Q_{chem\_site\_yr\_recalc}$; $Q_{chem\_site\_yr}$; AR_{RS3} ; $TIME_{operating\_days}$

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Release source	Model(s) Applied	Variables Used
Release source 4: Release to Air from Equipment Cleaning.	Not assessed; release is expected to be covered by incorporated NEI release data in release source 3.	Not applicable
Release source 5: Release to Water from Vapor Degreasing Wastewater.	Equation_Apx A-41	WS_{chem} ; CF ; $V_{wastewater}$
Release source 6: Release to Incineration from Cleaning Degreasing Machine and Disposing Waste Solvent.	No model applicable; all chemicals used in the vapor degreasing operation are expected to be disposed of after they have reached their usable lifetime. Remaining chemical not released from the previous release sources is released here.	Not applicable

Equation_Apx A-39.If $N_{container\_unload\_site\_yr} < TIME_{operating\_days}$

$$DR_{RS2} = V_{container} \times RHO \times F_{chem\_product} \times F_{cont\_disp} \times 1 \frac{container}{site - day}$$

Where:

$V_{container}$	=	Container volume (See Section A.6.12) [gal]
RHO	=	Density of vapor degreasing product (See Section A.6.6) [kg/L]
$F_{chem\_product}$	=	Concentration of chemical in vapor degreasing product (See Section A.6.5) [kg/kg]
F_{cont_disp}	=	Fraction of residue in drum (See Section A.6.17) [kg/kg]

If $N_{container\_unload\_site\_yr} > TIME_{operating\_days}$

$$DR_{RS2} = Q_{chem\_site\_day} \times F_{container\_disp}$$

Where:

$Q_{chem\_site\_day}$	=	Daily throughput of chemical (See Section A.6.8) [kg/site-day]
F_{cont_disp}	=	Fraction of residue in drum (See Section A.6.17) [kg/kg]

Equation_Apx A-40.

$$AR_{RS3\_recalc} = AR_{RS3} \times \frac{Q_{chem\_site\_yr\_recalc}}{Q_{chem\_site\_yr}}$$

Where:

AR_{RS3_recalc}	=	Recalculated annual release of chemical to air [kg/site-yr]
AR_{RS3}	=	Annual release of chemical to air [kg/site-yr]
$Q_{chem\_site\_yr\_recalc}$	=	Recalculated annual throughput of chemical [kg/site-yr]
$Q_{chem\_site\_yr}$	=	Annual throughput of chemical [kg/site-yr]

Equation_Apx A-41.

$$Elocal_{wastewater} = WS_{chem} \times CF \times V_{wastewater} \times \frac{3.785 L}{gal} \times \frac{kg}{1000 grams}$$

Where:

$Elocal_{wastewater}$	=	Daily release of chemical from wastewater [kg/site-day]
WS_{chem}	=	Water solubility of the vapor degreasing chemical of

interest [g/L]

CF

=

A factor to account for any variability, such as a known or estimated correction of the water solubility of the chemical or other corrections [unitless]

$V_{wastewater}$

=

Daily volume of wastewater discharged (see Section A.6.20) [gal/day]

A.6.2 Model Input Parameters

Table_Apx A-15 summarizes the model parameters and their values for the vapor degreasing chemical Monte Carlo simulation. Additional explanations of EPA's selection of the distributions for each parameter are provided following this table.

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Table_Apx A-15. Summary of Parameter Values and Distributions Used in the Vapor Degreasing Release Model

Input Parameter	Symbol	Unit	Deterministic Values	Uncertainty Analysis Distribution Parameters				Rationale/Basis
				Lower Bound	Upper Bound	Mode	Distribution Type	
Loss Fraction for Vapor Degreaser	LF _{air}	kg/kg	–	1.0E–08	1	–	Beta	See Appendix A.6.16
Saturation Factor During Unloading	F _{saturation_unloading}	unitless	0.5	0.5	1.45	0.5	Triangular	See Appendix A.6.15
Operating Days	TIME _{operating_days}	days/yr	–	260	364	–	Discrete	See Appendix A.6.3
Annual Releases of Chemical to Air	AR _{RS3}	kg/site-yr	–	8.0E–03	7,230	–	Discrete	See Appendix A.6.7
Container volume	V _{container}	gal	55	20	100	55	Triangular	See Appendix A.6.12
Fraction of Solvent Residue in Drum	F _{cont_disp}	kg/kg	0.025	0.017	0.03	0.025	Triangular	See Appendix A.6.17
Daily Volume of Wastewater Discharged	V _{wastewater}	gal/day	11	2	20	–	Uniform	See Appendix A.6.20
Daily Hours Spent Performing Degreasing Operations	OH _{degreasing_day}	hours/day	16	8	24	–	Discrete	See Appendix A.6.4
Production Volume	PV	kg/yr	34,019	–	–	–	–	See Appendix A.6.8
Concentration of 1,1,2-Trichloroethane in Product	F _{chem_product}	unitless	1.0	–	–	–	–	See Appendix A.6.5
Density of Product	RHO	kg/L	1.43216	–	–	–	–	See Appendix A.6.6
Fill Rate of Drums	RATE _{fill_drum}	containers/hr	20	–	–	–	–	See Appendix A.6.14
Temperature	T	k	298	–	–	–	–	Process parameter
Pressure (torr)	P _{torr}	torr	760	–	–	–	–	Process parameter
Pressure (atm)	P _{atm}	Atm	1	–	–	–	–	Process parameter
Gas Constant	R	atm-cm ³ /mol-K	82.05	–	–	–	–	Universal constant
1,1,2-Trichloroethane Vapor Pressure	VP	torr	23	–	–	–	–	Physical property
1,1,2-Trichloroethane Molecular Weight	MW _{112TCA}	g/mol	133.41	–	–	–	–	Physical property
Frequency of Solvent Changeout	FT _{changeout}	days/yr	26	–	–	–	–	See Appendix A.6.18

Input Parameter	Symbol	Unit	Deterministic Values	Uncertainty Analysis Distribution Parameters				Rationale/Basis
				Lower Bound	Upper Bound	Mode	Distribution Type	
Correction Factor	CF	kg/kg	1	–	–	–	–	See Appendix A.6.19
Water Solubility	WS _{chem}	g/L	4.59	–	–	–	–	Physical property

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A.6.3 Operating Days

EPA used a discrete distribution of available operating frequencies provided by facilities performing vapor degreasing operations in the 2017 and 2020 NEI to calculate the operating days for degreasing operations. EPA utilized operating frequencies from ten reports from facilities classified as vapor degreasing facilities with a lower bound of 260 days/year and an upper bound of 364 days/year. The annual operating days were calculated using the NEI-reported days/week and weeks/year frequencies using the equation below:

Equation_Apx A-42.

$$TIME_{operating\_days} = TIME_{days\ per\ week} \times TIME_{weeks\ per\ year}$$

Where:

$$\begin{aligned} TIME_{operating\_days} &= \text{Annual operating days [days/yr]} \\ TIME_{days\ per\ week} &= \text{NEI-provided weekly operating days [days/week]} \\ TIME_{weeks\ per\ year} &= \text{NEI-provided annual operating weeks [weeks/yr]} \end{aligned}$$

A.6.4 Operating Hours

EPA estimated operating hours or hours of duration using data provided from the ChemSTEER User Guide ([U.S. EPA, 2015a](#)), 2017/2020 NEI data, and/or through calculation from other parameters. Release points with operating hours provided from these sources include unloading and vapor degreasing operations.

For unloading (release point 1), the operating hours are calculated based on the number of containers unloaded at the site and the unloading rate using the following equation:

Equation_Apx A-43.

$$OH_{RP1} = \frac{N_{cont\_unload\_site\_day}}{RATE_{fill\_drum}}$$

Where:

$$\begin{aligned} OH_{RP1} &= \text{Operating time for release point 1 [hrs/site-day]} \\ N_{cont\_unload\_site\_day} &= \text{Daily number of containers unloaded (see Section A.6.13)} \\ &\quad [\text{container/site-year}] \\ RATE_{fill\_drum} &= \text{Container fill rate (see Section A.6.14) [containers/hr]} \end{aligned}$$

For vapor degreasing operations (release point 3), EPA used a discrete distribution of available degreasing operation operating hours provided by facilities performing vapor degreasing operations using 1,1,2-trichloroethane in the 2017/2020 NEI. Based on the NEI-reported operating hours, EPA utilized a lower bound of 8 hours per day and an upper bound of 24 hours per day for the discrete distribution.

A.6.5 Concentration of Vapor Degreasing Product

The concentration of vapor degreasing chemical was based on the ESD on the Use of Vapour Degreasers ([OECD, 2021](#)) default value of 100%. EPA utilized the ESD default concentration as concentration data for 1,1,2-trichloroethane-containing cleaning and degreasing chemicals was not available.

A.6.6 Density of Vapor Degreasing Chemical

Based on the ESD on the Use of Vapour Degreasers ([OECD, 2021](#)) assumption of pure chemical being used for vapor degreasing operations, the density of 1,1,2-trichloroethane, 1.43216 kg/L, was utilized for the product density.

A.6.7 Annual Releases of Chemical to Air

EPA used a discrete distribution of available 1,1,2-trichloroethane release amounts provided by facilities performing vapor degreasing operations in the 2017/2020 NEI to characterize annual releases to air from vapor degreasing operations. EPA utilized the annual release amounts from 15 reports from facilities classified as vapor degreasing facilities with a lower bound of 8.0E-03 kg/site-yr and an upper bound of 7,230 kg/site-yr.

A.6.8 Annual Use Rate of 1,1,2-Trichloroethane

EPA back-calculated the annual use rate of 1,1,2-trichloroethane from 2017 and 2020 NEI-reported air release data and loss fractions to air from vapor degreasing operations provided by the ESD on the Use of Vapour Degreasers ([OECD, 2021](#)). The solvent annual use rate was calculated using the equation below:

Equation_Apx A-44.

$$Q_{chem\_site\_yr} = \frac{AR_{RS3}}{LF_{air}}$$

Where:

$Q_{chem\_site\_yr}$	=	Annual throughput of 1,1,2-trichloroethane [kg/site-yr]
AR_{RS3}	=	NEI-provided vapor degreaser emissions [kg/site-yr]
LF_{air}	=	Loss fraction to air from vapor degreasers [kg/kg]

A.6.9 Daily Use Rate of 1,1,2-Trichloroethane

EPA calculated the daily use rate of 1,1,2-trichloroethane from the annual use rate of 1,1,2-trichloroethane and the number of annual operating days for degreasing operations. The daily use rate of 1,1,2-trichloroethane was calculated using the equation below:

Equation_Apx A-45.

$$Q_{chem\_site\_day} = \frac{Q_{chem\_site\_yr}}{TIME_{operating\_days}}$$

Where:

$Q_{chem\_site\_day}$	=	Daily throughput of 1,1,2-trichloroethane [kg/site-yr]
$Q_{chem\_site\_yr}$	=	Annual throughput of 1,1,2-trichloroethane (see Section A.6.8) [kg/site-yr]
$TIME_{operating\_days}$	=	Annual operating days for degreasing operations (see Section A.6.3) [days/yr]

A.6.10 Number of Sites

Number of sites is calculated using the following equation:

Equation_Apx A-46,

$$N_{sites} = \frac{PV}{Q_{chem\_site\_yr} \times F_{chem\_product}}$$

Where:

N_{sites}	=	Number of sites [sites]
PV	=	Production volume [kg/year]
$Q_{chem\_site\_yr}$	=	Facility annual throughput of 1,1,2-trichloroethane (see Section A.6.8) [kg/site-yr]
$F_{chem\_product}$	=	1,1,2-trichloroethane concentration in vapor degreasing chemical (see Section A.6.5) [kg/site-yr]

A.6.11 Recalculated Annual Use Rate of 1,1,2-Trichloroethane

To account for rounding errors when calculating the number of sites, EPA recalculated the annual use rate of 1,1,2-trichloroethane using the following equation:

Equation_Apx A-47

$$Q_{chem\_site\_yr\_recalc} = \frac{PV}{N_{sites}}$$

Where:

$Q_{chem\_site\_yr\_recalc}$	=	Recalculates facility annual throughput of 1,1,2-trichloroethane [kg/site-yr]
PV	=	Production volume of 1,1,2-trichloroethane [kg/yr]
N_{sites}	=	Number of sites (see Section A.6.10) [sites]

A.6.12 Drum Volume

EPA assumed that vapor degreasing sites would receive 1,1,2-trichloroethane in drums. According to the ESD on the Use of Vapour Degreasers ([OECD, 2021](#)), 55-gallon drums are expected to be the default container size for vapor degreasing chemicals. According to the ChemSTEER User Guide, drums are defined as containing between 20 and 100 gallons of liquid, and the default drum size is 55 gallons ([U.S. EPA, 2015a](#)). Therefore, EPA modeled the incoming container size using a triangular distribution with a lower bound of 20 gallons, an upper bound of 100 gallons, and a mode of 55 gallons.

A.6.13 Number of Containers Unloaded Daily Per Site

The number of 1,1,2-trichloroethane raw material containers received and unloaded by a site per year is calculated using the following equation:

Equation_Apx A-48

$$N_{cont\_unload\_site\_day} = \frac{Q_{chem\_site\_day}}{F_{chem\_prod} \times RHO \times V_{container} \times \left(0.00379 \frac{m^3}{gal}\right)}$$

Where:

$N_{cont\_unload\_site\_day}$	=	Daily number of containers unloaded [container/site-day]
$Q_{chem\_site\_yr}$	=	Facility annual throughput of 1,1,2-trichloroethane (see Section A.6.8) [kg/site-yr]
RHO	=	Product density (see Section A.6.6) [kg/L]

$V_{container}$ = Drum volume (see Section A.6.12) [gal/container]

A.6.14 Container Fill Rates

The ChemSTEER User Guide ([U.S. EPA, 2015a](#)) provides a typical fill rate of 20 containers per hour for containers with 20 to 100 gallons of liquid.

A.6.15 Saturation Factor

The CEB Manual indicates that during splash filling, the saturation concentration was reached or exceeded by misting with a maximum saturation factor of 1.45 ([CEB, 1991](#)). The CEB Manual indicates that saturation concentration for bottom filling was expected to be about 0.5 ([CEB, 1991](#)). The underlying distribution of this parameter is not known; therefore, EPA assigned a triangular distribution based on the lower bound, upper bound, and mode of the parameter. Because a mode was not provided for this parameter, EPA assigned a mode value of 0.5 for bottom filling as bottom filling minimizes volatilization ([CEB, 1991](#)). This value also corresponds to the typical value provided in the ChemSTEER User Guide for the EPA/OAQPS AP-42 Loading Model ([U.S. EPA, 2015a](#)).

A.6.16 Loss Fraction for Vapor Degreaser

The ESD on the Use of Vapour Degreasers ([OECD, 2021](#)) estimates solvent loss fractions of vapor degreasers and provides 91 loss fraction data points, with a lower bound of 1E-08 and an upper bound of 1 kg/kg. EPA utilized the ESD-provided data and @Risk to fit a Beta distribution to the loss fraction data and derived an alpha value of 0.84422 and a beta value of 0.20966.

A.6.17 Drum Residue Loss Fraction

For drums, EPA paired the data from the PEI Associates Inc. study ([PEI Associates, 1988](#)) such that the residuals data for emptying drums by pouring was aligned with the default central tendency and high-end values from the EPA/OPPT Drum Residual Model. For unloading drums by pumping in the PEI Associates Inc. study ([PEI Associates, 1988](#)), EPA found that the average % residual from the pilot-scale experiments showed a range of 0.017 to 0.03 % and an average of 0.025 %. The EPA/OPPT Drum Residual Model from the ChemSTEER User Guide ([U.S. EPA, 2015a](#)) recommends a default central tendency loss fraction of 0.025 % and a high-end loss fraction of 0.03 %.

The underlying distribution of the loss fraction parameter for drums is not known; therefore, EPA assigned a triangular distribution, since triangular distributions require least assumptions and are completely defined by range and mode of a parameter. EPA assigned the mode and maximum values for the loss fraction probability distribution using the central tendency and high-end values, respectively, prescribed by the EPA/OPPT Drum Residual Model in the ChemSTEER User Guide ([U.S. EPA, 2015a](#)). EPA assigned the minimum value for the triangular distribution using the minimum average percent residual measured in the PEI Associates, Inc. study ([PEI Associates, 1988](#)) for emptying drums by pumping.

A.6.18 Frequency of Solvent Changeout

The ESD on the Use of Vapor Degreasers ([OECD, 2021](#)) estimates that dirty solvent will be changed out once every 2 weeks, or 26 times per year.

A.6.19 Correction Factor

The ESD on the Use of Vapor Degreasers ([OECD, 2021](#)) applies a correction factor (CF) to account for any variability, such as a known or estimated correction of the water solubility of the

chemical or other corrections. The default correction factor is 1.

A.6.20 Daily Volume of Wastewater Discharged

The ESD on the Use of Vapor Degreasers ([OECD, 2021](#)) estimates that the range of wastewater discharged is 2 to 20 gallons per day. EPA modeled the daily volume of wastewater discharged using a uniform distribution with a lower bound of 2 gallons per day and an upper bound of 20 gallons per day.

A.7 Use of Laboratory Chemicals Model Approaches and Parameters

This appendix presents the modeling approach and equations used to estimate environmental releases for 1,1,2-trichloroethane during the use of laboratory chemicals OES. This approach utilizes the *Generic Scenario on Use of Laboratory Chemicals* ([U.S. EPA, 2023d](#)) and CDR data ([U.S. EPA, 2020b](#)) combined with Monte Carlo simulation (a type of stochastic simulation).

Based on the GS, EPA identified the following release sources from use of laboratory chemicals:

- Release source 1: Transfer Operation Losses to Air from Unloading Laboratory Chemicals.
- Release source 2: Dust Emissions from Transferring Powders (not assessed).
- Release source 3: Container Cleaning Wastes.
- Release source 4: Open Surface Losses to Air During Container Cleaning.
- Release source 5: Equipment Cleaning Wastes.
- Release source 6: Open Surface Losses to Air During Equipment Cleaning.
- Release source 7: Releases During Laboratory Analysis.
- Release source 8: Laboratory Waste Disposal.

Environmental releases for 1,1,2-trichloroethane during the use of laboratory chemicals are a function of 1,1,2-trichloroethane's physical properties, container size, mass fractions, and other model parameters. While physical properties are fixed, some model parameters are expected to vary. EPA used a Monte Carlo simulation to capture variability in the following model input parameters: facility throughput, operating days, 1,1,2-trichloroethane concentrations, air speed, saturation factor, container size, loss fractions, and diameters of openings. EPA used the outputs from a Monte Carlo simulation with 100,000 iterations and the Latin Hypercube sampling method in @Risk to calculate release amounts for this OES.

A.7.1 Model Equations

Table_Apx A-16 provides the models and associated variables used to calculate environmental releases for each release source within each iteration of the Monte Carlo simulation. EPA used these environmental releases to develop a distribution of release outputs for the use of laboratory chemicals OES. The variables used to calculate each of the following values include deterministic or variable input parameters, known constants, physical properties, conversion factors, and other parameters. The values for these variables are provided in Appendix A.7.2. The Monte Carlo simulation calculated the total 1,1,2-trichloroethane release (by environmental media) across all release sources during each iteration of the simulation. EPA then selected 50th percentile and 95th percentile values to estimate the central tendency and high-end releases, respectively.

Table_Apx A-16. Models and Variables Applied for Release Sources in the Use of Laboratory Chemicals OES

Release Source	Model(s) Applied	Variables Used
Release source 1: Transfer Operation Losses to Air from Unloading Laboratory Chemicals.	EPA/OAQPS AP-42 Loading Model (Appendix A.1)	Vapor Generation Rate: $F_{chem\_product}$; VP ; f_{sat} ; MW_{112TCA} ; T_K ; V_{cont} ; $RATE_{fill}$ Operating Time: $N_{cont\_unload\_yr}$; $RATE_{fill}$; OD
Release source 2: Dust Emissions from Transferring Powders.	Not assessed; release is not expected since 1,1,2-trichloroethane is assumed to be managed as a liquid	Not applicable
Release source 3: Container Cleaning Wastes.	EPA/OAQPS AP-42 Small Container Residual Model (Appendix A.1)	$Q_{chem\_site\_day}$; $F_{container\_residue}$
Release source 4: Open Surface Losses to Air During Container Cleaning.	EPA/OPPT Penetration Model or EPA/OPPT Mass Transfer Coefficient Model, based on air speed (Appendix A.1)	Vapor Generation Rate: $F_{chem\_product}$; MW_{112TCA} ; VP_{112TCA} ; $RATE_{air\_speed}$; $D_{cleaning}$; T_K ; P_{Torr} Operating Time: $N_{cont\_unload\_yr}$; $RATE_{fill}$; OD
Release source 5: Equipment Cleaning Wastes.	EPA/OPPT Multiple Process Vessel Residual Model (Appendix A.1)	$Q_{chem\_site\_day}$; $F_{lab\_residue}$
Release source 6: Open Surface Losses to Air During Equipment Cleaning.	EPA/OPPT Penetration Model or EPA/OPPT Mass Transfer Coefficient Model, based on air speed (Appendix A.1)	Vapor Generation Rate: $F_{chem\_product}$; MW_{112TCA} ; VP_{112TCA} ; $RATE_{air\_speed}$; $D_{cleaning}$; T_K ; P_{Torr} Operating Time: $OH_{equip\_cleaning}$; OD
Release source 7: Releases During Laboratory Analysis.	EPA/OPPT Penetration Model or EPA/OPPT Mass Transfer Coefficient Model, based on air speed (Appendix A.1)	Vapor Generation Rate: $F_{chem\_product}$; MW_{112TCA} ; VP_{112TCA} ; $RATE_{air\_speed}$; $D_{cleaning}$; T_K ; P_{Torr} Operating Time: $OH_{testing}$
Release source 8: Laboratory Waste Disposal.	No model applicable; all chemicals used in the laboratory are expected to be disposed at the end of each working day. Remaining chemical not released from the previous release sources is released here	Not applicable

A.7.2 Model Input Parameters

Table_Apx A-17 summarizes the model parameters and their values for the Use of Laboratory Chemicals Monte Carlo simulation. Additional explanations of EPA's selection of the distributions for each parameter are provided after this table.

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Table_Apx A-17. Summary of Parameter Values and Distributions Used in the Use of Laboratory Chemicals Model

Input Parameter	Symbol	Unit	Deterministic Values	Uncertainty Analysis Distribution Parameters				Rationale / Basis
			Value	Lower Bound	Upper Bound	Mode	Distribution Type	
Total Production Volume of 1,1,2-trichloroethane	PV	kg/yr	34,019.40	—	—	—	—	See Section A.7.3
Daily Facility Throughput of 1,1,2-trichloroethane	Q _{stock_site_day}	mL/site-day	2000	0.50	4000	2000	Triangular	See Section A.7.3
1,1,2-Trichloroethane Concentration	F _{112TCA_product}	kg/kg	—	0.001	1.0	—	Discrete	See Section A.7.7
Operating Days	OD	days/yr	260	174	260	260	Discrete	See Section A.7.9
Air Speed	RATE _{air_speed}	ft/min	19.7	2.56	398.03	—	Lognormal	See Section A.7.10
Saturation Factor	f _{sat}	dimensionless	0.5	0.5	1.45	0.5	Triangular	See Section A.7.11
Container Size	V _{cont}	gal	0.066	0.00026	0.66	0.066	Triangular	See Section A.7.12
Container Loss Fraction	F _{container_residue}	kg/kg	0.003	0.003	0.006	0.003	Triangular	See Section A.7.13
Vapor Pressure at 25C	VP	Torr	23	—	—	—	—	Physical property
Molecular Weight	MW	g/mol	133.41	—	—	—	—	Physical property
Gas Constant	R	atm-cm ³ /gmol-L	82.05	—	—	—	—	Universal constant
Density of Products	RHO	kg/L	—	1.43	1.4416	—	Discrete	See Section A.7.8
Temperature	T	K	298	—	—	—	—	Process parameter
Pressure	P	atm	1	—	—	—	—	Process parameter
Small Container Fill Rate	RATE _{fill}	containers/hr	60	—	—	—	—	See Section A.7.14

Input Parameter	Symbol	Unit	Deterministic Values	Uncertainty Analysis Distribution Parameters				Rationale / Basis
			Value	Lower Bound	Upper Bound	Mode	Distribution Type	
Diameter of Opening – Container Cleaning	D _{cleaning}	cm	5.08	–	–	–	–	See Section A.7.15
Lab Testing Duration	OH _{sampling}	hr/day	1	–	–	–	–	See Section A.7.9
Equipment Cleaning Duration	OH _{equip}	hr/day	4	–	–	–	–	See Section A.7.9
Equipment Cleaning Loss Fraction	F _{lab_residue}	kg/kg	0.02	–	–	–	–	See Section A.7.13

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A.7.3 Throughput Parameters

The *Use of Laboratory Chemicals – Generic Scenario for Estimating Occupational Exposures and Environmental Releases* ([U.S. EPA, 2023d](#)) provides daily throughput of 1,1,2-trichloroethane required for laboratory stock solutions. According to the GS, laboratory liquid use rates range from 0.5 mL up to four liters per day with a midpoint of 2 liters/day. Laboratory stock solutions are used for multiple analyses and eventually need to be replaced. The expiration or replacement times range from daily to six months ([U.S. EPA, 2023d](#)). For this scenario, EPA assumes stock solutions are prepared daily. Therefore, EPA initially assigned a triangular distribution for the daily throughput of laboratory stock solutions with upper and lower bounds corresponding to the high and low use rates, and the midpoint as the mode.

The daily throughput of 1,1,2-trichloroethane in laboratory chemicals is calculated using Equation_Apx A-49 by multiplying the daily throughput of all laboratory solutions by the concentration of 1,1,2-trichloroethane in the solutions and converting volume to mass.

Equation_Apx A-49.

$$Q_{chem\_site\_day} = Q_{stock\_site\_day} \times F_{112TCA} \times RHO \times \frac{0.001L}{mL}$$

Where:

$Q_{chem\_site\_day}$	=	Facility throughput of 1,1,2-trichloroethane [kg/site-day]
$Q_{stock\_site\_day}$	=	Facility annual throughput of liquid laboratory chemicals [mL/site-day]
F_{112TCA}	=	Concentration of 1,1,2-trichloroethane in liquid laboratory chemicals (see Section A.7.7) [kg/kg]
RHO	=	Density of 1,1,2-trichloroethane [kg/L]

A.7.4 Number of Sites

Per 2020 U.S. Census Bureau data for the NAICS codes identified in the *Use of Laboratory Chemicals – Generic Scenario for Estimating Occupational Exposures and Environmental Releases* ([U.S. EPA, 2023d](#)) there are 36,873 laboratory use sites ([U.S. BLS, 2016](#)). Therefore, this value is used as a bounding limit, not to be exceeded by the calculation. Number of sites is calculated using the following equation.:

Equation_Apx A-50.

$$N_s = \frac{PV}{Q_{chem\_site\_day} \times OD}$$

Where:

N_s	=	Number of sites [sites]
PV	=	Production volume [kg/year]
$Q_{chem\_site\_day}$	=	Facility daily throughput of 1,1,2-trichloroethane (see Section A.7.3) [kg/site-yr]

A.7.5 Number of Containers Per Year

The number of 1,1,2-trichloroethane laboratory containers unloaded by a site per year is calculated using the following equation:

Equation_Apx A-51.

$$N_{cont\_unload\_yr} = \frac{Q_{chem\_site\_day} \times OD}{F_{chem\_product} \times Q_{cont}}$$

Where:

$Q_{chem\_site\_day}$	=	Facility daily throughput of 1,1,2-trichloroethane (see Section A.7.3) [kg/site-yr]
OD	=	Operating days [days/yr]
$F_{chem\_product}$	=	Mass fraction of 1,1,2-trichloroethane in product (see Section A.7.7) [kg/kg]
Q_{cont}	=	Mass of 1,1,2-trichloroethane in container [kg/container]

A.7.6 Operating Hours

EPA estimated operating hours or hours of duration using data provided from the Generic Scenario on Use of Laboratory Chemicals ([U.S. EPA, 2023d](#)), ChemSTEER User Guide ([U.S. EPA, 2015a](#)), and/or through calculation from other parameters. Release points with operating hours provided from these sources include unloading, container cleaning, equipment cleaning, and product sampling.

For unloading and container cleaning (release points 1 and 4), the operating hours are calculated based on the number of containers unloaded at the site and the unloading rate using the following equation:

Equation_Apx A-52.

$$OH_{RP1/RP4} = \frac{N_{cont\_unload\_yr}}{RATE_{fill} \times OD}$$

Where:

$OH_{RP1/RP4}$	=	Operating time for release points 1 and 4 [hrs/site-day]
$N_{cont\_unload\_yr}$	=	Annual number of containers unloaded (see Section A.7.5) [container/site-year]
$RATE_{fill}$	=	Container fill rate (see Section A.7.14) [containers/hr]
OD	=	Operating days (see Section A.7.6) [days/site-year]

For equipment cleaning (release point 6), the ChemSTEER User Guide provides an estimate of four hours per day for cleaning multiple vessels ([U.S. EPA, 2015a](#)).

For product sampling (release point 7), the ChemSTEER User Guide ([U.S. EPA, 2015a](#)) indicates a single value of one hour/day.

A.7.7 1,1,2-Trichloroethane Concentration in Laboratory Chemicals

EPA modeled 1,1,2-trichloroethane concentration in laboratory products using a discrete distribution with a lower bound of 0.1 % and an upper bound of 100 %. EPA built the discrete distribution by using the available weight fractions identified in product SDSs.

A.7.8 1,1,2-Trichloroethane Product Density

EPA modeled the density of laboratory products using a discrete distribution with a lower bound of 1.43 kg/L and an upper bound of 1.4416 kg/L. EPA built the discrete distribution by using the available

weight fractions identified in product SDSs.

A.7.9 Operating Days

EPA modeled the operating days per year using a discrete distribution with a low end of 174 days/year and a high end of 260 days/year. These values were based on U.S. BLS Occupational Employment Statistics ([U.S. BLS, 2016](#)). Per the U.S. BLS website, operating duration for each NAICS code is assumed as a 'year-round, full-time' hours figure of 2,080 hours ([U.S. BLS, 2016](#)). Therefore, dividing this time by an assumed working duration of eight or 12 hours/day yields 174 or 260 days/year. To ensure that only integer values of this parameter were selected, EPA modeled a discrete distribution that listed each integer between (and including) 174 and 260 days/year.

A.7.10 Air Speed

Baldwin and Maynard measured indoor air speeds across a variety of occupational settings in the United Kingdom ([Baldwin and Maynard, 1998](#)). Fifty-five work areas were surveyed across a variety of workplaces. EPA analyzed the air speed data from Baldwin and Maynard and categorized the air speed surveys into settings representative of industrial facilities and representative of commercial facilities. EPA fit separate distributions for these industrial and commercial settings and used the industrial distribution for this OES.

EPA fit a lognormal distribution for the data set as consistent with the authors' observations that the air speed measurements within a surveyed location were lognormally distributed and the population of the mean air speeds among all surveys were lognormally distributed ([Baldwin and Maynard, 1998](#)). Since lognormal distributions are bound by zero and positive infinity, EPA truncated the distribution at the largest observed value among all of the survey mean air speeds.

EPA fit the air speed surveys representative of industrial facilities to a lognormal distribution with the following parameter values: mean of 22.414 cm/s and standard deviation of 19.958 cm/s. In the model, the lognormal distribution is truncated at a minimum allowed value of 1.3 cm/s and a maximum allowed value of 202.2 cm/s (largest surveyed mean air speed observed in Baldwin and Maynard) to prevent the model from sampling values that approach infinity or are otherwise unrealistically small or large ([Baldwin and Maynard, 1998](#)).

Baldwin and Maynard only presented the mean air speed of each survey. The authors did not present the individual measurements within each survey. Therefore, these distributions represent a distribution of mean air speeds and not a distribution of spatially variable air speeds within a single workplace setting. However, a mean air speed (averaged over a work area) is the required input for the model. EPA converted the units to ft/min prior to use within the model equations.

A.7.11 Saturation Factor

The CEB Manual indicates that during splash filling, the saturation concentration was reached or exceeded by misting with a maximum saturation factor of 1.45 ([CEB, 1991](#)). The CEB Manual indicates that saturation concentration for bottom filling was expected to be about 0.5 ([CEB, 1991](#)). The underlying distribution of this parameter is not known; therefore, EPA assigned a triangular distribution based on the lower bound, upper bound, and mode of the parameter. Because a mode was not provided for this parameter, EPA assigned a mode value of 0.5 for bottom filling as bottom filling minimizes volatilization ([CEB, 1991](#)). This value also corresponds to the typical value provided in the ChemSTEER User Guide for the EPA/OAQPS AP-42 Loading Model ([U.S. EPA, 2015a](#)).

A.7.12 Container Size

The Generic Scenario on Use of Laboratory Chemicals ([U.S. EPA, 2023d](#)) states that laboratory chemicals are packaged in bottles, typically one gallon in size (liquids). According to the ChemSTEER User Guide, bottles are defined as containing between one and five gallons of liquid ([U.S. EPA, 2015a](#)). EPA identified laboratory products containing 1,1,2-trichloroethane as having available container sizes as small as 1 mL (liquids). EPA built a triangular distribution for liquid volumes with a lower bound of 0.00026 gallons (1 mL), an upper bound of 0.66 gallons (250mL), and median of 0.066 gallons (25 mL) based on the identified products.

A.7.13 Container Loss Fraction

EPA used data from the PEI Associates Inc. study ([PEI Associates, 1988](#)) and the EPA/OPPT Small Container Residual Model. For unloading drums by pouring in the PEI Associates Inc. study ([PEI Associates, 1988](#)), EPA found that the average % residual from the pilot-scale experiments showed a range of 0.03 to 0.79 % and an average of 0.32 %. The EPA/OPPT Small Container Residual Model from the ChemSTEER User Guide ([U.S. EPA, 2015a](#)) recommends a default central tendency loss fraction of 0.3 % and a high-end loss fraction of 0.6 %.

The underlying distribution of the loss fraction parameter for small containers is not known; therefore, EPA assigned a triangular distribution, since triangular distributions require least assumptions and are completely defined by range and mode of a parameter. EPA assigned the mode and maximum values for the loss fraction probability distribution using the central tendency and high-end values, respectively, prescribed by the EPA/OPPT Small Container Residual Model in the ChemSTEER User Guide ([U.S. EPA, 2015a](#)). EPA assigned the minimum value for the triangular distribution using the minimum average % residual measured in the PEI Associates, Inc. study ([PEI Associates, 1988](#)) for emptying drums by pouring.

A.7.14 Small Container Fill Rate

The ChemSTEER User Guide ([U.S. EPA, 2015a](#)) provides a typical fill rate of 60 containers per hour for containers with less than 20 gallons of liquid.

A.7.15 Diameters of Opening

For container cleaning activities, the ChemSTEER User Guide indicates a single default value of 5.08 cm for containers less than 5,000 gallons ([U.S. EPA, 2015a](#)).

A.7.16 Equipment Cleaning Loss Fraction

For liquids, EPA used the EPA/OPPT Multiple Process Residual Model to estimate the releases from equipment cleaning. The EPA/OPPT Multiple Process Residual Model, as detailed in the ChemSTEER User Guide ([U.S. EPA, 2015a](#)) provides an overall loss fraction of two % from equipment cleaning.

A.8 Occupational Dermal Exposure Modeling Method

This appendix presents the modeling approach and equations to estimate occupational dermal exposures. This method was developed through review of relevant literature and consideration of existing exposure models, such as EPA/OPPT models.

A.8.1 Dermal Dose Equation

EPA used the following equation to estimate the acute absorbed dose rate (AADR) from occupational dermal exposures:

Equation_Apx A-53.

$$AADR = S \times Q_u \times f_{abs} \times Y_{derm} \times FT / BW$$

Where:

S	=	Surface area of skin in contact with the chemical formulation (cm ²)
Q_u	=	Dermal load (<i>i.e.</i> , the quantity of the chemical formulation on the skin after the dermal contact event, mg/cm ² -event)
f_{abs}	=	Fractional absorption, (<i>i.e.</i> , the portion of chemical formulation absorbed systemically, accounting for evaporation of the chemical from the dermal load, Q_u (unitless, $0 \leq f_{abs} \leq 1$))
Y_{derm}	=	Weight fraction of the chemical of interest in the liquid (unitless, $0 \leq Y_{derm} \leq 1$)
FT	=	Frequency of events (integer number/day)
BW	=	Body weight (kg)

The inputs to the dermal dose equation are described in Appendix A.8.2.

A.8.2 Model Input Parameters

Table_Apx A-18 summarizes the model parameters and their values for estimating dermal exposures. Additional explanations of EPA's selection of the inputs for each parameter are provided in the subsections after the following table.

Table_Apx A-18. Summary of Dermal Model Input Values

Input Parameter	Symbol	Unit	Deterministic Values	Uncertainty Analysis Distribution Parameters				Rationale
			Value	Lower Bound	Upper Bound	Mode	Distribution Type	
Surface Area	S	cm ²	1,070	535	1,070	–	Uniform	See Appendix A.8.2.1
Dermal Load	Q _u	mg/cm ² -event	2.1	0.7	2.1	–	Uniform	See Appendix A.8.2.2
Frequency of Events	FT	events/day	1	–	–	–	–	See Appendix A.8.2.5
Fraction Absorbed	F _{abs}	unitless	Chemical weight fraction-dependent	–	–	–	–	See Appendix A.8.2.3
Chemical Weight Fraction	Y _{derm}	unitless	OES-dependent	–	–	–	–	Appendix A.8.2.4
Exposure Days	EF	days/yr	OES-dependent	–	–	–	–	

A.8.2.1 Surface Area

EPA used an exposed skin surface area (S) for workers of 1,070 cm² for the upper bound based on the mean two-hand surface area for adult males ages 21 or older from Chapter 7 of EPA's *Exposure Factors Handbook* ([U.S. EPA, 2011](#)). For the lower bound, EPA assumed the exposure surface area was equivalent to only a single hand (or one side of two hands) and used half the mean values for two-hand surface areas (*i.e.*, 535 cm² for workers).

It should be noted that while the surface area of exposed skin is derived from data for hand surface area, EPA did not assume that only the workers hands may be exposed to the chemical. Nor did EPA assume that the entirety of the hands is exposed for all activities. Rather, EPA assumed that dermal exposures occur to some portion of the hands plus some portion of other body parts (*e.g.*, arms) such that the total exposed surface area is approximately equal to the surface area of one hand (front and back) or two hands (front and back) for the central tendency and high-end exposure scenario, respectively.

A.8.2.2 Dermal Load

The dermal load (Q_u) is the quantity of chemical on the skin after the dermal contact event. This value represents the quantity remaining after the bulk chemical formulation has fallen from the hand that cannot be removed by wiping the skin (*e.g.*, the film that remains on the skin). To estimate the dermal load from each activity, EPA used data from references cited by EPA's September 2013 engineering policy memorandum: *Updating CEB's Method for Screening-Level Assessments of Dermal Exposure* ([U.S. EPA, 2013](#)). That memorandum provides for the following dermal exposure scenarios:

- Routine and incidental contact with liquids (*e.g.*, maintenance activities, manual cleaning of equipment, filling drums, connecting transfer lines, sampling, and bench-scale liquid transfers);
- Routine immersion in liquids (*e.g.*, handling of wet surfaces and spray painting);
- Routine contact with container surfaces (*e.g.*, handling closed or empty bags of solid materials); and
- Routine, direct handling of solids (*e.g.*, filling/dumping containers of powders/flakes/granules, weighing powder/scooping/mixing, handling wet or dried material in a filtration and drying process).

For liquids, the memorandum uses values of 0.7 to 2.1 mg/cm²-event for routine or incidental contact with liquids and 1.3 to 10.3 mg/cm²-event for routine immersion in liquids ([U.S. EPA, 2013](#)). For 1,1,2-trichloroethane, EPA did not assess an immersion scenario for any of the OES that were assessed. PA used the maximum to estimate high-end dermal loads.

For 1,1,2-trichloroethane, EPA used a probabilistic modeling approach and applied a uniform distribution of 0.7 to 2.1 mg/cm²-event, respectively, for each OES.

A.8.2.3 Fractional Absorption

The *Dermal Exposure to Volatile Liquids Model* accounts for evaporation through the fraction absorbed parameter which is a measure of the fraction absorbed to the skin with the remainder lost to evaporation. Values for 1,1,2-trichloroethane were obtained via test order. The value for fraction absorbed can vary by weight fraction and the test order for 1,1,2-trichloroethane required that the fraction absorbed be tested at neat, mid-range and dilute concentrations. Table_Apx A-19 provides a summary of the fraction absorbed data that was used by EPA in the DEVL model to estimate dermal exposure. Table_Apx A-20 describes the fraction absorbed used for each OES (which is based on the available information on weight fraction).

Table_Apx A-19. Fraction Absorbed Parameter Values

Test Concentration of 1,1,2-Trichloroethane	Fractional Absorption Used (f_{abs}) ^a	Reference
Neat 1,1,2-trichloroethane sample	0.96%	(Labcorp Early Development, 2023)
50% 1,1,2-trichloroethane in 1,2-DCA sample	0.84%	
10% 1,1,2-trichloroethane in 1,2-DCA sample	0.47%	
1% 1,1,2-trichloroethane in 1,2-DCA sample)	0.63%	

^a Represents a mass balance corrected mean fractional absorption value. Mass balance corrections were performed to account for mass balance less than 95%, absorption less than 5%, and the coefficient of variation (e.g., high % coefficient of variation >25%), in accordance with 2022 OECD GD156 and 2017 EFSA dermal guidance (OECD, 2022). These calculations and adjustments are further described in Section 2.2.1 and Table 2-1 of the *Draft Human Health and Environmental Hazard Assessment for 1,1,2-Trichloroethane Technical Support Document* (U.S. EPA, 2026l).

A.8.2.4 Chemical Weight Fraction

Table_Apx A-20 summarizes the chemical weight fraction parameters for each OES and the associated distribution type.

Table_Apx A-20. Summary of OES Chemical Weight Fraction and Fraction Absorbed Model Input Parameters

OES	Approach Used to Estimate Dermal Exposure
Manufacturing as a Byproduct in Chemical Manufacturing	EPA assessed dermal exposures for this OES using a weight fraction uniform distribution from 0.045 to 45% based on information provided in the Vinyl Institute Final Study Report (Stantec ChemRisk, 2024a). The purification process for the intended product at the sites where the unintended 1,1,2-trichloroethane byproduct is produced can result in multiple process streams containing the byproduct chemicals which can create a wide range in concentrations. Based on the expected weight fractions, EPA applied fraction absorbed values of 0.63%, 0.47% and 0.84%.
Import-Repackaging for Laboratory Chemical Use	EPA applied a discrete distribution for the weight fraction ranging from 0.1 to 100% based on product safety data sheets identified for laboratory chemicals containing 1,1,2-trichloroethane (Sigma-Aldrich Inc, 2020; Santa Cruz Biotechnology, 2019; SPEX CertiPrep LLC, 2019; Phenova, 2018; ThermoFisher Scientific, 2018; Matheson Tri-Gas, 2017). EPA applied fraction absorbed values of 0.63%, 0.47%, 0.84%, and 0.96%. The wide range in 1,1,2-trichloroethane weight fractions is due to its presence as an impurity in some SDS for some products and as a main component for SDS for other products,
Processing as a Reactant	EPA applied a uniform distribution for the weight fraction ranging from 0.045 to 100% based on product safety data sheets (Spectrum Chemical, 2019; Westlake Vinyls, 2015). EPA applied fraction absorbed values of 0.63%, 0.47%, 0.84%, and 0.96%. The weight fraction from manufacturing ranged from 0.045% to 45%. The byproduct streams would need to be concentrated further to get to weight fractions up to 100% to be used in

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OES	Approach Used to Estimate Dermal Exposure
	processing as a reactant.
Formulation of Adhesives and Sealants	EPA applied a uniform distribution from 1 to 45% based on the product safety data sheet for adhesive containing 1,1,2-trichloroethane (1%) and the manufacturing distribution (upper bound of 45%). The chemical arrives at formulation sites in manufactured form, and workers may come into contact with these higher concentrations when handling raw 1,1,2-trichloroethane. EPA applied fraction absorbed values of 0.63%, 0.47%, 0.84%, and 0.96%.
Use of Adhesives and Sealants	The concentration range evaluated for this OES is a uniform distribution from 1 to 10% based on a product safety data sheet for an adhesive containing 1,1,2-trichloroethane and a comment from the American Coatings Association ((Huntsman, 2018); EPA-HQ-OPPT-2018-0421-0003). Based on the expected concentration, EPA applied a fraction absorbed value of 0.63%.
Use as a Solvent for Cleaning/Degreasing	The concentration evaluated for this OES is a static 100% based on the typical halogenated solvent concentration provided by the ESD on the Use of Vapour Degreasers (OECD, 2021). EPA applied a fraction absorbed value of 0.96%.
Use of Laboratory Chemicals	EPA applied a discrete distribution for the weight fraction ranging from 0.1 to 100% based on product safety data sheets identified for laboratory chemicals containing 1,1,2-trichloroethane (Sigma-Aldrich Inc, 2020 ; Santa Cruz Biotechnology, 2019 ; SPEX CertiPrep LLC, 2019 ; Phenova, 2018 ; ThermoFisher Scientific, 2018 ; Matheson Tri-Gas, 2017). EPA applied fraction absorbed values of 0.63%, 0.47%, 0.84%, and 0.96%. The wide range in 1,1,2-trichloroethane weight fractions is due to its presence as an impurity in some SDS for some products and as a main component for SDS for other products.
Disposal to Incineration, Disposal to Landfills, and Disposal to POTW/WWT	The concentration range evaluated for these OES is a uniform distribution from 0.045 to 100 % based on the range of expected upstream concentrations. EPA assumed that the weight fraction of 1,1,2-trichloroethane in waste streams sent for disposal would correspond to the range of weight fractions in the chemical's lifecycle. EPA applied fraction absorbed values of 0.63%, 0.47%, 0.84%, and 0.96%.

A.8.2.5 Frequency of Events

The frequency of events, FT, refers to the number of dermal exposure events/day. Depending on the OES, workers may perform multiple activities throughout their shift that could potentially result in dermal exposures. Equation_Apx A-53 shows a linear relationship between FT and acute potential dose rate; however, this fails to account for time between contact events. Because the chemical simultaneously evaporates from and absorbs into the skin, dermal exposure is a function of both the number of contact events/day and the time between contact events. Subsequent dermal exposure events may only meaningfully increase the dermal dose if there is sufficient time between the contact events to allow for significant evaporation/absorption of the previous exposure event. EPA did not identify information on how many contact events may occur and the time between contact events. Therefore, the Agency assumes a single contact event/day for estimating dermal exposures for all OES.

Appendix B PROCEDURES FOR MAPPING FACILITIES FROM STANDARD ENGINEERING SOURCES TO OCCUPATIONAL EXPOSURE SCENARIOS AND CONDITIONS OF USE

B.1 Conditions of Use and Occupational Exposure Scenarios

Condition of Use (COU)

TSCA section 3(4) defines COUs as “the circumstances, as determined by the Administrator, under which a chemical substance is intended, known, or reasonably foreseen to be manufactured, processed, distributed in commerce, used, or disposed of.” COUs included in the scope of EPA’s risk evaluations are typically tabulated in scope documents and risk evaluation documents as summaries of life cycle stages, categories, and subcategories of use, as shown in Table_Apx B-1. Therefore, a COU is defined as a combination of life cycle stage, category, and subcategory. The Agency identifies COUs for chemicals during the scoping phase; this process is not discussed in this document.

Occupational Exposure Scenario (OES)

EPA has not adopted a standardized definition for OES. The purpose of an OES is to group or segment COUs for assessment of releases and exposures based on similarity of the operations and data availability for each COU. For example, EPA may assess a group of multiple COUs together as one OES due to similarities in release and exposure potential (*e.g.*, the COUs for formulation of paints, formulation of cleaning solutions, and formulation of other products may be assessed together as a single OES). Alternatively, EPA may assess multiple OES for one COU because there are different release and exposure potentials for a given COU (*e.g.*, the COU for batch vapor degreasing may be assessed as separate OES for open-top vapor degreasing and closed-loop vapor degreasing). OES determinations are also largely driven by the availability of data and modeling approaches to assess occupational releases and exposures. For example, even if there are similarities between multiple COUs, if there is sufficient data to separately assess releases and exposures for each COU, and evidence that the exposure scenarios are distinct enough that it would be appropriate to assess them separately, EPA would not group them into the same OES. This is depicted in Figure_Apx B-1.

For chemicals undergoing risk evaluation, EPA maps each industrial and commercial COU to one or more OESs based on reasonably available data and information (*e.g.*, CDR, use reports, process information, public and stakeholder comments), assumptions, and inferences that describe how release and exposure take place within a COU. The Agency identifies OESs for COUs—not vice-versa (*i.e.*, COUs are not altered during OES mapping). The mapping of COUs to OES is separate from and occurs after the identification of COUs. Both the identification of COUs and subsequent mapping of COUs to OESs occur early in the risk evaluation process and are described in this document in Section 4.1.1. This section is intended to just provide background context on COUs and OESs.

Table Apx B-1. Example Condition of Use Table with Mapped Occupational Exposure Scenarios

COU			OES
Life Cycle Stage	Category ^a	Subcategory ^b	
Manufacturing	Domestic manufacturing	Domestic manufacturing	Manufacturing
	Import	Import	Repackaging
Processing	As a reactant	Intermediate in all other basic organic chemical manufacturing	Processing as a reactant
	Processing – incorporation into formulation, mixture, or reaction product	Solvents (for cleaning or degreasing)	Formulation
		Adhesives and sealant chemicals	
	Repackaging	Solvents (for cleaning or degreasing)	Repackaging
	Etc.		

COU = condition of use; OES = occupational exposure scenario

^a Categories reflect Chemical Data Reporting (CDR) codes and broadly represent the industrial and/or commercial settings of the condition of use (COU).

^b The subcategories reflect more specific COUs.

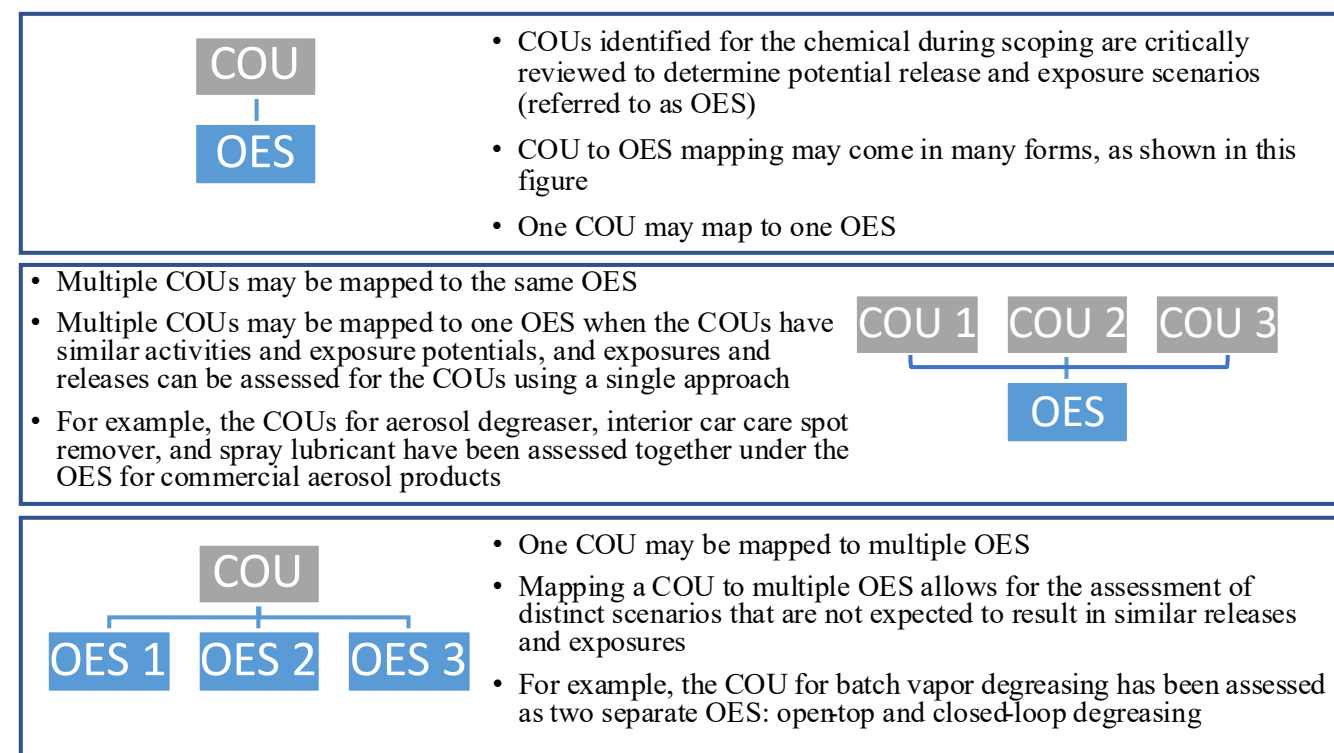


Figure Apx B-1. Condition of Use to Occupational Exposure Scenario Mapping Options

B.2 Standard Sources Requiring Facility Mapping

EPA utilizes release data from EPA programmatic databases and exposure data from standard sources to complete occupational exposure and environmental release assessments, which are described below (all hyperlinks accessed August 11, 2025):

- [Chemical Data Reporting \(CDR\)](#), to which import and manufacturing sites producing the chemical at or above a specified threshold must report. EPA uses CDR to identify COUs, OES, sites that import or manufacture the chemical, and for information on physical form and concentration of the chemical. In addition, EPA is currently developing the Tiered Data Reporting (TDR) rule, which would establish reporting requirements, including changes to CDR, to collect information that better meets data needs for the TSCA existing chemical program. The rule is expected to have reporting requirements tiered to specific stages of existing chemical assessments (*e.g.*, prioritization, risk evaluation) and harmonized to the Organization for Economic Co-operation and Development (OECD) risk assessment framework, which would help to better inform uses of chemicals and improve upon the OES mapping procedures in this document.
- [Toxics Release Inventory \(TRI\)](#), to which facilities handling a chemical covered by the TRI program at or above a specified threshold must report. EPA uses TRI data to quantify air, water, and land releases of the chemical undergoing risk evaluation.
- [National Emissions Inventory \(NEI\)](#), a compilation of air emissions of criteria pollutants, criteria precursors and hazardous air pollutants from point and non-point source air emissions. EPA uses NEI data to quantify air emissions of the chemical undergoing risk evaluation.
- [Discharge Monitoring Report \(DMR\)](#), a periodic report required of National Pollutant Discharge Elimination System (NPDES) permitted facilities discharging to surface waters. EPA uses NEI data to quantify surface water discharges of the chemical undergoing risk evaluation.
- Occupational Safety and Health Administration (OSHA): [Chemical Exposure Health Data \(CEHD\)](#), a compilation of industrial hygiene samples taken when OSHA monitors worker exposures to chemical hazards. EPA uses OSHA CEHD to quantify occupational inhalation exposures to the chemical undergoing risk evaluation.
- National Institute of Occupational Safety and Health (NIOSH): [Health Hazard Evaluations \(HHEs\)](#), a compilation of voluntary employee, union, or employer requested evaluations of health hazards present at given workplace. EPA uses NIOSH HHE data to quantify occupational inhalation exposures to the chemical undergoing risk evaluation.

To utilize the data from these sources, the facilities that report to each must first be mapped to an OES. There may be other sources of data for specific facilities that require mapping the facilities to an OES; however, this document covers the most common data sources. Additionally, EPA often uses data from sources such as public and stakeholder comments, generic scenarios, and process data that are usually not specific to an individual site; therefore, unlike the above sources, they do not involve the mapping of specific sites to an OES.

Mapping procedures for the above sources are discussed in detail in the subsequent sections; however, Table_Apx B-2 includes a summary of the type of information reported by companies in each database that helps to inform OES and COU mapping. This includes industrial classification codes such as those associated with the [North American Industry Classification System \(NAICS\)](#) and [Standard Industrial Classification \(SIC\)](#) system (both URLs accessed August 11, 2025). Note that the U.S. government replaced SIC codes with NAICS codes in 1997; however, SIC codes are still used in DMR and are applicable for data from all listed sources for years prior to 1997. Additionally, some of the sources in Table_Apx B-2 have specific reporting requirements that include flags for the type of processes that occur at the site.

12040 Assessors should be sure that a facility that reports to multiple databases/sources is consistently mapped
12041 to the same OES, as applicable. This is not applicable if the facility reports separately for different
12042 areas/processes of their facility (*e.g.*, a large chemical plant may report 1 block of unit operations
12043 separate from another such that they have different OESs).

12044

Table Apx B-2. EPA Programmatic Database Information that Aids OES/COU Mapping

Source	Reported Information Useful for Mapping OES/COU	Reporting Frequency	Notes
CDR	- Indication if the chemical is imported or domestically manufactured - Indication if the chemical is imported but never at the site, used on-site, or exported	- Facilities must report to CDR every 4 years - New datasets take years to become publicly available - Latest reporting year with available data: 2020	- While CDR also includes information on downstream processing and use, it does not include site identities for these operations; thus, it does not inform reporting site OES/COU mapping. - Claims of confidential business information (CBI) can limit data utility in risk evaluations.
TRI	- NAICS codes - Flags for uses and subuses of the chemical - Release media information	- Facilities must report to TRI annually - New datasets become publicly available in October for the previous year - Latest reporting year with available data: 2021	- Reporters must select from specific uses (<i>e.g.</i>, manufacture, import, processing) and subuses (<i>e.g.</i>, formulation additive, degreaser, lubricant). - Sub-use information is only available in datasets starting in 2018. - Facilities may report with a Form A under certain circumstances; ^a Form A's do not require use/sub-use reporting.
NEI	- SCCs, which classify different types of activities that generate air emissions - Emissions Inventory System (EIS) Sectors, which classify industry sectors - NAICS codes - Process description free-text field (used for additional information about the process related to the emission unit) - Emission unit description free-text field	- Facilities must report to NEI every three years - New datasets take years to become publicly available - Latest reporting year with available date: 2020	- NEI contains specific SCC codes and industry sectors from which reporters select. - Free-text fields are not mandatory for the reporter to fill out.
DMR	- SIC codes - NPDES) permit numbers	- Facilities must report to DMR at the frequency specified in their NPDES permit, which is typically monthly - Data typically flows through the State DMR reporting platform to EPA's ECHO database continuously	- Sites that only report non-detection of the chemical for the year are generally excluded from mapping. - NPDES permit numbers can sometimes indicate the type of general permit, which can inform mapping (<i>e.g.</i>, remediation general permit).
OSHA	- NAICS or SIC codes	- OSHA conducts monitoring as-needed	- CEHD includes data from 1984 and forward.

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Source	Reported Information Useful for Mapping OES/COU	Reporting Frequency	Notes
		for site investigations - Monitoring data is available in CEHD when the investigation and any subsequent litigation cases are closed - Latest year in CEHD with data: 2025	
NIOSH HHE	- Facility process information - Worker activities	- NIOSH conducts HHEs upon request - HHEs are published online when NIOSH is completed with the evaluation - Latest year with a published HHE: 2025	- NIOSH HHEs generally include narrative descriptions of facility processes and worker activities, with specific information on how the chemical being monitored for is used.
CDR = Chemical Data Reporting; CEHD = Chemical Exposure Health Data; COU = condition of use; DMR = Discharge Monitoring Report; ECHO = Enforcement and Compliance History Online; HHE = Health Hazard Evaluation; NAICS = North American Industry Classification System; NEI = National Emissions Inventory; NIOSH = National Institute for Occupational Safety and Health; NPDES = National Pollutant Discharge Elimination System; OES = occupational exposure scenario; OSHA = Occupational Safety and Health Administration; SIC = Standard Industrial Classification; TRI = Toxics Release Inventory ^a Facilities may report using a Form A if the annual reportable release amount of the chemical did not exceed 500 lb for the reporting year, and the amounts manufactured, or processed, or otherwise used did not exceed 1 million lb for that year.			

12045

B.3 OES Mapping Procedures

This section contains procedures for mapping facilities to OES for each source discussed in Section B.2.

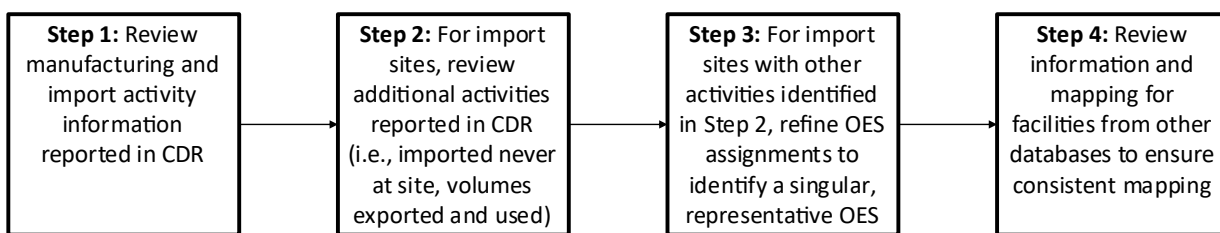
B.3.1 Chemical Data Reporting (CDR)

The only facilities required to report to CDR are those that manufacture or import specific chemicals at or above a specified threshold.¹⁵ Therefore, sites that report for the chemical of interest in CDR will generally be mapped to either the Manufacturing or Import/repackaging OES. These sites must also report the processing and uses of the chemical; however, these procedures are specific to mapping of the reporting site and not downstream processing or use sites.

CDR, under TSCA, requires manufacturers (including importers) to provide EPA with information on the production and use of chemicals in commerce. These facilities must report to CDR every four years. For risk evaluations conducted under the amended TSCA, EPA has primarily used 2016 and 2020 CDR. The procedures in this document are applicable to both 2016 and 2020 CDR data; however, there are some data elements that are only applicable to 2020 CDR, which are called out in the procedures where applicable. These procedures should be applicable to future CDR reporting, depending on changes to reporting requirements. If the TDR rule is promulgated, these procedures will be updated accordingly.

Chemical data reported under CDR is classified using Industrial Function Category (IFC) codes and/or commercial/consumer use product categories (PCs). CDR IFC codes describe the “intended physical or chemical characteristics for which a chemical substance or mixture is consumed as a reactant; incorporated into a formulation, mixture, reaction product, or article, repackaged; or used.” Alternatively, PCs describe the consumer and commercial products in which each reportable chemical is used. EPA typically uses these CDR codes to identify the COUs for the chemical in the published scope documents.

Figure_Apx B-2 depicts the steps that should be followed to map CDR reporting sites to OES. Each step is explained in the text below the figure. Additionally, Section B.5.1 shows step-by-step examples for using the mapping procedures to determine the OES for three example CDR reporting facilities.



Figure_Apx B-2. OES Mapping Procedures for CDR

To map sites reporting to CDR, the following procedures should be used with the non-CBI CDR:

1. **Review Manufacturing and Import Activity Information:** The first step in the process is to review the reported activity information to identify if the facility imports or manufactures the chemical.

¹⁵ See [2020 CDR reporting instructions](#) (accessed August 11, 2025) for further information, including descriptions on the information required to be reported.

- a. If the facility reports domestic manufacturing, the manufacturing OES should be assigned, even if the facility also reports importation or the facility may conduct other operations with the chemical. This is because manufacturing of the chemical is expected to be the primary operation, with any other processing or uses being ancillary operations.
- b. If the chemical is being manufactured as a byproduct (this is a voluntary reporting element starting in 2020 CDR), this may need to be considered separately from non-byproduct manufacturing depending on assessment needs for the chemical.
- c. If the facility does not manufacture the chemical and only imports the chemical, check if additional processes occur at the site as described in the subsequent steps.

2. **For Importation Sites, Review Fields for “Imported Never at Site,” “Volume Exported,” and “Volume Used”:** The next step is to review these additional fields to determine if the reporting facility conducts more than just importation activities.

- a. If the facility imports the chemical, they must report if it is imported but never physically at the reporting site. If the facility indicates the chemical is imported and never at site, the facility does not handle the chemical and the only applicable OES is importation. In such cases, the assessor should proceed to Step 4. If the facility does not indicate the chemical is imported and never at site, proceed to Step 2b.
- b. If the facility reports a quantity for “volume exported” and this quantity is the same as that imported, no additional OES occurs at the site beyond importation. In such cases, the assessor should proceed to Step 4. If the exported quantity is not equal to volume imported, assessors should check if any of the chemical is used at the reporting site per Step 2c.
- c. If the facility reports a quantity for “volume used”, additional OES may be applicable to the facility beyond manufacturing or importation. Proceed to Step 3 to identify and refine additional OES.

3. **Refine OES Assignments:** If multiple OES were identified from the previous steps, a single primary OES must be selected using additional facility information. OES determinations should be made with the following considerations:

- a. 6-digit NAICS code reported by the facility in CDR – note that this is only a requirement starting in 2020 CDR (*e.g.*, for a facility that reported NAICS code was 325520, Adhesive Manufacturing, the incorporation into a formulation, mixture, or reaction product OES may be appropriate; for a facility reporting a NAICS code starting in 424690, Other Chemical and Allied Products Merchant Wholesalers, only the repackaging OES is likely applicable).
- b. Downstream processing and use information reported in CDR. The reporting site must provide information on downstream processing and use of the chemical for all sites, meaning it cannot be distinguished which processing and use information includes the reporting site operations versus downstream site operations. However, this information may still help inform the operations at the reporting site and should be reviewed. Specifically, for a given processing/use activity, if the submitter reports “Fewer than 10 sites” for the “number of sites” field (which is the lowest number of sites that can be reported), there is a likelihood that the facility’s operations may be included in this processing/use activity. In such cases, review the corresponding fields for “type of processing or use operation,” “industrial sector,” and “function category” to help identify the OES. The greater number of sites that are reported, the more likely that the associated

processing and use information includes information from downstream sites and the less reliable the information is for mapping OES to the reporting site.

- c. Internet research of the types of products made at the facility (*e.g.*, if a facility's website indicates the facility manufactures plastic products, the chemical may be used as a processing aid or component in the plastic products, depending on the known uses of the chemical within the plastics industry).
- d. Information from other reporting databases as described in Step 2c.
- e. An evaluation of the OES that is most likely to result in a release (*e.g.*, for facilities that reported importation and may also conduct formulation per the reported NAICS code, the formulation OES may be assigned, because, in most cases, importation would have a lower likelihood of a release).
- f. Grouped OES for similar uses (*e.g.*, multiple facilities that may conduct formulation operations based on the reported NAICS code may be assigned a grouped formulation OES that covers all types of formulation [*e.g.*, adhesives, paints, cleaning products])).

4. **Review Information from Other Databases:** Other databases/sources (such as TRI, NEI, and DMR) should be checked to see if the facility has reported to these. If so, the OES determined from the mapping procedures for those databases (discussed in other sections of this document) should also be used. It is important that the same facility is mapped consistently across multiple databases/sources. The facility's TRI identification number (TRFID) and Facility Registry Services identification number (FRS ID) can be used to identify sites that report to TRI, DMR, and NEI. If the facility does not report to these databases, but additional OES are possible per Step 2, the assessor should search available facility information on the internet.

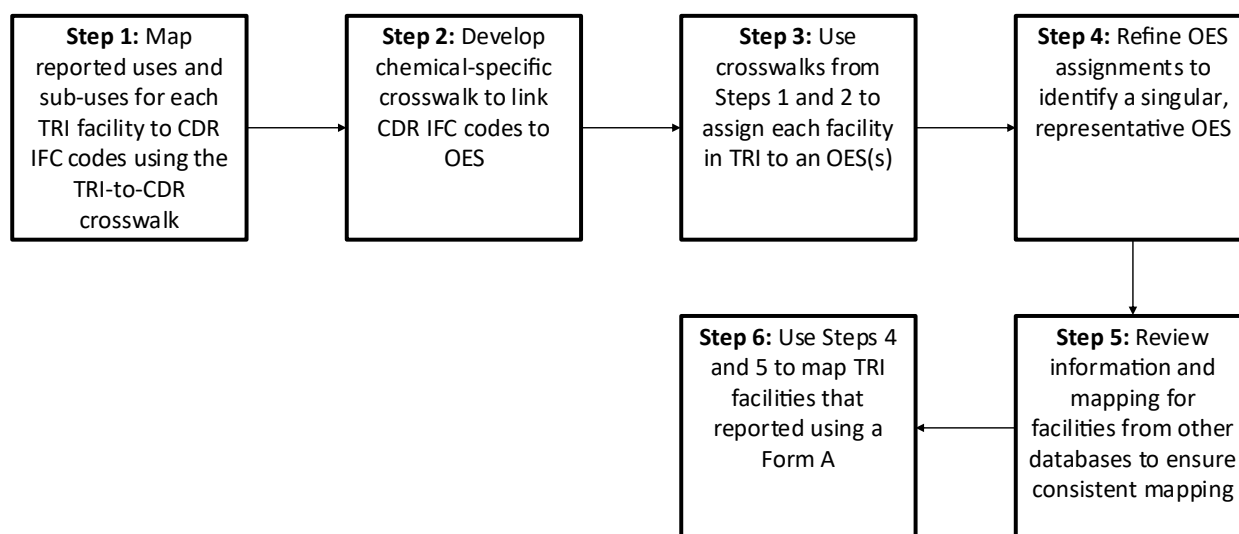
Given the information available in CDR, ERG/EPA expects that, for most chemicals, 100 % of the sites reporting to CDR can feasibly be mapped to an OES.

B.3.2 Toxics Release Inventory (TRI)

TRI reporting is required for facilities that manufacture (including import), process, or otherwise use any TRI-listed chemical in quantities greater than the established threshold in the calendar year AND have 10 or more full-time employee equivalents (*i.e.*, a total of 20,000+ hours) and are included in a covered NAICS code. Therefore, unlike CDR reporters that are primarily manufacturers and importers, TRI reporters can be mapped to a variety of different OES.

Figure_Apx B-3 depicts the steps that should be followed to map TRI reporting sites to OES. Each step is explained in the text below the figure. Additionally, Section B.5.2 shows step-by-step examples for using the mapping procedures to determine the OES for three example TRI reporting facilities.

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Figure_Apx B-3. OES Mapping Procedures for TRI

To map sites reporting to TRI, the following procedures should be used:

1. **Assign Chemical Data Reporting Codes Using TRI-to-CDR Crosswalk:** The first step in the TRI mapping process is to map the uses and sub-uses reported by each facility to one or more 2016 CDR IFC codes. To do this, first compile all TRI uses/sub-uses for the reporting facility into a single column, then map them to CDR IFC codes using the TRI-to-CDR Use Mapping crosswalk. This is a universal crosswalk that applies to all chemicals.
2. **Develop Chemical-Specific Crosswalk to Link CDR Codes to OES:** The next step is to develop a separate CDR IFC code-to-OES crosswalk that links CDR IFC codes to OES for the chemical. To create this crosswalk, match the COU categories and subcategories from the COU table in the published scope documents (such as the example provided Table 4-2) to the list of 2016 CDR IFC codes in the CDR reporting instructions.¹⁶ The categories and subcategories of COUs typically match the IFC code category. Recent examples of already completed CDR IFC code-to-OES crosswalk can be found for the fenceline chemicals (1-bromopropane, methylene chloride, n-Methylpyrrolidone, carbon tetrachloride, perchloroethylene, trichloroethylene, and 1,4-dioxane).
3. **Assign OESs:** Each TRI facility is then mapped to one or more OES using the CDR IFC codes assigned to each facility in Step 1 and the CDR IFC code-to-OES crosswalk developed in Step 2.
4. **Refine OES Assignments:** If a facility maps to more than one OES in Step 3, a single primary OES must be selected using additional facility information. OES determinations should be made with the following considerations:
 - a. 6-digit NAICS codes reported by the facility in TRI (*e.g.*, for a facility that reported TRI uses for both formulation and use as cleaner, EPA assigned the Formulation OES if the NAICS code was 325199, All Other Basic Organic Chemical Manufacturing; another example is NAICS codes 562211, Hazardous Waste Treatment and Disposal, and

¹⁶ IFC codes and their definitions can be found in Table 4-11 of the CDR reporting instructions:

<https://www.epa.gov/chemical-data-reporting/instructions-reporting-2016-tsca-chemical-data-reporting> (accessed August 11, 2025).

327310, Cement Manufacturing, almost always correspond to the disposal OES, regardless of the reported TRI uses and sub-uses).

- b. Internet research of the types of products made at the facility (*e.g.*, if a facility's website indicates the facility manufactures metal parts, the facility is likely to use chemicals for degreasing or in a metalworking fluid) and information from sources cited in the COU table and scoping document, such as public and stakeholder comments (*i.e.*, EPA/ERG will review sources cited in the COU table and scoping document to see if there is any information specific to the reporting site that can be used to inform the mapping).
- c. Information from other reporting databases as described in Step 5.
- d. An evaluation of the OES that is most likely to result in a release (*e.g.*, facilities that reported both importation and formulation may be assigned a formulation OES, because, in most cases, importation would have a lower likelihood of a release).
- e. Grouped OES for similar uses/sub-uses (*e.g.*, facilities that reported cleaner and degreaser sub-uses may be assigned a grouped OES that covers both cleaning and degreasing because the specific cleaning/degreasing operation cannot be determined from the TRI data).

5. **Review Information from Other Databases:** Other databases/sources (including CDR, NEI, and DMR) should be checked to see whether the facility has reported to these. If so, the OES determined from the mapping procedures for those databases (discussed in other sections of this document) should also be used. It is important that the same facility is mapped consistently across multiple databases/sources. The facility's TRFID and FRS ID can be used to identify sites that report to TRI, DMR, and NEI.

6. Note that facilities that submit using a TRI Form A do not report TRI uses/sub-uses. To determine the OES for these facilities, EPA will use information from Steps 4 and 5 above.

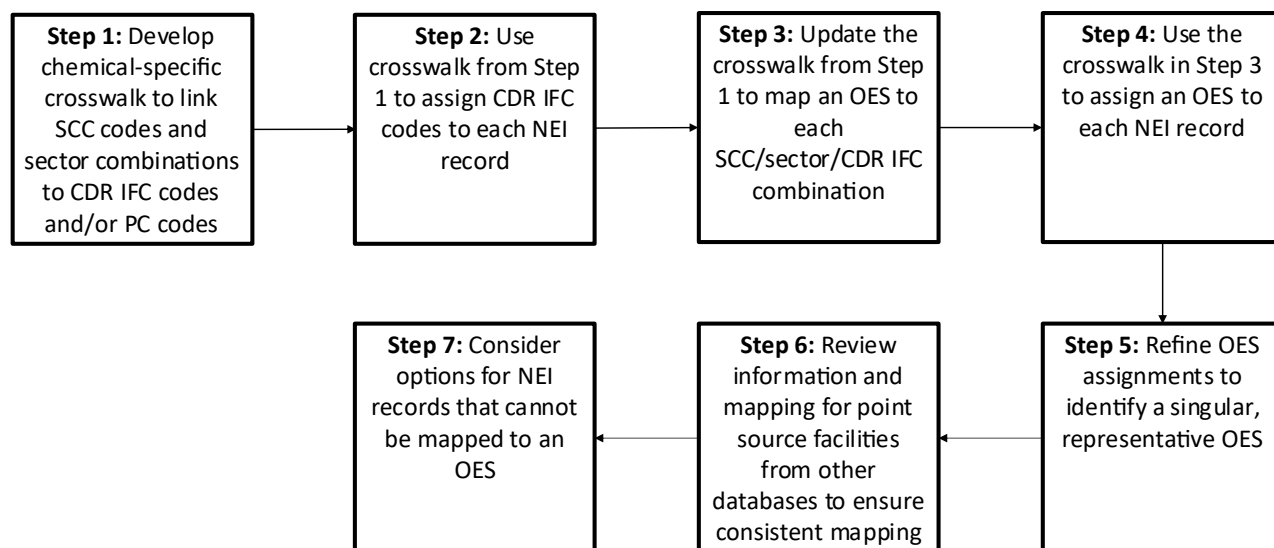
Given the information available in TRI, ERG/EPA expects that, for most chemicals, 100 % of the sites reporting to TRI can feasibly be mapped to an OES.

B.3.3 National Emissions Inventory (NEI)

The NEI is a compilation of air emissions of criteria pollutants, criteria precursors, and hazardous air pollutants from point and non-point source air emissions. Air emissions data for the NEI are collected at the state, local, and tribal (SLT) level. The Air Emissions Reporting Requirement rule requires SLT air agencies to collect, compile, and submit criteria pollutant air emissions data to EPA. Many SLT air agencies also voluntarily submit data for pollutants on EPA's list of hazardous air pollutants. Major sources are required to report point source emissions data to their SLT air agency. Each SLT entity must, in turn, report point source emissions data to EPA every 1 to 3 years, depending upon the size of the source. Nonpoint estimates are typically developed by state personnel.

Figure_Apx B-4 depicts the steps that should be followed to map NEI reporting sites/records to OES. Each step is explained in the text below the figure. Additionally, Section B.5.3 shows step-by-step examples for using the mapping procedures to determine the OES for one point source example and one nonpoint source example.

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Figure_Apx B-4. OES Mapping Procedures for NEI

To map sites reporting point source emissions and nonpoint emissions records for the chemical of interest to NEI, the following procedures should be used:

1. **Develop Crosswalks to Link NEI-Reported SCC and Sector Combinations to Chemical Data Reporting Codes:** The first step in mapping NEI data to potentially relevant OES is to develop a crosswalk to map each unique combination of NEI-reported Source Classification Code (SCC) (levels 1–4) and industry sectors to one or more CDR codes. This crosswalk is developed on a chemical-by-chemical basis rather than an overall crosswalk for all chemicals because SCCs correspond to emission sources rather than chemical uses such that the crosswalk to CDR codes may differ from chemical to chemical. In some cases, it may not be possible to assign all SCC sector combinations to CDR codes, in which case information from Step 5 can be used to help make OES assignments. Separate crosswalks are needed for point and nonpoint source records, as discussed below.
 - a. For the point source NEI data, the crosswalk should map each unique combination of NEI-reported SCC and industry sectors to one or more *CDR IFC codes*.
 - b. For nonpoint source NEI data, the crosswalk should link the SCC codes and sectors to *both CDR IFC codes and/or commercial/consumer use PCs*. This is because the nonpoint source data may include commercial operations, for which CDR PCs may be more appropriate.
2. **Use CDR Crosswalks to Assign CDR Codes:** Next, the chemical-specific CDR crosswalk developed in Step 1 should be used to assign CDR IFC codes to each point source NEI record and CDR IFC codes and/or commercial/consumer use PCs to each nonpoint source NEI record.
3. **Update CDR Crosswalks to Link CDR Codes to OESs:** The chemical-specific crosswalk developed in Step 1 is then used to link the SCCs, sectors, and CDR codes in the crosswalk to an OES. The OES will be assigned based on the chemical specific COU categories and subcategories and the OES mapped to them as discussed in Section B.1.
4. **Use CDR Crosswalks to Assign OESs:** The chemical-specific CDR crosswalks developed in Steps 1-3 are then used to assign OES to each point source and nonpoint source NEI data record (*i.e.*, each combination of facility-SCC-sector). Note that the individual facilities in the point source dataset may have multiple emission sources, described by different SCC and sector

combinations within NEI, such that multiple OES map to these NEI records. In such cases, a single, representative OES must be selected for each NEI record using the additional information described in Step 5. Similarly, the sectors reported by nonpoint sources may map to multiple CDR IFC or PC codes, such that multiple OES are applicable and must be refined to a single OES for each NEI record.

5. **Refine OES Assignments:** The initial OES assignments may need to be confirmed and/or refined to identify a single primary OES using the following information described below for point source and nonpoint source records.
- a. For point source records in NEI, use the following information to refine OES assignments:
 - Additional information available in NEI:
 - Facility name.
 - Primary NAICS code and description, populated from the EIS lookup tables.
 - Facility site description, which, when populated, is intended to describe the type of industry the facility operates (similar to a NAICS description).
 - Process description, which is a free-text field where reporters can provide additional information about the process related to their emission unit.
 - Emission unit description, which is a free-text field where reporters can provide additional information about their emission units.
 - Internet research of the types of products made at the facility (*e.g.*, if a facility's website indicates the facility manufactures metal parts, the facility is likely to use chemicals for degreasing or in a metalworking fluid) and information from sources cited in the COU table and scoping document, such as public and stakeholder comments (*i.e.*, EPA/ERG will review sources cited in the COU table and scoping document to see if there is any information specific to the reporting site that can be used to inform the mapping).
 - Information from other reporting databases as described in Step 5b.
 - An evaluation of the OES that is most likely to result in a release (*e.g.*, facilities that map to both lubricant use and vapor degreasing may be assigned a vapor degreasing OES, because, in most cases, vapor degreasing results in higher air emissions).
 - Grouped OES for similar uses/sub-uses (*e.g.*, facilities that map to both general cleaning and vapor degreasing may be assigned a grouped OES that covers both cleaning and degreasing because the specific cleaning/degreasing operation cannot be determined from the NEI data).
 - b. For nonpoint source records in NEI, use the following information to refine OES assignments (there is no additional data reported to NEI by nonpoint sources that can help refine the OES mapping):
 - General knowledge about the use of the chemical in the reported sector, such as from scope documents, public or stakeholder comments, process descriptions, professional judgment, or already-identified sources from systematic review.
 - Internet research of the uses of the chemical in the reported sector, if insufficient information is not already available per the previous bullet.

- An evaluation of the OES that is most likely to result in a release (*e.g.*, sectors that map to both lubricant use and vapor degreasing may be assigned a vapor degreasing OES, because, in most cases, vapor degreasing results in higher air emissions).
- Grouped OES for similar uses/sub-uses (*e.g.*, sectors that map to both general cleaning and vapor degreasing may be assigned a grouped OES that covers both cleaning and degreasing because the specific cleaning/degreasing operation cannot be determined from the NEI data).

- Review Information from Other Databases for Point Source Facilities:** Other databases/sources (including CDR, TRI, and DMR) should be checked to see if the point source facilities have reported to these. If so, the OES determined from the mapping procedures for those databases (discussed in other sections of this document) should also be used. It is important that the same facility is mapped consistently across multiple databases/sources. The facility's TRFID and FRS ID can be used to identify sites that report to TRI, DMR, and NEI.
- Consider Options for NEI Records that Cannot be Mapped to an OES:** Given the number of records in NEI and the information available, it may not always be feasible to achieve mapping of 100 % of the sites reporting to NEI to an OES. For example, there may be NEI records for restaurants or the commercial cooking sector, which do not map to an in-scope COU or OES. Additionally, NEI records may include emissions from combustion byproducts for the chemical, which does not correspond to a COU or OES. In such cases, multiple options may be appropriate depending on assessment needs, such as:
 - Assigning the sites as having an unknown OES with 250 release days/year. This allows for subsequent exposure modeling and the assessment of risk. For sites with identified risk, the OES can then be mapped using the below resources.
 - Contacting the facility for clarification on the use of the chemical. ICR requirements also apply when contacting 10 or more facilities. Note that information requests such as these may require an Information Collection Request (ICR) if 10 or more entities are contacted.¹⁷

B.3.4 Discharge Monitoring Report (DMR)

Facilities must submit DMRs for chemicals when the following two conditions are met: (1) the facility has an NPDES permit for direct discharges to surface water, and (2) the NPDES permit contains monitoring requirements for the chemical of interest. Indirect discharges (*e.g.*, those sent to an off-site wastewater treatment plant or publicly owned treatment works) are not covered under the NPDES program.

If a facility has discharge monitoring requirements for the chemical of interest, these requirements are either technology-based or water-quality based. Typically, a facility has NPDES monitoring requirements for a chemical because the facility somehow manufactures, processes, or uses the chemical. However, it is possible for a facility to have monitoring requirements for a chemical they do not handle if the facility falls within a guideline containing requirements for that chemical, as described below.

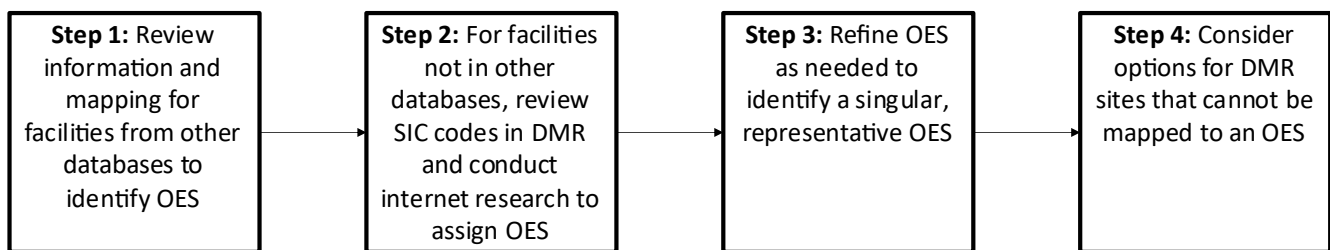
- **Technology-Based Guidelines:** If the facility falls within a certain industrial sector, it may be covered by a national effluent guideline. Effluent guidelines are industry-specific and contain treatment technology-based guidelines for discharges of specified pollutants (chemicals)

¹⁷ More on Information Collection Requests can be found at <https://www.epa.gov/icr/icr-basics> (accessed August 11, 2025).

commonly found within that industry.¹⁸ A common effluent guideline containing requirements for chemicals that have or are currently undergoing risk evaluation is the Organic Chemicals, Plastics & Synthetic Fibers (OCPSF) effluent guideline. Alternatively, if there is no applicable effluent guideline for the facility, the permitting authority may establish technology-based guidelines using best professional judgment. If a facility falls within an existing effluent guideline, the permitting authority will generally include monitoring requirements in the facility's NPDES permit that are consistent with the effluent guideline, even if the facility does not handle all the chemicals for which there are monitoring requirements. Therefore, under this reasoning, it is possible that a facility reporting for the chemical of interest in DMRs does not actually handle the chemical.¹⁹

- **Water Quality-Based Guidelines:** The receiving water for the facility's discharges is impaired such that the permitting authority sets general water-quality based effluent limits and monitoring requirements for chemicals that may further impair the water quality. It is possible that the permitting authority uses these same general water-quality based requirements for all facilities that discharge to the water body. Therefore, under this reasoning, it is possible that a facility reporting for the chemical of interest in DMRs does not actually handle the chemical.⁵

Figure_Apx B-5 depicts the steps that should be followed to map DMR reporting sites to OESs. Each step is explained in the text below the figure. Additionally, Section B.5.4 shows step-by-step examples for using the mapping procedures to determine the OES for two example DMR reporting facilities.



Figure_Apx B-5. OES Mapping Procedures for DMR

To map sites reporting to DMR, the following procedures should be used:

1. **Review Information from Other Databases:** Given the limited facility information reported in DMRs, the first step for mapping facilities reporting to DMR should be to check other databases/sources (including CDR, TRI, and NEI). If so, the OES determined from the mapping procedures for those databases (discussed in other sections of this document) should be used. It is important that the same facility is mapped consistently across multiple databases/sources. The facility's TRFID and FRS ID can be used to identify sites that report to TRI, DMR, and NEI.
2. **Assign OESs:** If the facility does not report to other databases, the following information should be used to assign an OES.
 - a. 4-digit SIC codes reported by the facility in DMR (e.g., a facility that reported SIC code 2891, Adhesives and Sealants, likely formulates these products; a facility that reported SIC code 4952, Sewerage Systems, likely treats wastewater). Note that SIC codes can be

¹⁸ A list of the industries for which EPA has promulgated effluent guidelines is available at: <https://www.epa.gov/eg/industrial-effluent-guidelines#existing> (accessed August 11, 2025).

¹⁹ Note that a facility may request to have monitoring requirements reduced or removed from the permit where historical sampling demonstrates that these chemicals are consistently measured below the effluent limits. Thus, it is possible for a facility to cease monitoring for the chemical of interest upon approval by the permitting authority.

- crosswalked to NAICS codes, which are often more useful for mapping OES because they are more descriptive than SIC codes.
- b. Internet research of the types of products made at the facility (*e.g.*, if a facility's website indicates the facility manufactures metal parts, the facility is likely to use chemicals for degreasing or in a metalworking fluid) and information from sources cited in the COU table and scoping document, such as public and stakeholder comments (*i.e.*, EPA/ERG will review sources cited in the COU table and scoping document to see if there is any information specific to the reporting site that can be used to inform the mapping).
3. **Refine OES:** If the specific OES still cannot be determined using the information in Step 2, the following should be considered.
- a. NPDES permit numbers reported in DMR. The permit number generally indicates if the permit is an individual permit or a general permit.²⁰ If the permit is a general permit, the permit number can often indicate the type of general permit, which can provide information on the operations at the facility.
- Individual NPDES permits are numbered in the format of the state abbreviation followed by a seven-digit number (*e.g.*, VA0123456). General permits are usually numbered in the format of state abbreviation followed by one letter then a six-digit number (*e.g.*, VAG112345 or MAG912345).
 - Since each state is slightly different in their general permit numbering, the general permit number should be searched on the internet to determine the type of general permit. For the general permit number examples provided above, a permit number beginning in "VAG11" signifies Virginia's general permit for concrete products facilities and a permit number beginning with "MAG91" signifies Massachusetts' general permit for groundwater remediation. Other common general permit types include those for construction sites, mining operations, sites that only discharge non-contact cooling water, and vehicle washes.
- b. Searching for the permit online. If the specific NPDES permit for the facility can be found online, it may contain some general process information for the facility that can help inform the OES mapping. However, NPDES permits may be difficult to find online and do not generally contain much information on process operations.
- c. An evaluation of the OES that is most likely to result in a water release (*e.g.*, for facilities that report an SIC code for the production of metal products, both vapor degreasing and metalworking fluid OES are applicable; in such cases, the metalworking fluid OES may be assigned because it is more likely to result in water releases than vapor degreasing).
- d. Grouped OES for similar uses (*e.g.*, multiple facilities that may conduct formulation operations based on the reported SIC code may be assigned a grouped formulation OES that covers all types of formulation [*e.g.*, adhesives, paints, cleaning products]).
4. **Consider Options for DMR Sites that Cannot be Mapped to an OES:** Given the limited information available in DMR, it may not always be feasible to achieve mapping of 100 % of the sites reporting to DMR to an OES. In such cases, multiple options may be appropriate depending on assessment needs, such as:
- a. Assigning the sites as having an unknown OES with 250 release days/year. This allows for subsequent exposure modeling and the assessment of risk. For sites with identified risk, the OES can then be mapped using the below resources.

²⁰ Information on individual and general NPDES permits can be found at: <https://www.epa.gov/npdes/npdes-permit-basics>.

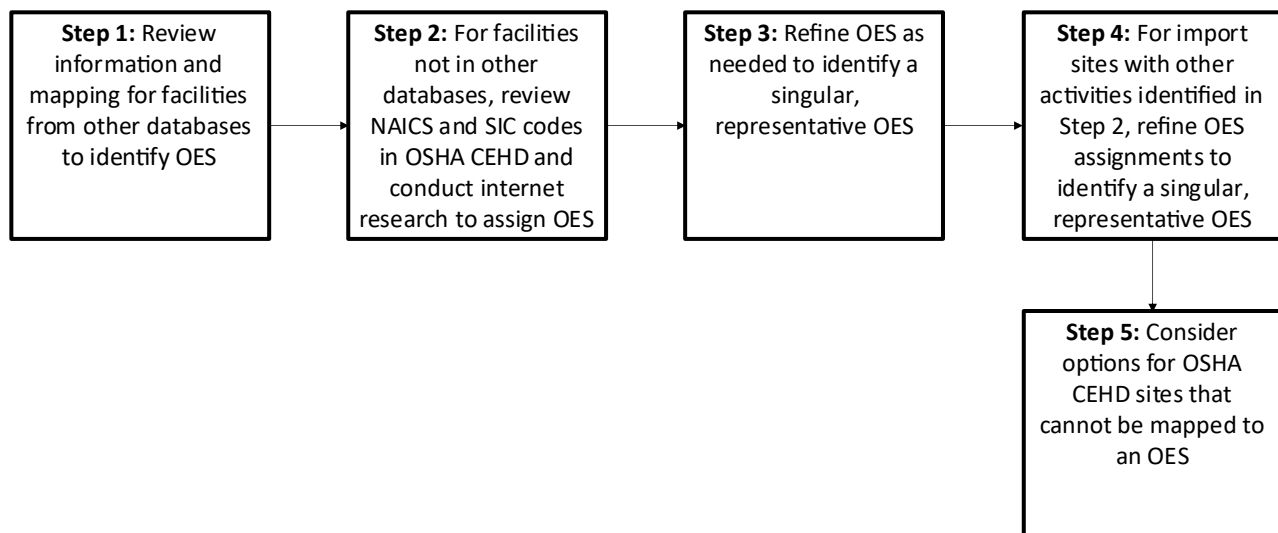
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- b. Contacting the state government for the NPDES permit, permit applications, past inspection reports, and any available information on facility operations. Note that information requests such as these may require an ICR if 10 or more entities are contacted.
- c. Contacting the facility for clarification on the use of the chemical. ICR requirements also apply when contacting 10 or more facilities.

B.3.5 Occupational Safety and Health Administration CEHD Data

OSHA CEHD is a compilation of industrial hygiene samples (*i.e.*, occupational exposure data) taken when OSHA monitors worker exposures to chemical hazards. OSHA will conduct monitoring at facilities that fall within targeted industries based on national and regional emphasis programs.²¹ OSHA conducts monitoring to compare against occupational health standards. Therefore, unlike CDR, TRI, NEI, and DMR, facilities are not required to report data to OSHA CEHD. Also, OSHA only visits selected facilities, so the amount of OSHA data available for each OES is often limited.

Figure_Apx B-6 depicts the steps that should be followed to map OSHA CEHD sites to OES. Each step is explained in the text below the figure. Additionally, Section B.5.5 shows step-by-step examples for using the mapping procedures to determine the OES for two example OSHA CEHD facilities.



Figure_Apx B-6. OES Mapping Procedures for OSHA CEHD

Within the OSHA CEHD data, there may be sites for which all air sampling data are non-detect (below the limit of detection) for the chemical. In these cases, if there is also no bulk sampling data indicating the presence of the chemical, there is no evidence that the chemical is present at the site. OSHA may have sampled for the chemical based on a suspicion or pre-determined sampling plan, and not because the chemical was actually present at the site. Therefore, these sites do not need to be mapped to OES. To map sites for which there is OSHA CEHD data that are not all non-detect for the chemical, the following procedures should be used:

1. **Review Information from Other Databases:** Given the limited facility information reported in OSHA CEHD, the first step for mapping facilities should be to check other databases/sources

²¹ More information on OSHA CEHD can be found at: <https://www.osha.gov/opengov/health-samples> (accessed August 11, 2025).

(including CDR, TRI, NEI, and TRI). If so, the OES determined from the mapping procedures for those databases (discussed in other sections of this document) should be used. It is important that the same facility is mapped consistently across multiple databases/sources. Because facility identifiers such as TRFID and FRS ID are not available in the CEHD, the name of the facility in the CEHD will need to be compared to the facility names in other databases to identify if the facility is present in multiple databases/sources.

2. **Assign OES:** If the facility does not report to other databases, the following information should be used to assign an OES.
 - a. 4-digit SIC and 6-digit NAICS codes reported in the CEHD (*e.g.*, a facility that reported SIC code 2891, Adhesives and Sealants, likely formulates these products; a facility that reported NAICS code 313320, Fabric Coating Mills, likely uses the chemical in fabric coating).
 - b. Internet research of the types of products made at the facility (*e.g.*, if a facility's website indicates the facility manufactures metal parts, the facility is likely to use chemicals for degreasing or in a metalworking fluid) and information from sources cited in the COU table and scoping document, such as public and stakeholder comments (*i.e.*, EPA/ERG will review sources cited in the COU table and scoping document to see if there is any information specific to the reporting site that can be used to inform the mapping).
3. **Refine OES:** If the specific OES still cannot be determined using the information in Step 2, the following should be considered.
 - a. An evaluation of the OES that is most likely to result in occupational exposures (*e.g.*, for facilities that report an SIC code for janitorial services, multiple OES may be applicable, such as cleaning, painting (*e.g.*, touch-ups), other maintenance activities; in such cases, the cleaning OES may be assigned for volatile chemicals because it has the highest exposure potential).
 - b. Grouped OES for similar uses (*e.g.*, multiple facilities that may conduct formulation operations based on the reported NAICS or SIC code may be assigned a grouped formulation OES that covers all types of formulation [*e.g.*, adhesives, paints, cleaning products]).
4. **Consider Options for OSHA CEHD Sites that Cannot be Mapped to an OES:** Given the limited information available in OSHA CEHD, it may not always be feasible to achieve mapping of 100 % of the sites in the database to an OES. In such cases, multiple options may be appropriate depending on assessment needs, such as:
 - a. Assigning the sites as having an unknown OES with 250 exposure days/year. This allows for subsequent health modeling and the assessment of risk. For workers with identified risk, the OES can then be mapped using the below resources.
 - b. Contacting OSHA for additional information on the facility from the OSHA inspection/monitoring.
 - c. Contacting the facility for clarification on the use of the chemical. Note that information requests such as these may require an ICR if 10 or more entities are contacted.
 - d. As discussed previously, sites for which all air monitoring data is non-detect for the chemical and for which there is no bulk data indicating the presence of the chemical do not need to be mapped to an OES. This is because the data do not provide evidence that the chemical is present at the site.

B.3.6 National Institute of Occupational Safety and Health Health Hazard Evaluation (HHE)

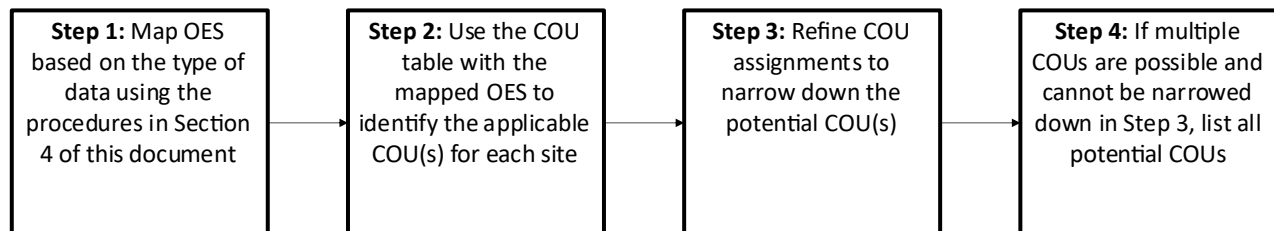
NIOSH conducts HHEs at facilities to evaluate current workplace conditions and to make recommendations to reduce or eliminate the identified hazards.²² NIOSH conducts HHEs at the request of employers, unions, or employees in workplaces where employee health and wellbeing is affected by the workplace. Therefore, unlike CDR, TRI, NEI, and DMR, facilities are not required to report data to NIOSH under the HHE program. Also, NIOSH only visits selected facilities where an HHE was requested, so the number of NIOSH HHEs available for each OES is often limited.

To map a facility that is the subject of a NIOSH HHE, the information in the HHE report should be used. Specifically, the HHE report typically includes general process information for the facility, information on how the chemical is used, worker activities, and the facility's SIC code. This information should be sufficient to map the facility to a single representative OES. Additionally, given the extent of information available about the subject facilities in NIOSH HHE reports, 100 % of these facilities can be mapped to an OES. Additionally, Appendix B.5.6 shows two examples of how to map NIOSH HHE facilities to OES.

B.4 COU Mapping Procedures

As discussed in Section B.1, there is not always a one-to-one mapping between COUs and OESs.

Figure_Apx B-7 depicts the steps that should be followed to map sites from the standard sources discussed in this document to COUs, using the OES mapping completed in Appendix B.1. Each step is explained in the text below the figure. Additionally, Appendix B.5.7 shows step-by-step examples for using the mapping procedures to determine the COU for three example facilities.



Figure_Apx B-7. COU Mapping Procedures for Standard Sources Already Mapped to OES

To map facilities from standard sources (*i.e.*, CDR, TRI, NEI, DMR, OSHA CEHD, NIOSH HHE) to COUs, the following procedures should be used:

1. **Map the Facility to an OES:** To map a facility from a standard source to a COU, the facility should first be mapped to an OES following the procedures for the specific source of data (discussed in Section B.3).
2. **Use the COU Table with Mapped OES to Assign COUs:** At the point of the risk evaluation process where EPA are mapping data from standard sources to OES and COU, EPA have already mapped OES to each of the COUs from the scope document, like is shown in Appendix B.2.

²² More information about NIOSH HHEs is available at: <https://www.osha.gov/opengov/health-samples> and https://www.cdc.gov/niosh/hhe/about/?CDC_AAref_Val=https://www.cdc.gov/niosh/hhe/about.html (both hyperlinks accessed October 22, 2025) <https://www.cdc.gov/niosh/hhe/about.html>.

This crosswalk between COUs and OES should be used to identify the COU(s) for the facility using the OES mapped per Section B.3.

3. **Refine the COU Assignment:** In some instances, more than one COU may map to the facility. In such cases, the following information should be used to try to narrow down the list of potentially applicable COUs:

- a. Information from the standard sources (*e.g.*, if ERG/EPA assigned a grouped OES like “Industrial Processing Aid” and the facility’s NAICS code in TRI or NEI is related to battery manufacturing, the COU can be identified as the “Processing Aid” category and Process solvent used in battery manufacture” subcategory).
- b. Internet research of the types of products made at the facility (*e.g.*, if a facility’s website indicates the facility makes adhesives, the COU category of “Processing – Incorporation into formulation, mixture or reaction product” and subcategory of “Adhesives and sealant chemicals” can be assigned and the remaining subcategories [*e.g.*, solvents for cleaning or degreasing, solvents which become part of the product formulation or mixture] are not applicable) and information from sources cited in the COU table and scoping document, such as public and stakeholder comments (*i.e.*, EPA/ERG will review sources cited in the COU table and scoping document to see if there is any information specific to the reporting site that can be used to inform the mapping).

4. **List all Potential COUs:** Where the above information does not narrow down the list of potentially applicable COUs, EPA/ERG will list all the potential COUs and will not attempt to select just one from the list where there is insufficient information to do so.

B.5 Example Case Studies

This section contains step-by-step examples of how to implement the OES and COU mapping procedures listed in Appendices B.1 and B.4 to determine OES for facilities that report to standard engineering sources.

B.5.1 CDR Mapping Examples

This section includes examples of how to implement the OES mapping procedures for sites reporting to CDR, as listed in Section B.3.1. Specifically, this section includes examples for three example sites that reported to 2020 CDR for the round 2 chemical Di-isobutyl phthalate (DIBP). These example sites are referred to as Facility A, Facility B, and Facility C.

To map Facilities A, B, and C to an OES, the following procedures are used with the non-CBI 2020 CDR database.

1. **Review Manufacturing and Import Activity Information:** The first step in the process is to review the reported activity information to identify if the facility imports or manufactures the chemical. Table_Apx B-3 summarizes the information gathered from 2020 CDR for the three example sites for this step.

Table Apx B-3. Step 1 for CDR Mapping Facilities

Facility Name	Step 1a: Reported Activity	Step 1b: Byproduct Information	Step 1c: Check Other Activities?	OES Determination
Facility A	Domestically Manufactured/Imported	Not Known or Reasonably Ascertainable	Not needed – per Step 1 in Section B.3.1	Per Step 1a, this site maps to the Manufacturing OES
Facility B	Imported	CBI	Yes	Cannot be determined in Step 1 – Proceed with Step 2
Facility C	Imported	Not Known or Reasonably Ascertainable	Yes	Cannot be determined in Step 1 – Proceed with Step 2

For Importation Sites, Review Fields for “Imported Never at Site,” “Volume Exported,” and “Volume Used”: The next step is to review these additional fields to determine if the reporting facility conducts more than just importation activities.

2. Table Apx B-4 summarizes the information gathered from 2020 CDR for the three example sites for this step.

Table Apx B-4. Step 2 for CDR Mapping Example Facilities

Facility Name	Step 2a: Imported Never at Site	Step 2b: Volume Exported	Step 2c: Volume Used	OES Determination
Facility A	N/A – OES determined in Step 1			
Facility B	CBI	CBI	CBI	Cannot be determined in Step 2 – Proceed with Step 3.
Facility C	Yes	0	0	Because the facility only imports and does not use DINP, this site maps to the Import/Repackaging OES.

Refine OES Assignments: If multiple OES were identified from the previous steps, a single primary OES must be selected using additional facility information as discussed in Steps 3a to 3f.

3. Table Apx summarizes the information gathered from 2020 CDR for the three example sites for this step.

Table Apx B-5. Step 3 for CDR Mapping Example Facilities

Facility Name	Step 3a: NAICS	Step 3b: Processing/Use Information	Step 3c: Internet Research	Step 3d–e: Other Databases and OES Grouping	OES Determination
Facility A	N/A – OES determined in Step 1				
Facility B	325110, Petrochemical Manufacturing	CBI	Research indicates the facility is a petrochemical plant and does not indicate how DINP is used.	Check other databases per Step 4.	Cannot be determined in Step 2 – Proceed with Step 4.
Facility C	N/A – OES determined in Step 2				

Review Information from Other Databases: Lastly, other databases/sources (such as TRI, NEI, and DMR) should be checked to see if the facility has reported to these. If the facility does not

report to these databases, but additional OES are possible per Step 2, search available facility information on the internet.

4. Table_Apx summarizes the information gathered from 2020 CDR for the three example sites for this step.

Table_Apx B-6. Step 4 for CDR Mapping Example Facilities

Facility Name	Step 4: Other Databases	OES Determination
Facility A	N/A – OES determined in Step 1	
Facility B	Using the FRS ID reported in CDR, this facility does not report to TRI, NEI, or DMR. The Agency searched the facility in EPA's ECHO database and found that the facility does not have any listed NAICS codes, SIC codes, or permits, and appears to be a warehouse from aerial imagery. Therefore, this facility is likely just an importer.	Using the information from Step 4, this site maps to the Import/repackaging OES.
Facility C	N/A – OES determined in Step 2	

B.5.2 TRI Mapping Examples

This appendix includes examples of how to implement the OES mapping procedures for sites reporting to TRI, as listed in Section B.3.2. Specifically, this appendix includes examples for three example sites that reported to TRI for the round 2 chemical 1,2-dichloroethane (1,2-dichloroethane). These example sites are referred to as Facility D, Facility E, and Facility F.

To map Facilities D, E, and F to an OES, the following procedures are used with information from TRI.

1. **Assign Chemical Data Reporting Codes Using TRI-to-CDR Crosswalk:** The first step in the TRI mapping process is to map the uses and sub-uses reported by each facility to one or more 2016 CDR IFC codes. The uses and sub-uses reported to TRI by each example site are compiled in Table_Apx B-7.

Table_Apx B-7. Step 1 for TRI Mapping Example Facilities

Facility Name	TRI Form Type	TRI Uses (Sub-Uses)	2016 CDR IFC Codes
Facility D	R	Manufacture: produce, import, for onsite use/processing, for sale/distribution, as a byproduct Processing: as a reactant, as a formulation component (P299 Other) Otherwise Used: ancillary or other use (Z399 Other)	PK, U001, U003, U016, U013, U014, U018, U019, U020, U023, U027, U028, or U999
Facility E	R	Otherwise Used: ancillary or other use (Z399 Other)	U001, U013, U014, U018, U020, or U023
Facility F	A	None – not reported in Form A submissions	

2. **Develop Chemical-Specific Crosswalk to Link CDR Codes to OES:** The next step is to develop a separate CDR IFC code-to-OES crosswalk that links CDR IFC codes to OES for the chemical. To create this crosswalk, match the COU and OES from the COU table in the published scope documents to the list of 2016 CDR IFC codes. The categories and subcategories

of COUs typically match the IFC code category. See Table_Apx B-8 for the completed crosswalk for 1,2-dichloroethane.

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COU and OES from Published Scope Document				Mapping		
Life Cycle Stage	Category	Subcategory	OES	2016 CDR IFC Code	2016 CDR IFC Code Name	Rationale
Manufacturing	Domestic manufacturing	Domestic manufacturing	Manufacturing	None	None	Per Section B.5.1, there is no corresponding CDR code for this COU/OES
Repackaging	Repackaging	Repackaging	Repackaging	PK	Processing – repackaging	Category matches CDR code
Processing	Processing – as a reactant	Intermediate in petrochemical manufacturing	Processing as a reactant	U015; U016; U019; U024	Processing as a reactant	Category matches CDR code
		Plastic material and resin manufacturing				
		All other basic organic chemical manufacturing				
Processing	Processing – incorporation into formulation, mixture, or reaction product	Fuels and fuel additives: all other petroleum and coal products manufacturing	Incorporated into formulation, mixture, or reaction product	U012	Fuel and fuel additives	Category matches CDR code
		Formulation of adhesives and sealants		U002	Adhesives and sealant chemicals	Category matches CDR code
		Processing aids: specific to petroleum production		U025	Processing aids: specific to petroleum production	Category matches CDR code
Distribution in Commerce	Distribution in commerce	Distribution in Commerce	Distribution in Commerce	None	None	Per Section B.5.1, there is no corresponding CDR code for this COU/OES
Industrial Use	Adhesives and sealants	Adhesives and Sealants	Adhesives and Sealants	U002	Adhesives and sealant chemicals	Category matches CDR code
	Functional fluids (closed systems)	Engine Coolant Additive	Functional Fluids (Closed Systems)	U013	Functional Fluids (closed systems)	Category matches CDR code

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COU and OES from Published Scope Document				Mapping		
Industrial Use	Lubricants and greases	Paste lubricants and greases	Lubricants and Greases	U017	Lubricants and Lubricant additives	Category matches CDR code
	Oxidizing/reducing agents	Oxidation inhibitor in controlled oxidative chemical reactions	Oxidizing/Reducing Agents	U019	Oxidizing/reducing agents	Category matches CDR code
	Cleaning and degreasing	Industrial and commercial non-aerosol cleaning/degreasing	Solvents (for cleaning and degreasing)	U029	Solvents (for cleaning or degreasing)	Category matches CDR code
Commercial Use	Cleaning and degreasing	Commercial aerosol products (aerosol degreasing, aerosol lubricants, automotive care products)				
	Plastic and rubber products	Products such as: plastic and rubber products	Plastics and rubber products	None	None	Per Section B.5.1, there is no corresponding CDR code for this COU/OES.
	Fuels and related products	Fuels and related products	Fuels and related products	U012	Fuels and Fuel Additives	Category matches CDR code
	Other use	Laboratory chemical	Other use	None	Use-non-incorporative activities	This use does not match any other CDR codes and is non-incorporative
		Embalming agent				
Waste Handling, Disposal, Treatment, and Recycling	Waste handling, disposal, treatment, and recycling	Waste handling, disposal, treatment, and recycling	Waste handling, disposal, treatment, and recycling	None	None	Per Section B.5.1, there is no corresponding CDR code for this COU/OES.

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3. **Assign OES:** Each TRI facility is then mapped to one or more OES using the CDR IFC codes assigned to each facility in Step 1 and the CDR IFC code-to-OES crosswalk developed in Step 2. Table_Apx B-9 includes the potential OES for each example facility per this step.

Table_Apx B-9. Step 3 for TRI Mapping Example Facilities

Facility Name	TRI Form Type	2016 CDR IFC Codes	Crosswalked OES	OES Determination
Facility D	R	PK, U001, U003, U016, U013, U014, U018, U019, U020, U023, U027, U028, or U999	Repackaging, processing as a reactant, functional fluids (closed systems), or Oxidizing/reducing agents	Cannot be determined in Step 3 – proceed to Step 4
Facility E	R	U001, U013, U014, U018, U020, or U023	Functional fluids (closed systems)	Since the facility maps to only one OES, the OES is Functional fluids (closed systems)
Facility F	A	None – not reported in Form A submissions		Cannot be determined in Step 3 – proceed to Step 4

4. **Refine OES Assignments:** If a facility maps to more than one OES in Step 3, a single primary OES must be selected using additional facility information per Steps 4a to 4e. Table_Apx B-10 summarizes the information gathered for the three example sites for this step.

Table_Apx B-10. Step 4 for TRI Mapping Example Facilities

Facility Name	Step 4a: NAICS Code	Step 4b: Internet Research	Step 4c: Other Databases	Step 4d–e: Most Likely OES or OES Grouping	OES Determination
Facility D	486990, All Other Pipeline Transportation	The facility is a large chemical manufacturing plant	Check databases per Step 5	Based on the type of facility, the Processing as a reactant OES seems the most likely OES from Step 3	Most likely Processing as a reactant OES; check other databases in Step 5 to verify
Facility E		N/A – OES determined in Step 3			
Facility F	325199, All Other Basic Organic Chemical Manufacturing	The facility is a chemical supplier that does not appear to produce chemicals	Check databases per Step 5	Based on the NAICS code and type of facility, the Repackaging OES seems the most likely	Most likely Repackaging OES; check other databases in Step 5 to verify

5. **Review Information from Other Databases:** Other databases/sources (including CDR, NEI, and DMR) should be checked to see if the facility has reported to these. If so, the OES determined from the mapping procedures for those databases (discussed in other sections of this document) should also be used. It is important that the same facility is mapped consistently across multiple databases/sources. The facility's TRFID and FRS ID can be used to identify sites

that report to TRI, DMR, and NEI. Table_Apx B-11 summarizes the information gathered from other databases for the three example sites for this step.

Table_Apx B-11. Step 5 for TRI Mapping Example Facilities

Facility Name	Step 5: Other Databases	OES Determination
Facility D	The facility did not report to 2016 or 2020 CDR. The facility reported to 2020 NEI, reporting emissions of 1,2-dichloroethane from storage tanks and process equipment from chemical manufacturing processes and storage/transfer operations. The facility reported DMRs for the past few years but reported no releases of 1,2-dichloroethane to DMR.	The NEI information corroborates the most likely OES determined in Step 4d; therefore, this site maps to the Processing as a reactant OES
Facility E	N/A – OES determined in Step 3	
Facility F	The facility did not report to 2016 or 2020 CDR, 2020 NEI, or the past few years of DMR	Because no additional information was determined in Step 5, the site maps to the Repackaging OES per Step 4d

B.5.3 NEI Mapping Examples

This section includes examples of how to implement the OES mapping procedures for sites reporting to NEI, as listed in Section B.3.3. Specifically, this section includes two examples for 1,2-dichloroethane from 2017 NEI: (1) Facility G, which is an industrial site that reported point source emissions under multiple NEI records, and (2) Example H, which is a county that reported nonpoint source emissions under multiple NEI records.

To map Facility G (point source) and Example H (non-point source) NEI records to OES, the following procedures should be used:

- 1. Develop Crosswalks to Link NEI-Reported SCC and Sector Combinations to Chemical Data Reporting Codes:** The first step in mapping NEI data to potentially relevant OES is to develop a crosswalk to map each unique combination of NEI-reported SCC Levels 1 to 4 and industry sectors to one or more CDR codes. This crosswalk is developed on a chemical-by-chemical basis rather than an overall crosswalk for all chemicals because SCCs correspond to emission sources rather than chemical uses such that the crosswalk to CDR codes may differ from chemical to chemical. In some cases, it may not be possible to assign all SCC sector combinations to CDR codes, in which case information from Step 5 can be used to help make OES assignments. Separate crosswalks are needed for point and nonpoint source records, as shown in Table_Apx B-12 and Table_Apx B-13. Note that these tables only present the crosswalk for the SCC and sector codes relevant to Facility G (point source) and Example H (nonpoint source) examples; there are many more SCC and sector codes reported for 1,2-dichloroethane in 2017 NEI.

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SCC Level One	SCC Level Two	SCC Level Three	SCC Level Four	Sector	Assigned CDR Code	Rationale
Chemical Evaporation	Organic Solvent Evaporation	Air Stripping Tower	Solvent	Solvent – Industrial Surface Coating & Solvent Use	U029 – Solvents (for Cleaning and Degreasing)	Based on Sector
Chemical Evaporation	Organic Solvent Evaporation	Cold Solvent Cleaning/ Stripping	Other Not Classified	Solvent – Degreasing	U029 – Solvents (for Cleaning and Degreasing)	Based on Sector
Chemical Evaporation	Organic Solvent Evaporation	Dry Cleaning	Other Not Classified	Solvent – Dry Cleaning	U029 – Solvents (for Cleaning and Degreasing)	Based on Sector
Chemical Evaporation	Organic Solvent Evaporation	Fugitive Emissions	General	Solvent – Degreasing	U029 – Solvents (for Cleaning and Degreasing)	Based on Sector
Chemical Evaporation	Organic Solvent Evaporation	Miscellaneous Volatile Organic Compound Evaporation	Miscellaneous	Solvent – Industrial Surface Coating & Solvent Use	U029 – Solvents (for Cleaning and Degreasing)	Based on Sector
Chemical Evaporation	Organic Solvent Evaporation	Solvent Storage	General Processes: Drum Storage – Pure Organic Chemicals	Industrial Processes – Storage and Transfer	N/A – no matching CDR IFC, likely Distribution in Commerce	Matched SCC and sector code
Chemical Evaporation	Organic Solvent Evaporation	Solvent Storage	General Processes: Spent Solvent Storage	Industrial Processes – Storage and Transfer	N/A – no matching CDR IFC, likely Distribution in Commerce	Matched SCC and sector code
Chemical Evaporation	Organic Solvent Evaporation	Waste Solvent Recovery Operations	Other Not Classified	Solvent – Industrial Surface Coating & Solvent Use	N/A – no matching CDR IFC, likely Waste Handling, Disposal and Treatment	Matched to SCC level 3 code
Chemical Evaporation	Organic Solvent Evaporation	Waste Solvent Recovery Operations	Solvent Loading	Industrial Processes – Storage and Transfer	N/A – no matching CDR IFC, likely Waste Handling, Disposal and Treatment	Matched to SCC level 3 code
Industrial Processes	Photo Equip/Health Care/Labs/Air Condit/ SwimPools	Health Care – Crematoriums	Cremation – Animal	Industrial Processes – NEC	U999 – Other	Does not fit other CDR code

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SCC Level One	SCC Level Two	SCC Level Three	SCC Level Four	Sector	Assigned CDR Code	Rationale
Industrial Processes	Photo Equip/Health Care/Labs/Air Condit/SwimPools	Health Care – Crematoriums	Cremation – Human	Industrial Processes – NEC	U999 – Other	Does not fit other CDR code
Industrial Processes	Photo Equip/Health Care/Labs/Air Condit/SwimPools	Health Care – Crematoriums	Crematory Stack – Human and Animal Crematories	Industrial Processes – NEC	U999 – Other	Does not fit other CDR code
Industrial Processes	Photo Equip/Health Care/Labs/Air Condit/SwimPools	Health Care	Miscellaneous Fugitive Emissions	Industrial Processes – NEC	U999 – Other	Assume use as a laboratory chemical in the healthcare industry
Industrial Processes	Photo Equip/Health Care/Labs/Air Condit/SwimPools	Laboratories	Bench Scale Reagents: Research	Industrial Processes – NEC	U999 – Other	SCC for laboratories
Industrial Processes	Photo Equip/Health Care/Labs/Air Condit/SwimPools	Laboratories	Bench Scale Reagents: Testing	Industrial Processes – NEC	U999 – Other	SCC for laboratories

Table_Apx B-13. Step 1b for NEI Mapping Example Facilities

Sector	Assigned CDR Code	Rationale
Commercial Cooking	N/A – no matching CDR IFC	Unknown
Fuel Comb – Comm/Institutional – Biomass	U012 – Fuels and fuel additives	Consistent with sector code
Fuel Comb – Comm/Institutional – Coal	U012 – Fuels and fuel additives	Consistent with sector code
Fuel Comb – Industrial Boilers, ICEs – Biomass	U012 – Fuels and fuel additives	Consistent with sector code
Fuel Comb – Industrial Boilers, ICEs – Coal	U012 – Fuels and fuel additives	Consistent with sector code
Fuel Comb – Residential – Other	U012 – Fuels and fuel additives	Consistent with sector code
Gas Stations	U012 – Fuels and fuel additives	Consistent with sector code
Solvent – Consumer & Commercial Solvent Use	U029 – Solvents (for cleaning or degreasing)	Consistent with sector code
Waste Disposal	N/A – no matching CDR IFC, likely Waste Handling, Disposal and Treatment	Consistent with sector code

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2. **Use CDR Crosswalks to Assign CDR Codes:** Next, the chemical-specific CDR crosswalk developed in Step 1 should be used to assign CDR IFC codes to each point source NEI record and CDR IFC codes and/or commercial/consumer use PCs to each nonpoint source NEI record. This is shown in Table_Apx B-15 for Facility G (point source) and Example H (non-point source).

Table Apx B-14. Step 2 for NEI Mapping Example Facilities

Facility Name	SCC Level One	SCC Level Two	SCC Level Three	SCC Level Four	Sector	Assigned CDR IFC Code
Facility G	Chemical Evaporation	Organic Solvent Evaporation	Air Stripping Tower	Solvent	Solvent – Industrial Surface Coating & Solvent Use	U029 – Solvents (for Cleaning and Degreasing)
	Industrial Processes	Photo Equip/Health Care/Labs/Air Condit/SwimPools	Laboratories	Bench Scale Reagents: Testing	Industrial Processes – NEC	U999 – Other
Example H	N/A – not applicable to nonpoint source				Commercial Cooking	N/A – no matching CDR IFC
	N/A – not applicable to nonpoint source				Fuel Comb – Residential – Other	U012 – Fuels and fuel additives
	N/A – not applicable to nonpoint source				Gas Stations	U012 – Fuels and fuel additives

2. **Update CDR Crosswalks to Link CDR Codes to OES:** The chemical-specific crosswalk developed in Step 1 is then used to link the SCCs, sectors, and CDR codes in the crosswalk to an OES. The OES will be assigned based on the chemical specific COU categories and subcategories and the OES mapped to them. The same crosswalk developed in Table_Apx B-15 (TRI Step 2) links CDR codes to COUs and OES and is used in this example.
3. **Use CDR Crosswalks to Assign OES:** The chemical-specific CDR crosswalks developed in Steps 1 to 3 are then used to assign OES to each point source and nonpoint source NEI data record (*i.e.*, each combination of facility-SCC-sector). Note that the individual facilities in the point source dataset may have multiple emission sources, described by different SCC and sector combinations within NEI, such that multiple OES map to each NEI record. In such cases, a single, representative OES must be selected for each NEI record using the additional information described in Step 5. Similarly, the sectors reported by nonpoint sources may map to multiple CDR IFC or PC codes, such that multiple OES are applicable and must be refined to a single OES. See Table_Apx B-16 for completed Step 4 for the example facilities.

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Table Apx B-15. Step 4 for NEI Mapping Example Facilities

Facility Name	SCC Level One	SCC Level Two	SCC Level Three	SCC Level Four	Sector	Assigned CDR IFC Code	Mapped OES	OES Determination
Facility G	Chemical Evaporation	Organic Solvent Evaporation	Air Stripping Tower	Solvent	Solvent – Industrial Surface Coating & Solvent Use	U029 – Solvents (for Cleaning and Degreasing)	Solvents (for cleaning and degreasing)	Because only one OES maps to this NEI record, the OES is: Solvents (for cleaning and degreasing)
	Industrial Processes	Photo Equip/Health Care/Labs/Air Condit/ SwimPools	Laboratories	Bench Scale Reagents: Testing	Industrial Processes – NEC	U999 – Other	Laboratory chemical embalming agent	Cannot be determined in Step 4 – Proceed with Step 5
Example H	N/A – not applicable to nonpoint source				Commercial Cooking	N/A – no matching CDR IFC	None	Cannot be determined in Step 4 – Proceed with Step 5
	N/A – not applicable to nonpoint source				Fuel Comb – Residential – Other	U012 – Fuels and fuel additives	Incorporated into formulation, mixture, or reaction product fuels and related products	Cannot be determined in Step 4 – Proceed with Step 5
	N/A – not applicable to nonpoint source				Gas Stations	U012 – Fuels and fuel additives	Incorporated into formulation, mixture, or reaction product fuels and related products	Cannot be determined in Step 4 – Proceed with Step 5

- 4. Refine OES Assignments:** The initial OES assignments may need to be confirmed and/or refined to identify a single primary OES using the following information described in Steps 5a to 5b. See Table_Apx B-16 for Facility G (point source) and Example H (non-point source).

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Table Apx B-16. Step 5 for NEI Mapping Example Facilities

Facility Name	Sector	Step 5a: Additional Point Source Information	Step 5b: Additional Non-Point Source Information	OES Determination
Facility G	Solvent – Industrial Surface Coating & Solvent Use	N/A – mapped to OES in Step 4		
	Industrial Processes – NEC	NAICS is 336415, Guided Missile and Space Vehicle Propulsion Unit and Propulsion Unit Parts Manufacturing. Emitting process is analytical lab operations	N/A	Information from Step 4 and 5a affirm the OES is: Laboratory chemical
Example H	Commercial Cooking	N/A	No knowledge is available on the use of 1,2-dichloroethane in commercial cooking	Cannot be determined in Step 5 – Proceed to Step 7
	Fuel Comb – Residential – Other	N/A	1,2-Dichloroethane may be used in fuel additives	Information from Step 4 and 5a affirm the OES is: Fuels and related products
	Gas Stations	N/A	1,2-Dichloroethane may be used in fuel additives	Information from Step 4 and 5a affirm the OES is: Fuels and related products

5. **Review Information from Other Databases for Point Source Facilities:** Other databases/sources (including CDR, TRI, and DMR) should be checked to see if the point source facilities have reported to these. Facility G does not report to other databases. This step is not applicable to non-point source Example H.
6. **Consider Options for NEI Records that Cannot be Mapped to an OES:** Given the number of records in NEI and the information available, it may not always be feasible to achieve mapping of 100 % of the sites reporting to NEI to an OES. This is the case for the NEI record Example H – Commercial Cooking. In this case, the OES will be assessed per Step 7a – as “unknown OES” with 250 release days/year. This allows for subsequent exposure modeling and the assessment of risk.

B.5.4 DMR Mapping Examples

This section includes examples of how to implement the OES mapping procedures for sites reporting to DMR, as listed in Section B.3.4. Specifically, this appendix includes examples for two example sites that reported to DMR for 1,2-dichloroethane. These example sites are referred to as Facility I and J.

To map Facilities I and J to an OES, the following procedures are used with information from DMR:

1. **Review Information from Other Databases:** Given the limited facility information reported in DMRs, the first step for mapping facilities reporting to DMR should be to check other databases/sources (including CDR, TRI, and NEI). For these examples, neither Facility I nor J reported to other databases.

- 12722 2. **Assign OES:** If the facility does not report to other databases, the reported SIC code from DMR
12723 and internet research should be used to map the facility to an OES, per Steps 2a and 2b. See
12724 Table_Apx B-17 for completed Step 2 for the example facilities.

Table_Apx B-17. Step 2 for DMR Mapping Example Facilities

Facility Name	Step 2a: SIC Code	Step 2b: Internet Research	OES Determination
Facility I	4613, Refined Petroleum Pipeline	Internet research indicates that the facility is a fuel terminal	Cannot be determined in Step 2 – Proceed with Step 3
Facility J	2821, Plastics Materials and Resins	Internet research indicates the facility makes poly vinyl chloride; 1,2-dichloroethane is known to be used as a reactant in this process	This facility maps to the Processing as a reactant OES, based on the SIC code (which matches the subcategory of use in the COU table) and internet research

3. **Refine OES:** If the specific OES still cannot be determined using the information in Step 2, information in Steps 3a to 3d should be considered. This includes searching for the facility NPDES permit and trying to determine which OES (or group of OES) is the most likely. See Table_Apx B-18 for completed Step 3 for the example facilities.

Table_Apx B-18. Step 3 for DMR Mapping Example Facilities

Facility Name	Step 3a: NPDES Permit Number	Step 3b: Finding the NPDES Permit	Steps 3c–d: Most Likely OES or Grouped OED	OES Determination
Facility I	VAG83#### → A search of VA NPDES permits indicates that permit numbers starting in “VAG0083” are remediation general permits.	The facility’s NPDES permit could not be found online	None of COUs or OES for 1,2-dichloroethane cover remediation	Because the facility’s permit is for remediation, the facility most likely does not use 1,2-dichloroethane but the chemical is present as a contaminant at the site. This does not correspond to an in-scope OES. However, the OES should be designated as “Remediation” for EPA to determine how/if to present the release data.
Facility J	N/A – This facility was mapped to an OES in Step 2.			

B.5.5 OSHA CEHD Mapping Examples

This section includes examples of how to implement the OES mapping procedures for sites in the OSHA CEHD dataset, as listed in Section B.3.5. Specifically, this section includes examples for two example sites in the OSHA CEHD dataset for 1,4-dioxane. These example sites are referred to as Facility K and L.

To map Facilities K and L to an OES, the following procedures are used with information from OSHA CEHD:

1. **Review Information from Other Databases:** Given the limited facility information reported in OSHA CEHD, the first step for mapping facilities should be to check other databases/sources (including CDR, TRI, NEI, and TRI). For these examples, neither Facility K nor L reported to other databases.

Assign OES: If the facility does not report to other databases, the reported SIC code from OSHA CEHD and internet research should be used to map the facility to an OES, per Steps 2a and 2b. See Table_Apx B-19 for completed Step 2 for the example facilities.

Table Apx B-19. Step 2 for OSHA CEHD Mapping Example Facilities

Facility Name	Step 2a: SIC or NAICS Code	Step 2b: Internet Research	OES Determination
Facility K	339112, Surgical and Medical Instrument Manufacturing	Internet research indicates that the facility produces medical equipment for cardiovascular procedures	Based on the OES, the most applicable OES are likely Processing as a reactant (for the production of plastics used in equipment), Solvents (for Cleaning or Degreasing), Plastics and rubber products, or Other use. The specific OES cannot be determined in Step 2 – Proceed with Step 3.
Facility L	5169, Chemicals and Allied Products, Not Elsewhere Classified	Internet research indicates the facility is a waste management company	This facility maps to the <i>Waste handling, disposal, treatment, and recycling</i> , based on information from internet research

2. **Refine OES:** If the specific OES still cannot be determined using the information in Step 2, an evaluation of the OES that is most likely or a group of OES should be considered per Steps 3a and 3b. See Table_Apx B-20 for completed Step 3 for the example facilities.

Table Apx B-20. Step 3 for OSHA CEHD Mapping Example Facilities

Facility Name	Step 3a: Mostly Likely OES	Step 3b: Grouped OED	OES Determination
Facility K	The scope document for 1,2-dichloroethane indicates that the chemical is used to make polyvinyl chloride that is then used in medical devices. The use of 1,2-dichloroethane to produce polyvinyl chloride falls under the Processing as a reactant OES (as an intermediate for plastics).	Not needed – the OES was determined as Processing as a Reactant in Step 3a	Per Step 3a, this facility maps to the Processing as a reactant OES. To further support this determination, EPA may contact OSHA for additional information on the visit to this facility, per Step 4b.
Facility L	N/A – This facility was mapped to an OES in Step 2.		

B.5.6 NIOSH HHE Mapping Examples

This section includes examples of how to implement the OES mapping procedures listed in Section B.3.6, for two example NIOSH HHEs for 1,2-dichloroethane. To map facilities that are the subject of a NIOSH HHE, the process information and other narrative descriptions in the NIOSH HHE should be used.

1. The first example is for the following NIOSH HHE:
<https://www.cdc.gov/niosh/hhe/reports/pdfs/80-186-1149.pdf> (accessed August 11, 2025). The following information is found in the NIOSH HHE:

- a. The facility produces plastic products, primarily plastic tubes for packaging.
- b. 1,2-Dichloroethane was used as a bonding agent for sealing packaging.

OES Determination: Based on the OES for 1,2-dichloroethane (listed in Table_Apx B-20), the use of 1,2-dichloroethane for sealants falls under the Adhesives and Sealants OES.

2. The second example is for the following NIOSH HHE:
<https://www.cdc.gov/niosh/hhe/reports/pdfs/77-73-610.pdf> (accessed August 11, 2025). The following information is found in the NIOSH HHE:

- a. The facility is a chemical manufacturer.
- b. The facility uses 1,2-dichloroethane as a solvent in a reaction to produce another chemical.

OES Determination: Based on the OES for 1,2-dichloroethane (listed in Table_Apx B-20), the use of 1,2-dichloroethane as a reactant falls under the Processing as a Reactant OES.

As discussed in Section B.3.6, NIOSH HHEs typically contain detailed process information and description of how the chemical is used at the facility. Therefore, the mapping of NIOSH HHE facilities to OES is straightforward.

B.5.7 COU Mapping Examples

This appendix includes examples of how to implement the COU mapping procedures for sites from standard sources (*i.e.*, CDR, TRI, NEI, DMR, OSHA CEHD, NIOSH HHE, as listed in Section B.4 . Specifically, this appendix uses the same example facilities (Facility D, Facility E, and Facility F) for the TRI examples in Section B.5.2.

To map Facilities D, E, and F to an COUs, the following procedures should be used:

1. **Map the Facility to an OES:** To map a facility from a standard source to a COU, the facility should first be mapped to an OES following the procedures for the specific source of data (discussed in Section 1.1.1.1A.1). This mapping was completed in Section B.5.2 and is summarized in Table_Apx B-21.

Table_Apx B-21. Step 1 for COU Mapping Example Facilities

Facility Name	Step 1: OES Determination from Appendix A.2
Facility D	Processing as a Reactant
Facility E	Functional Fluids (Closed Systems)
Facility F	Repackaging

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2. **Use the COU Table with Mapped OES to Assign COUs:** At the point of the risk evaluation process where EPA/ERG are mapping data from standard sources to OES and COU, EPA/ERG have already mapped OES to each of the COUs from the scope document. This crosswalk between COUs and OES, which is in Table_Apx B-22, for the example facilities should be used to identify the COU(s). See Table_Apx B-22 for completed Step 2 for the example facilities.

Table_Apx B-22. Step 2 for COU Mapping Example Facilities

Facility Name	OES Determination from Appendix A.2	Step 2: Mapped COUs		
Facility D	Processing as a reactant	Using the COU to OES crosswalk previously developed, the COUs that map to this OES are:		
		Life Cycle Stage	Category	Subcategory
		Processing	Processing – as a reactant	Intermediate in Petrochemical manufacturing
				Plastic material and resin manufacturing
				All other basic organic chemical manufacturing
Facility E	Functional fluids (closed systems)	Using the COU to OES crosswalk previously developed, only one COU maps to this OES:		
		Life Cycle Stage	Category	Subcategory
		Industrial use	Functional fluids (closed systems)	Engine coolant additive
Facility F	Repackaging	Using the COU to OES crosswalk previously developed, only one COU maps to this OES:		
		Life Cycle Stage	Category	Subcategory
		Repackaging	Repackaging	Repackaging

3. **Refine the COU Assignment:** In some instances, more than one COU may map to the facility. In such cases, the reported NAICS code and internet research should be used to try to narrow down the list of potentially applicable COUs, per Steps 3a to 3b. See Table_Apx B-23 for completed Step 3 for the example facilities.

Table_Apx B-23. Step 3 for COU Mapping Example Facilities

Facility Name	Step 3a: NAICS Code	Step 3b: Internet Research	COU Determination
Facility D	486990, All Other Pipeline Transportation	The facility is a large chemical manufacturing plant	The COU subcategory for “Plastic material and resin manufacturing” can be eliminated. However, the COU cannot be narrowed down between the remaining two subcategories of use. Proceed to Step 4.
Facility E	N/A – COU determined in Step 2		
Facility F	N/A – COU determined in Step 2		

4. **List all Potential COUs:** Where the above information does not narrow down the list of potentially applicable COUs, EPA/ERG will list all the potential COUs and will not attempt to select just one from the list where there is insufficient information to do so. Because a singular OES was identified for Facility D and F, this step is not applicable to those facilities. For Facility F, there are two possible COUs that are listed in Table_Apx . While a COU consists of a life cycle stage, category, and subcategory, all three should be presented in this step.

Table_Apx B-24. Step 4 for COU Mapping Example Facilities

Facility Name	Step 4: All Potential COUs		
Facility D	All potential COUs for this facility are as follows:		
	Life Cycle Stage	Category	Subcategory
	Processing	Processing – as a reactant	Intermediate in Petrochemical manufacturing
			All other basic organic chemical manufacturing

B.6 TRI to CDR Use Mapping Crosswalk

Table_Apx presents the TRI-CDR Crosswalk used to map facilities to the OES for each chemical. “N/A” in the 2016 CDR code column indicates there is no corresponding CDR code that matches the TRI code. 2020 CDR introduced new codes for chemicals designated as high priority for risk evaluation; however, reporters may still use the same 2016 CDR codes listed in Table_Apx B-25 for all other chemicals. For 2020 CDR reporting facilities using the new codes, the crosswalk between 2016 CDR codes and 2020 CDR codes in Table 4-15 of the [2020 CDR reporting instructions](#) (accessed August 11, 2025) should be used with Table_Apx .

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Table Apx B-25. Toxics Release Inventory-Chemical Data Recording (TRI-CDR) Use Code Crosswalk

TRI Section	TRI Description	TRI Sub-Use Code	TRI Sub-Use Code Name	2016 CDR Code	2016 CDR Code Name	2016 CDR Functional Use Definition
3.1.a	Manufacture: Produce	N/A	N/A	N/A	N/A	N/A
3.1.b	Manufacture: Import	N/A	N/A	N/A	N/A	N/A
3.1.c	Manufacture: For on-site use/processing	N/A	N/A	N/A	N/A	N/A
3.1.d	Manufacture: For sale/distribution	N/A	N/A	N/A	N/A	N/A
3.1.e	Manufacture: As a byproduct	N/A	N/A	N/A	N/A	N/A
3.1.f	Manufacture: As an impurity	N/A	N/A	N/A	N/A	N/A
3.2.a	Processing: As a reactant	N/A	N/A	PC	Processing as a Reactant	Chemical substance is used in chemical reactions for the manufacturing of another chemical substance or product
3.2.a	Processing: As a reactant	P101	Feedstocks	N/A	N/A	N/A
3.2.a	Processing: As a reactant	P102	Raw Materials	N/A	N/A	N/A
3.2.a	Processing: As a reactant	P103	Intermediates	U015	Intermediates	Chemical substances consumed in a reaction to produce other chemical substances for commercial advantage. A residual of the intermediate chemical substance which has no separate function may remain in the reaction product.
3.2.a	Processing: As a reactant	P104	Initiators	U024	Process Regulators	Chemical substances used to change the rate of a chemical reaction, start or stop the reaction, or otherwise influence the course of the reaction. Process regulators may be consumed or become part of the reaction product.
3.2.a	Processing: As a reactant	P199	Other	U016	Ion Exchange Agents	Chemical substances, usually in the form of a solid matrix, are used to selectively remove targeted ions from a solution. Examples generally consist of an

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TRI Section	TRI Description	TRI Sub-Use Code	TRI Sub-Use Code Name	2016 CDR Code	2016 CDR Code Name	2016 CDR Functional Use Definition
						inert hydrophobic matrix such as styrene divinylbenzene or phenol-formaldehyde, cross-linking polymer such as divinylbenzene, and ionic functional groups including sulfonic, carboxylic or phosphonic acids. This code also includes aluminosilicate zeolites.
3.2.a	Processing: As a reactant	P199	Other	U019	Oxidizing/ Reducing Agent	Chemical substances used to alter the valence state of another substance by donating or accepting electrons or by the addition or removal of hydrogen to a substance. Examples of oxidizing agents include nitric acid, perchlorates, hexavalent chromium compounds, and peroxydisulfuric acid salts. Examples of reducing agents include hydrazine, sodium thiosulfate, and coke produced from coal.
3.2.a	Processing: As a reactant	P199	Other	U999	Other (Specify)	Chemical substances used in a way other than those described by other codes.
3.2.b	Processing: As a formulation component	N/A	N/A	PF	Processing – Incorporation into Formulation, Mixture, or Reaction Product	Chemical substance is added to a product (or product mixture) prior to further distribution of the product.
3.2.b	Processing: As a formulation component	P201	Additives	U007	Corrosion Inhibitors and Antiscaling Agents	Chemical substances used to prevent or retard corrosion or the formation of scale. Examples include phenylenediamine, chromates, nitrates, phosphates, and hydrazine.
3.2.b	Processing: As a formulation component	P201	Additives	U009	Fillers	Chemical substances used to provide bulk, increase strength, increase hardness, or improve resistance to impact. Fillers incorporated in a matrix reduce production costs by minimizing the amount of more expensive substances used in the production of articles. Examples include calcium carbonate, barium sulfate, silicates, clays, zinc oxide and aluminum oxide.

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TRI Section	TRI Description	TRI Sub-Use Code	TRI Sub-Use Code Name	2016 CDR Code	2016 CDR Code Name	2016 CDR Functional Use Definition
3.2.b	Processing: As a formulation component	P201	Additives	U010	Finishing Agents	Chemical substances used to impart such functions as softening, static proofing, wrinkle resistance, and water repellence. Substances may be applied to textiles, paper, and leather. Examples include quaternary ammonium compounds, ethoxylated amines, and silicone compounds.
3.2.b	Processing: As a formulation component	P201	Additives	U017	Lubricants and Lubricant Additives	Chemical substances used to reduce friction, heat, or wear between moving parts or adjacent solid surfaces, or that enhance the lubricity of other substances. Examples of lubricants include mineral oils, silicate and phosphate esters, silicone oil, greases, and solid film lubricants such as graphite and PTFE. Examples of lubricant additives include molybdenum disulphide and tungsten disulphide.
3.2.b	Processing: As a formulation component	P201	Additives	U034	Paint Additives and Coating Additives Not Described by Other Codes	Chemical substances used in a paint or coating formulation to enhance properties such as water repellence, increased gloss, improved fade resistance, ease of application, foam prevention, etc. Examples of paint additives and coating additives include polyols, amines, vinyl acetate ethylene emulsions, and aliphatic polyisocyanates.
3.2.b	Processing: As a formulation component	P202	Dyes	U008	Dyes	Chemical substances used to impart color to other materials or mixtures (<i>i.e.</i> , substrates) by penetrating the surface of the substrate. Example types include azo, anthraquinone, amino azo, aniline, eosin, stilbene, acid, basic or cationic, reactive, dispersive, and natural dyes.
3.2.b	Processing: As a formulation component	P202	Dyes	U021	Pigments	Chemical substances used to impart color to other materials or mixtures (<i>i.e.</i> , substrates) by attaching themselves to the surface of the substrate through binding or adhesion. This code includes fluorescent agents, luminescent agents, whitening agents, pearlizing agents, and opacifiers. Examples include metallic oxides of iron, titanium, zinc, cobalt, and chromium; metal powder suspensions; lead

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TRI Section	TRI Description	TRI Sub-Use Code	TRI Sub-Use Code Name	2016 CDR Code	2016 CDR Code Name	2016 CDR Functional Use Definition
						chromates; vegetable and animal products; and synthetic organic pigments.
3.2.b	Processing: As a formulation component	P203	Reaction Diluents	U030	Solvents (which Become Part of Product Formulation or Mixture)	Chemical substances used to dissolve another substance (solute) to form a uniformly dispersed mixture (solution) at the molecular level. Examples include diluents used to reduce the concentration of an active material to achieve a specified effect and low gravity materials added to reduce cost.
3.2.b	Processing: As a formulation component	P203	Reaction Diluents	U032	Viscosity Adjustors	Chemical substances used to alter the viscosity of another substance. Examples include viscosity index (VI) improvers, pour point depressants, and thickeners.
3.2.b	Processing: As a formulation component	P204	Initiators	U024	Process Regulators	Chemical substances used to change the rate of a chemical reaction, start, or stop the reaction, or otherwise influence the course of the reaction. Process regulators may be consumed or become part of the reaction product.
3.2.b	Processing: As a formulation component	P205	Solvents	U030	Solvents (which Become Part of Product Formulation or Mixture)	Chemical substances used to dissolve another substance (solute) to form a uniformly dispersed mixture (solution) at the molecular level. Examples include diluents used to reduce the concentration of an active material to achieve a specified effect and low gravity materials added to reduce cost.
3.2.b	Processing: As a formulation component	P206	Inhibitors	U024	Process Regulators	Chemical substances used to change the rate of a chemical reaction, start, or stop the reaction, or otherwise influence the course of the reaction. Process regulators may be consumed or become part of the reaction product.
3.2.b	Processing: As a formulation component	P207	Emulsifiers	U003	Adsorbents and Absorbents	Chemical substances used to retain other substances by accumulation on their surface or by assimilation. Examples of adsorbents include silica gel, activated alumina, and activated carbon. Examples of absorbents include straw oil, alkaline solutions, and kerosene.

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3.2.b	Processing: As a formulation component	P208	Surfactants	U002	Adhesives and Sealant Chemicals	Chemical substances used to promote bonding between other substances, promote adhesion of surfaces, or prevent seepage of moisture or air. Examples include epoxides, isocyanates, acrylamides, phenol, urea, melamine, and formaldehyde.
3.2.b	Processing: As a formulation component	P208	Surfactants	U023	Plating Agents and Surface Treating Agents	Chemical substances applied to metal, plastic, or other surfaces to alter physical or chemical properties of the surface. Examples include metal surface treating agents, strippers, etchants, rust and tarnish removers, and descaling agents.
3.2.b	Processing: As a formulation component	P208	Surfactants	U031	Surface Active Agents	Chemical substances used to modify surface tension when dissolved in water or water solutions or reduce interfacial tension between two liquids or between a liquid and a solid or between liquid and air. Examples include carboxylates, sulfonates, phosphates, carboxylic acid, esters, and quaternary ammonium salts.
3.2.b	Processing: As a formulation component	P209	Lubricants	U017	Lubricants and Lubricant Additives	Chemical substances used to reduce friction, heat, or wear between moving parts or adjacent solid surfaces, or that enhance the lubricity of other substances. Examples of lubricants include mineral oils, silicate and phosphate esters, silicone oil, greases, and solid film lubricants such as graphite and PTFE. Examples of lubricant additives include molybdenum disulphide and tungsten disulphide.
3.2.b	Processing: As a formulation component	P210	Flame Retardants	U011	Flame Retardants	Chemical substances used on the surface of or incorporated into combustible materials to reduce or eliminate their tendency to ignite when exposed to heat or a flame for a short period of time. Examples include inorganic salts, chlorinated, or brominated organic compounds, and organic phosphates/phosphonates.

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3.2.b	Processing: As a formulation component	P211	Rheological Modifiers	U022	Plasticizers	Chemical substances used in plastics, cement, concrete, wallboard, clay bodies, or other materials to increase their plasticity or fluidity. Examples include phthalates, trimellitates, adipates, maleates, and lignosulphonates.
3.2.b	Processing: As a formulation component	P211	Rheological Modifiers	U032	Viscosity Adjustors	Chemical substances used to alter the viscosity of another substance. Examples include viscosity index (VI) improvers, pour point depressants, and thickeners.
3.2.b	Processing: As a formulation component	P299	Other	U003	Adsorbents and Absorbents	Chemical substances used to retain other substances by accumulation on their surface or by assimilation. Examples of adsorbents include silica gel, activated alumina, and activated carbon. Examples of absorbents include straw oil, alkaline solutions, and kerosene.
3.2.b	Processing: As a formulation component	P299	Other	U016	Ion Exchange Agents	Chemical substances, usually in the form of a solid matrix, are used to selectively remove targeted ions from a solution. Examples generally consist of an inert hydrophobic matrix such as styrene divinylbenzene or phenol-formaldehyde, cross-linking polymer such as divinylbenzene, and ionic functional groups including sulfonic, carboxylic or phosphonic acids. This code also includes aluminosilicate zeolites.
3.2.b	Processing: As a formulation component	P299	Other	U018	Odor Agents	Chemical substances used to control odors, remove odors, mask odors, or impart odors. Examples include benzenoids, terpenes and terpenoids, musk chemicals, aliphatic aldehydes, aliphatic cyanides, and mercaptans.
3.2.b	Processing: As a formulation component	P299	Other	U019	Oxidizing/ Reducing Agent	Chemical substances used to alter the valence state of another substance by donating or accepting electrons or by the addition or removal of hydrogen to a substance. Examples of oxidizing agents include nitric acid, perchlorates, hexavalent chromium compounds,

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						and peroxydisulfuric acid salts. Examples of reducing agents include hydrazine, sodium thiosulfate, and coke produced from coal.
3.2.b	Processing: As a formulation component	P299	Other	U020	Photosensitive Chemicals	Chemical substances used for their ability to alter their physical or chemical structure through absorption of light, resulting in the emission of light, dissociation, discoloration, or other chemical reactions. Examples include sensitizers, fluorescents, photovoltaic agents, ultraviolet absorbers, and ultraviolet stabilizers.
3.2.b	Processing: As a formulation component	P299	Other	U027	Propellants and Blowing Agents	Chemical substances used to dissolve or suspend other substances and either to expel those substances from a container in the form of an aerosol or to impart a cellular structure to plastics, rubber, or 441hermos set resins. Examples include compressed gasses and liquids and substances which release ammonia, carbon dioxide, or nitrogen.
3.2.b	Processing: As a formulation component	P299	Other	U028	Solid Separation Agents	Chemical substances used to promote the separation of suspended solids from a liquid. Examples include flotation aids, flocculants, coagulants, dewatering aids, and drainage aids.
3.2.b	Processing: As a formulation component	P299	Other	U999	Other (Specify)	Chemical substances used in a way other than those described by other codes.
3.2.c	Processing: As an article component	N/A	N/A	PA	Processing – Incorporation into Article	Chemical substance becomes an integral component of an article distributed for industrial, trade, or consumer use.
3.2.c	Processing: As an article component	N/A	N/A	U008	Dyes	Chemical substances used to impart color to other materials or mixtures (<i>i.e.</i> , substrates) by penetrating the surface of the substrate. Example types include azo, anthraquinone, amino azo, aniline, eosin, stilbene, acid, basic or cationic, reactive, dispersive, and natural dyes.

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3.2.c	Processing: As an article component	N/A	N/A	U009	Fillers	Chemical substances used to provide bulk, increase strength, increase hardness, or improve resistance to impact. Fillers incorporated in a matrix reduce production costs by minimizing the amount of more expensive substances used in the production of articles. Examples include calcium carbonate, barium sulfate, silicates, clays, zinc oxide and aluminum oxide.
3.2.c	Processing: As an article component	N/A	N/A	U021	Pigments	Chemical substances used to impart color to other materials or mixtures (<i>i.e.</i> , substrates) by attaching themselves to the surface of the substrate through binding or adhesion. This code includes fluorescent agents, luminescent agents, whitening agents, pearlizing agents, and opacifiers. Examples include metallic oxides of iron, titanium, zinc, cobalt, and chromium; metal powder suspensions; lead chromates; vegetable and animal products; and synthetic organic pigments.
3.2.c	Processing: As an article component	N/A	N/A	U034	Paint Additives and Coating Additives Not Described by Other Codes	Chemical substances used in a paint or coating formulation to enhance properties such as water repellence, increased gloss, improved fade resistance, ease of application, foam prevention, etc. Examples of paint additives and coating additives include polyols, amines, vinyl acetate ethylene emulsions, and aliphatic polyisocyanates.
3.2.c	Processing: As an article component	N/A	N/A	U999	Other (Specify)	Chemical substances used in a way other than those described by other codes.
3.2.d	Processing: Repackaging	N/A	N/A	PK	Processing – Repackaging	Preparation of a chemical substance for distribution in commerce in a different form, state, or quantity. This includes transferring the chemical substance from a bulk container into smaller containers. This definition does not apply to sites that only relabel or redistribute the reportable chemical substance without removing the chemical substance from the container in which it is received or purchased.

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3.2.e	Processing: As an impurity	N/A	N/A	N/A	N/A	N/A
3.2.f	Processing: Recycling	N/A	N/A	N/A	N/A	N/A
3.3.a	Otherwise Use: As a chemical processing aid	N/A	N/A	U	Use-Non Incorporative Activities	Chemical substance is otherwise used (<i>e.g.</i> , as a chemical processing or manufacturing aid).
3.3.a	Otherwise Use: As a chemical processing aid	Z101	Process Solvents	U029	Solvents (for Cleaning or Degreasing)	Chemical substances used to dissolve oils, greases, and similar materials from textiles, glassware, metal surfaces, and other articles. Examples include trichloroethylene, perchloroethylene, methylene chloride, liquid carbon dioxide, and n-propyl bromide.
3.3.a	Otherwise Use: As a chemical processing aid	Z102	Catalysts	U020	Photosensitive Chemicals	Chemical substances used for their ability to alter their physical or chemical structure through absorption of light, resulting in the emission of light, dissociation, discoloration, or other chemical reactions. Examples include sensitizers, fluorescents, photovoltaic agents, ultraviolet absorbers, and ultraviolet stabilizers.
3.3.a	Otherwise Use: As a chemical processing aid	Z102	Catalysts	U025	Processing Aids, Specific to Petroleum Production	Chemical substances added to water-, oil-, or synthetic drilling muds or other petroleum production fluids to control viscosity, foaming, corrosion, alkalinity and pH, microbiological growth, hydrate formation, etc., during the production of oil, gas, and other products from beneath the earth's surface.
3.3.a	Otherwise Use: As a chemical processing aid	Z102	Catalysts	U026	Processing Aids, Not Otherwise Listed	Chemical substances used to improve the processing characteristics or the operation of process equipment or to alter or buffer the pH of the substance or mixture, when added to a process or to a substance or mixture to be processed. Processing agents do not become a part of the reaction product and are not intended to affect the function of a substance or article created. Examples include buffers, dehumidifiers,

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TRI Section	TRI Description	TRI Sub-Use Code	TRI Sub-Use Code Name	2016 CDR Code	2016 CDR Code Name	2016 CDR Functional Use Definition
						dehydrating agents, sequestering agents, and chelators.
3.3.a	Otherwise Use: As a chemical processing aid	Z103	Inhibitors	U024	Process Regulators	Chemical substances used to change the rate of a chemical reaction, start or stop the reaction, or otherwise influence the course of the reaction. Process regulators may be consumed or become part of the reaction product.
3.3.a	Otherwise Use: As a chemical processing aid	Z103	Inhibitors	U025	Processing Aids, Specific to Petroleum Production	Chemical substances added to water-, oil-, or synthetic drilling muds or other petroleum production fluids to control viscosity, foaming, corrosion, alkalinity and pH, microbiological growth, hydrate formation, etc., during the production of oil, gas, and other products from beneath the earth's surface.
3.3.a	Otherwise Use: As a chemical processing aid	Z103	Inhibitors	U026	Processing Aids, Not Otherwise Listed	Chemical substances used to improve the processing characteristics or the operation of process equipment or to alter or buffer the pH of the substance or mixture, when added to a process or to a substance or mixture to be processed. Processing agents do not become a part of the reaction product and are not intended to affect the function of a substance or article created. Examples include buffers, dehumidifiers, dehydrating agents, sequestering agents, and chelators.
3.3.a	Otherwise Use: As a chemical processing aid	Z104	Initiators	U024	Process Regulators	Chemical substances used to change the rate of a chemical reaction, start, or stop the reaction, or otherwise influence the course of the reaction. Process regulators may be consumed or become part of the reaction product.
3.3.a	Otherwise Use: As a chemical processing aid	Z104	Initiators	U025	Processing Aids, Specific to Petroleum Production	Chemical substances added to water-, oil-, or synthetic drilling muds or other petroleum production fluids to control viscosity, foaming, corrosion, alkalinity and pH, microbiological growth, hydrate formation, etc., during the production of oil, gas, and other products from beneath the earth's surface.

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3.3.a	Otherwise Use: As a chemical processing aid	Z104	Initiators	U026	Processing Aids, Not Otherwise Listed	Chemical substances used to improve the processing characteristics or the operation of process equipment or to alter or buffer the pH of the substance or mixture, when added to a process or to a substance or mixture to be processed. Processing agents do not become a part of the reaction product and are not intended to affect the function of a substance or article created. Examples include buffers, dehumidifiers, dehydrating agents, sequestering agents, and chelators.
3.3.a	Otherwise Use: As a chemical processing aid	Z105	Reaction Terminators	U024	Process Regulators	Chemical substances used to change the rate of a chemical reaction, start, or stop the reaction, or otherwise influence the course of the reaction. Process regulators may be consumed or become part of the reaction product.
3.3.a	Otherwise Use: As a chemical processing aid	Z105	Reaction Terminators	U025	Processing Aids, Specific to Petroleum Production	Chemical substances added to water-, oil-, or synthetic drilling muds or other petroleum production fluids to control viscosity, foaming, corrosion, alkalinity and pH, microbiological growth, hydrate formation, etc., during the production of oil, gas, and other products from beneath the earth's surface.
3.3.a	Otherwise Use: As a chemical processing aid	Z105	Reaction Terminators	U026	Processing Aids, Not Otherwise Listed	Chemical substances used to improve the processing characteristics or the operation of process equipment or to alter or buffer the pH of the substance or mixture, when added to a process or to a substance or mixture to be processed. Processing agents do not become a part of the reaction product and are not intended to affect the function of a substance or article created. Examples include buffers, dehumidifiers, dehydrating agents, sequestering agents, and chelators.
3.3.a	Otherwise Use: As a chemical processing aid	Z106	Solution Buffers	U026	Processing Aids, Not Otherwise Listed	Chemical substances used to improve the processing characteristics or the operation of process equipment or to alter or buffer the pH of the substance or mixture, when added to a process or to a substance or

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						mixture to be processed. Processing agents do not become a part of the reaction product and are not intended to affect the function of a substance or article created. Examples include buffers, dehumidifiers, dehydrating agents, sequestering agents, and chelators.
3.3.a	Otherwise Use: As a chemical processing aid	Z199	Other	U002	Adhesives and Sealant Chemicals	Chemical substances used to promote bonding between other substances, promote adhesion of surfaces, or prevent seepage of moisture or air. Examples include epoxides, isocyanates, acrylamides, phenol, urea, melamine, and formaldehyde.
3.3.a	Otherwise Use: As a chemical processing aid	Z199	Other	U006	Bleaching Agents	Chemical substances used to lighten or whiten a substrate through chemical reaction, usually an oxidative process which degrades the color system. Examples generally fall into one of two groups: chlorine containing bleaching agents (<i>e.g.</i> , chlorine, hypochlorite, N-chloro compounds and chlorine dioxide); and, peroxygen bleaching agents (<i>e.g.</i> , hydrogen peroxide, potassium permanganate, and sodium perborate).
3.3.a	Otherwise Use: As a chemical processing aid	Z199	Other	U018	Odor Agents	Chemical substances used to control odors, remove odors, mask odors, or impart odors. Examples include benzenoids, terpenes and terpenoids, musk chemicals, aliphatic aldehydes, aliphatic cyanides, and mercaptans.
3.3.a	Otherwise Use: As a chemical processing aid	Z199	Other	U023	Plating Agents and Surface Treating Agents	Chemical substances applied to metal, plastic, or other surfaces to alter physical or chemical properties of the surface. Examples include metal surface treating agents, strippers, etchants, rust and tarnish removers, and descaling agents.
3.3.a	Otherwise Use: As a chemical processing aid	Z199	Other	U025	Processing Aids, Specific to Petroleum Production	Chemical substances added to water-, oil-, or synthetic drilling muds or other petroleum production fluids to control viscosity, foaming, corrosion, alkalinity and pH, microbiological growth, hydrate

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						formation, etc., during the production of oil, gas, and other products from beneath the earth's surface.
3.3.a	Otherwise Use: As a chemical processing aid	Z199	Other	U026	Processing Aids, Not Otherwise Listed	Chemical substances used to improve the processing characteristics or the operation of process equipment or to alter or buffer the pH of the substance or mixture, when added to a process or to a substance or mixture to be processed. Processing agents do not become a part of the reaction product and are not intended to affect the function of a substance or article created. Examples include buffers, dehumidifiers, dehydrating agents, sequestering agents, and chelators.
3.3.a	Otherwise Use: As a chemical processing aid	Z199	Other	U028	Solid Separation Agents	Chemical substances used to promote the separation of suspended solids from a liquid. Examples include flotation aids, flocculants, coagulants, dewatering aids, and drainage aids.
3.3.b	Otherwise Use: As a manufacturing aid	N/A	N/A	U	Use – Non Incorporative Activities	Chemical substance is otherwise used (e.g., as a chemical processing or manufacturing aid).
3.3.b	Otherwise Use: As a manufacturing aid	Z201	Process Lubricants	U017	Lubricants and Lubricant Additives	Chemical substances used to reduce friction, heat, or wear between moving parts or adjacent solid surfaces, or that enhance the lubricity of other substances. Examples of lubricants include mineral oils, silicate and phosphate esters, silicone oil, greases, and solid film lubricants such as graphite and PTFE. Examples of lubricant additives include molybdenum disulphide and tungsten disulphide.
3.3.b	Otherwise Use: As a manufacturing aid	Z202	Metalworking Fluids	U007	Corrosion Inhibitors and Antiscaling Agents	Chemical substances used to prevent or retard corrosion or the formation of scale. Examples include phenylenediamine, chromates, nitrates, phosphates, and hydrazine.
3.3.b	Otherwise Use: As a manufacturing aid	Z202	Metalworking Fluids	U014	Functional Fluids (Open Systems)	Liquid or gaseous chemical substances used for one or more operational properties in an open system. Examples include antifreezes and de-icing fluids such

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						as ethylene and propylene glycol, sodium formate, potassium acetate, and sodium acetate. This code also includes substances incorporated into metal working fluids.
3.3.b	Otherwise Use: As a manufacturing aid	Z203	Coolants	U013	Functional Fluids (Closed Systems)	Liquid or gaseous chemical substances used for one or more operational properties in a closed system. Examples include heat transfer agents (<i>e.g.</i> , coolants and refrigerants) such as polyalkylene glycols, silicone oils, liquified propane, and carbon dioxide; hydraulic/transmission fluids such as mineral oils, organophosphate esters, silicone, and propylene glycol; and dielectric fluids such as mineral insulating oil and high flash point kerosene. This code does not include fluids used as lubricants.
3.3.b	Otherwise Use: As a manufacturing aid	Z204	Refrigerants	U013	Functional Fluids (Closed Systems)	Liquid or gaseous chemical substances used for one or more operational properties in a closed system. Examples include heat transfer agents (<i>e.g.</i> , coolants and refrigerants) such as polyalkylene glycols, silicone oils, liquified propane, and carbon dioxide; hydraulic/transmission fluids such as mineral oils, organophosphate esters, silicone, and propylene glycol; and dielectric fluids such as mineral insulating oil and high flash point kerosene. This code does not include fluids used as lubricants.
3.3.b	Otherwise Use: As a manufacturing aid	Z205	Hydraulic Fluids	U013	Functional Fluids (Closed Systems)	Liquid or gaseous chemical substances used for one or more operational properties in a closed system. Examples include: heat transfer agents (<i>e.g.</i> , coolants and refrigerants) such as polyalkylene glycols, silicone oils, liquified propane, and carbon dioxide; hydraulic/transmission fluids such as mineral oils, organophosphate esters, silicone, and propylene glycol; and dielectric fluids such as mineral insulating oil and high flash point kerosene. This code does not include fluids used as lubricants.

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3.3.b	Otherwise Use: As a manufacturing aid	Z299	Other	U013	Functional Fluids (Closed Systems)	Liquid or gaseous chemical substances used for one or more operational properties in a closed system. Examples include: heat transfer agents (e.g., coolants and refrigerants) such as polyalkylene glycols, silicone oils, liquified propane, and carbon dioxide; hydraulic/transmission fluids such as mineral oils, organophosphate esters, silicone, and propylene glycol; and dielectric fluids such as mineral insulating oil and high flash point kerosene. This code does not include fluids used as lubricants.
3.3.b	Otherwise Use: As a manufacturing aid	Z299	Other	U023	Plating Agents and Surface Treating Agents	Chemical substances applied to metal, plastic, or other surfaces to alter physical or chemical properties of the surface. Examples include metal surface treating agents, strippers, etchants, rust and tarnish removers, and descaling agents.
3.3.c	Otherwise Use: Ancillary or other use	N/A	N/A	U	Use – Non-Incorporative Activities	Chemical substance is otherwise used (e.g., as a chemical processing or manufacturing aid).
3.3.c	Otherwise Use: Ancillary or other use	Z301	Cleaner	U007	Corrosion Inhibitors and Antiscaling Agents	Chemical substances used to prevent or retard corrosion or the formation of scale. Examples include phenylenediamine, chromates, nitrates, phosphates, and hydrazine.
3.3.c	Otherwise Use: Ancillary or other use	Z301	Cleaner	U029	Solvents (for Cleaning or Degreasing)	Chemical substances used to dissolve oils, greases, and similar materials from textiles, glassware, metal surfaces, and other articles. Examples include trichloroethylene, perchloroethylene, methylene chloride, liquid carbon dioxide, and n-propyl bromide.
3.3.c	Otherwise Use: Ancillary or other use	Z302	Degreaser	U003	Adsorbents and Absorbents	Chemical substances used to retain other substances by accumulation on their surface or by assimilation. Examples of adsorbents include silica gel, activated alumina, and activated carbon. Examples of absorbents include straw oil, alkaline solutions, and kerosene.

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3.3.c	Otherwise Use: Ancillary or other use	Z302	Degreaser	U029	Solvents (for Cleaning or Degreasing)	Chemical substances used to dissolve oils, greases, and similar materials from textiles, glassware, metal surfaces, and other articles. Examples include trichloroethylene, perchloroethylene, methylene chloride, liquid carbon dioxide, and n-propyl bromide.
3.3.c	Otherwise Use: Ancillary or other use	Z303	Lubricant	U017	Lubricants and Lubricant Additives	Chemical substances used to reduce friction, heat, or wear between moving parts or adjacent solid surfaces, or that enhance the lubricity of other substances. Examples of lubricants include mineral oils, silicate and phosphate esters, silicone oil, greases, and solid film lubricants such as graphite and PTFE. Examples of lubricant additives include molybdenum disulphide and tungsten disulphide.
3.3.c	Otherwise Use: Ancillary or other use	Z304	Fuel	U012	Fuels and Fuel Additives	Chemical substances used to create mechanical or thermal energy through chemical reactions, or which are added to a fuel for the purpose of controlling the rate of reaction or limiting the production of undesirable combustion products, or which provide other benefits such as corrosion inhibition, lubrication, or detergency. Examples of fuels include coal, oil, gasoline, and various grades of diesel fuel. Examples of fuel additives include oxygenated compound such as ethers and alcohols, antioxidants such as phenylenediamines and hindered phenols, corrosion inhibitors such as carboxylic acids, amines, and amine salts, and blending agents such as ethanol.
3.3.c	Otherwise Use: Ancillary or other use	Z305	Flame Retardant	U011	Flame Retardants	Chemical substances used on the surface of or incorporated into combustible materials to reduce or eliminate their tendency to ignite when exposed to heat or a flame for a short period of time. Examples include inorganic salts, chlorinated, or brominated organic compounds, and organic phosphates/phosphonates.
3.3.c	Otherwise Use: Ancillary or other use	Z306	Waste Treatment	U006	Bleaching Agents	Chemical substances used to lighten or whiten a substrate through chemical reaction, usually an

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						oxidative process which degrades the color system. Examples generally fall into one of two groups: chlorine containing bleaching agents (<i>e.g.</i> , chlorine, hypochlorites, N-chloro compounds and chlorine dioxide); and peroxygen bleaching agents (<i>e.g.</i> , hydrogen peroxide, potassium permanganate, and sodium perborate).
3.3.c	Otherwise Use: Ancillary or other use	Z306	Waste Treatment	U018	Odor Agents	Chemical substances used to control odors, remove odors, mask odors, or impart odors. Examples include benzenoids, terpenes and terpenoids, musk chemicals, aliphatic aldehydes, aliphatic cyanides, and mercaptans.
3.3.c	Otherwise Use: Ancillary or other use	Z306	Waste Treatment	U019	Oxidizing/Reducing Agent	Chemical substances used to alter the valence state of another substance by donating or accepting electrons or by the addition or removal of hydrogen to a substance. Examples of oxidizing agents include nitric acid, perchlorates, hexavalent chromium compounds, and peroxydisulfuric acid salts. Examples of reducing agents include hydrazine, sodium thiosulfate, and coke produced from coal.
3.3.c	Otherwise Use: Ancillary or other use	Z306	Waste Treatment	U028	Solid Separation Agents	Chemical substances used to promote the separation of suspended solids from a liquid. Examples include flotation aids, flocculants, coagulants, dewatering aids, and drainage aids.
3.3.c	Otherwise Use: Ancillary or other use	Z307	Water Treatment	U006	Bleaching Agents	Chemical substances used to lighten or whiten a substrate through chemical reaction, usually an oxidative process which degrades the color system. Examples generally fall into one of two groups: chlorine containing bleaching agents (<i>e.g.</i> , chlorine, hypochlorites, N-chloro compounds and chlorine dioxide); and peroxygen bleaching agents (<i>e.g.</i> , hydrogen peroxide, potassium permanganate, and sodium perborate).

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3.3.c	Otherwise Use: Ancillary or other use	Z307	Water Treatment	U018	Odor Agents	Chemical substances used to control odors, remove odors, mask odors, or impart odors. Examples include benzenoids, terpenes and terpenoids, musk chemicals, aliphatic aldehydes, aliphatic cyanides, and mercaptans.
3.3.c	Otherwise Use: Ancillary or other use	Z307	Water Treatment	U019	Oxidizing/Reducing Agent	Chemical substances used to alter the valence state of another substance by donating or accepting electrons or by the addition or removal of hydrogen to a substance. Examples of oxidizing agents include nitric acid, perchlorates, hexavalent chromium compounds, and peroxydisulfuric acid salts. Examples of reducing agents include hydrazine, sodium thiosulfate, and coke produced from coal.
3.3.c	Otherwise Use: Ancillary or other use	Z307	Water Treatment	U028	Solid Separation Agents	Chemical substances used to promote the separation of suspended solids from a liquid. Examples include flotation aids, flocculants, coagulants, dewatering aids, and drainage aids.
3.3.c	Otherwise Use: Ancillary or other use	Z308	Construction Materials	N/A	N/A	N/A
3.3.c	Otherwise Use: Ancillary or other use	Z399	Other	U001	Abrasives	Chemical substances used to wear down or polish surfaces by rubbing against the surface. Examples include sandstones, pumice, silex, quartz, silicates, aluminum oxides, and glass.
3.3.c	Otherwise Use: Ancillary or other use	Z399	Other	U013	Functional Fluids (Closed Systems)	Liquid or gaseous chemical substances used for one or more operational properties in a closed system. Examples include heat transfer agents (<i>e.g.</i> , coolants and refrigerants) such as polyalkylene glycols, silicone oils, liquified propane, and carbon dioxide; hydraulic/transmission fluids such as mineral oils, organophosphate esters, silicone, and propylene glycol; and dielectric fluids such as mineral insulating oil and high flash point kerosene. This code does not include fluids used as lubricants.

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TRI Section	TRI Description	TRI Sub-Use Code	TRI Sub-Use Code Name	2016 CDR Code	2016 CDR Code Name	2016 CDR Functional Use Definition
3.3.c	Otherwise Use: Ancillary or other use	Z399	Other	U014	Functional Fluids (Open Systems)	Liquid or gaseous chemical substances used for one or more operational properties in an open system. Examples include antifreeze and de-icing fluids such as ethylene and propylene glycol, sodium formate, potassium acetate, and sodium acetate. This code also includes substances incorporated into metal working fluids.
3.3.c	Otherwise Use: Ancillary or other use	Z399	Other	U018	Odor Agents	Chemical substances used to control odors, remove odors, mask odors, or impart odors. Examples include benzenoids, terpenes and terpenoids, musk chemicals, aliphatic aldehydes, aliphatic cyanides, and mercaptans.
3.3.c	Otherwise Use: Ancillary or other use	Z399	Other	U020	Photosensitive Chemicals	Chemical substances used for their ability to alter their physical or chemical structure through absorption of light, resulting in the emission of light, dissociation, discoloration, or other chemical reactions. Examples include sensitizers, fluorescents, photovoltaic agents, ultraviolet absorbers, and ultraviolet stabilizers.
3.3.c	Otherwise Use: Ancillary or other use	Z399	Other	U023	Plating Agents and Surface Treating Agents	Chemical substances applied to metal, plastic, or other surfaces to alter physical or chemical properties of the surface. Examples include metal surface treating agents, strippers, etchants, rust and tarnish removers, and descaling agents.

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Appendix C ESTIMATING DAILY WASTEWATER DISCHARGES FROM DISCHARGE MONITORING REPORTS AND TOXICS RELEASE INVENTORY DATA

This appendix provides steps and examples for estimating daily wastewater discharges from industrial and commercial facilities manufacturing, processing, or using chemicals undergoing risk evaluation under the TSCA. Wastewater discharges are reported either via DMRs under the NPDES or TRI.

The following estimation methods are provided:

- Average daily wastewater discharge rate (kg/site-day);
- High-end daily wastewater discharge rate (kg/site-day);
- One-day maximum wastewater discharge rate (kg/site-day); and
- Trends over 5 years for a facility including the minimum, maximum, and median wastewater discharge rate that has occurred for a facility within the past 5 years.

These estimates will be used in modeling to estimate surface water concentrations in receiving waters for the assessment of risks to aquatic species and to the general population from drinking water.

C.1 Collecting and Mapping Wastewater Discharge Data to COUs and OESs

The first step in estimating daily releases is obtaining and mapping the relevant data to the TSCA COUs for the chemical that were identified in the scoping document. Some COUs may be broad categories of use and additional steps may be taken in the draft risk evaluation to further define the COUs into more specific OESs. A methodology for how to do this mapping step has been developed and the key steps are described below.

1. Query the Loading Tool and TRI for each of the past 5 years, starting with the most recent calendar year for which TRI data are available. In general, when a facility reports under both the NPDES program and TRI, EPA will perform comparisons of the data to determine if any discrepancies exist and, if so, which data are more appropriate to use in the risk evaluation. However, the two datasets are not updated concurrently. The Loading Tool automatically and continuously checks ICIS-NPDES for newly submitted DMRs. The Loading Tool processes the data weekly and calculates pollutant loading estimates; therefore, water discharge data (DMR data) are available on a continual basis. Although the Loading Tool process data weekly, each permitted discharging facility is only required to report their monitoring results for each pollutant at a frequency specified in the permit (*e.g.*, monthly, every 2 months, quarterly). TRI data is only reported annually for the previous calendar year and is typically released in July (*i.e.*, 2020 TRI data is released in July 2021). To ensure EPA is making an appropriate comparison between the two datasets, EPA should only use data for years where data from both datasets are available.
2. Remove the following DMR facility types from further analysis:
 - a. Facilities reporting zero discharges for the chemical of interest for each of the 5 years queried as EPA cannot confirm if the pollutant is present at the facility.
3. Map each remaining facility to a COU and OES; the OES will inform estimates of average operating days per year for the facility.

C.2 Estimating the Number of Facility Operating Days per Year

The number of operating days per year (days/year) for each facility that reports wastewater discharges

may be available but will most likely be unknown. An approach has been developed for use in TSCA risk evaluations for estimating the number of facility operating days before and is described below.

1. **Facility-Specific Data:** Use facility-specific data if available. If facility-specific data is not available, estimate the days/year using one of the following approaches:
 - a. If facilities have known or estimated average daily use rates, calculate the days/year (days/year = estimated annual use rate for the site [kg/year] / average daily use rate from sites with available data [kg/day]).
 - b. If sites with days/year data do not have known or estimate average daily use rates, use the average number of days/year from the sites with such data.
2. **Industry-Specific Data:** Industry-specific data may be available in the form of GSs, ESDs, trade publications, or other relevant literature. In such cases, these estimates should take precedent over other approaches, unless facility-specific data are available.
3. **Manufacture of Large-Production Volume (PV) Commodity Chemicals:** For the manufacture of the large-PV commodity chemicals, a value of 350 days/year should be used. This assumes the plant runs 7 day/week and 50 week/year (with 2 weeks down for turnaround) and assumes that the plant is always producing the chemical.
4. **Manufacture of Lower-PV Specialty Chemicals:** For the manufacture of lower-PV specialty chemicals, it is unlikely the chemical is being manufactured continuously throughout the year. Therefore, a value of 250 days/year should be used. This assumes the plant manufactures the chemical 5 days/week and 50 weeks/year (with 2 weeks down for turnaround).
5. **Processing as Reactant (Intermediate Use) in the Manufacture of Commodity Chemicals:** Similar to #3, the manufacture of commodity chemicals is assumed to occur 350 days/year such that the use of a chemicals as a reactant to manufacture a commodity chemical will also occur 350 days/year.
6. **Processing as Reactant (Intermediate Use) in the Manufacture of Specialty Chemicals:** Similar to #4, the manufacture of specialty chemicals is not likely to occur continuously throughout the year. Therefore, a value of 250 days/year can be used.
7. **Other Chemical Plant OESs** (e.g., Processing into formulation and use of industrial processing aids): For these OES, it is reasonable to assume that the chemical of interest is not always in use at the facility, even if the facility operates 24/7. Therefore, in general, a value of 300 days/year can be used based on the “SpERC fact sheet – Formulation & (re)packing of substances and mixtures – Industrial (Solvent-borne)” which uses a default of 300 days/year for the chemical industry. However, in instances where the OES uses a low volume of the chemical of interest, 250 days/year can be used as a lower estimate for the days/year.
8. **POTWs:** Although POTWs are expected to operate continuously over 365 days/year, the discharge frequency of the chemical of interest from a POTW will be dependent on the discharge patterns of the chemical from the upstream facilities discharging to the POTW. The upstream discharge patterns will be addressed in a second-tier analysis. However, there can be multiple upstream facilities (possibly with different OES) discharging to the same POTW and information to determine when the discharges from each facility occur on the same day or separate days is typically not available. Therefore, an exact number of days/year the chemical of interest is discharged from the POTW cannot be determined and a value of 365 days/year should be used.
9. **All Other OESs:** Regardless of what the facility operating schedule is, other OES are unlikely to use the chemical of interest every day. Therefore, a value of 250 days/year should be used for these OESs.

C.3 Approach for Estimating Daily Discharges

After the initial steps of selecting and mapping of the water discharge data and estimating the number of facility operating days/year have been completed, the next steps in the analysis are to make estimates of daily wastewater discharges. This guidance presents approaches for making the following estimates:

- Average daily wastewater discharges – this approach averages out the yearly discharges into an average daily discharge rate for the entire year for the facility
- High-end daily wastewater discharges – this approach estimates a high-end daily discharge rate that may take place for a period of time during the year for the facility
- 1-Day maximum discharge rate – this approach estimates a discharge rate that may represent a 1-day maximum rate for the facility.

C.3.1 Average Daily Wastewater Discharges

The following steps should be used to estimate the average daily wastewater discharge for each facility for each year:

1. Obtain total annual loads calculated from the Loading Tool and reported annual surface water discharges in TRI.
2. For facilities with both TRI and DMR data, compare the annual surface water discharges reported to each to see if they agree. If not, select the data representing the highest annual discharge.
3. Divide the annual discharge over the number of estimated operating days for the OES to which the facility has been mapped. The number of operating days will differ for each OES and chemical but typically ranges from 200 to 350 days/year.

This approach can be used for both direct discharges to surface water and indirect discharges to POTW or non-POTW WWT. However, special care should be given to facilities reporting transfers to POTW or non-POTW WWT plants in TRI as the subsequent discharge to surface water from these transfers may already be accounted for in the receiving facilities DMRs.

C.3.2 High-End Daily Direct Discharge for Facilities with DMR Data

The following steps should be used to estimate the high-end daily direct discharge for each facility with DMR data for each year:

1. Use the Loading Tool to obtain the reporting periods (*e.g.*, monthly, bimonthly, quarterly, biannually, annually) and required reporting statistics (*e.g.*, average monthly concentration, max daily concentration) for each external outfall at each facility. When there is one outfall reported in the Loading Tool, assume it is an external outfall. If multiple outfalls are reported in the Loading Tool, further investigation to determine the external outfall would be required, such as a review of facility's permits.
2. For each external outfall at each facility, calculate the average daily load for each reporting period by multiplying the period average concentration by the period average wastewater flowrate. If there is one outfall reported in the Loading Tool, assume it is an external outfall. Further investigation is needed if multiple outfalls are reported in the Loading Tool to determine the external outfall, such as a review of the facility's permit.
3. Sum the average daily loads from each external outfall for each period.
4. Select the period with the highest average daily load across all external outfalls as an estimate of the high-end daily discharge assessed over the number of days in the period. The number of days in the reporting period does not necessarily equate to the number of operating days in the

reporting period. For example, for a plant that operates 200 days/year, use 200 rather than 365 days/year for average daily discharge. Therefore, discharges will not occur every day of the reporting period, but only for a fraction ($200/365 = 68\%$). The number of days of the reporting period should be multiplied by this factor to maintain consistency between operating days/year and operating days/reporting period.

C.3.3 High-End Daily Direct Consecutive Discharge for Facilities Without DMRs

Some facilities may report surface water discharges to TRI but are not required to monitor or report those discharges under the NPDES. In such cases, EPA will only have the annual discharge value and not discharge values from multiple periods throughout the year. To estimate the high-end daily direct discharges for these facilities the following steps should be used:

1. Identify facilities that report under the NPDES program for the same chemical, same year, and same OES as the TRI facility and report DMRs monthly. Note: if no monthly reporters exist, reporters with less frequent reporting can be substituted provided the number of release days per year are adjusted in subsequent steps.
2. For each facility identified in #1, calculate the percentage of the total annual discharge that occurred in the highest one-month period.
3. Calculate a generic factor for the OES as the average of the percentages calculated in #2.
4. Estimate the high-end daily discharge for each facility without DMRs by multiplying the annual discharge by the generic factor from #3. For example, a facility reports 500 lb released per year and has a generic factor of 15 % for the OES from #3. The estimated high-end chronic daily discharge for the facility would be ($500 \text{ lb} \times 15\% = 75 \text{ lb/month}$).
5. Use the value calculated in #4 as an estimate of the high-end daily discharge assessed over 30 days per year. For example, the high-end daily discharge assessed over 30 days per year for the facility with the estimated high-end chronic daily discharge of 75 lb/month (from #4 above) is ($75 \text{ lb/month} / 30 \text{ days} = 2.5 \text{ lb/day for 30 days}$).

This approach can also be applied to facilities that have less frequent reporting periods under the NPDES program (e.g., facilities that report quarterly or biannually). Use the facility-specific permit data for less frequent reporting periods. Refer to Section C.5 for additional details.

C.3.4 High-End Daily Indirect Discharges

In general, EPA is unlikely to have detailed information to estimate high-end daily indirect discharges to POTWs or non-POTW WWT plants and will only be able to calculate average daily discharges. However, in some cases, EPA may have site-specific information that allows for the estimation of a range for the release days per year (e.g., such information can be found in ECHO). In such instances, EPA can calculate the high-end daily discharge as the annual discharge divided by the minimum number of release days per year.

C.3.5 1-Day Discharges

Facilities required to report under the NPDES may sometimes be required to report a daily maximum discharge concentration for the period. These values can be used to estimate 1-day discharges by multiplying the maximum daily concentration by the corresponding month's maximum daily wastewater flow rate.

C.4 Trends in Wastewater Discharge Data – 5 Year Data Characterization

Wastewater discharge data may vary from year to year for a facility due to factors including the

economy. A trend of the releases from each facility can be used to characterize results and develop a range of potential discharges from each site. A 5-year period will be used for this analysis. Prior to calculating the 5-year statistics, it is recommended that an evaluation be done of whether the 5-year range includes any outlier years and remove them from the analysis to ensure no atypical years are being included in the statistics. The interquartile rule for outliers can be used for this analysis.

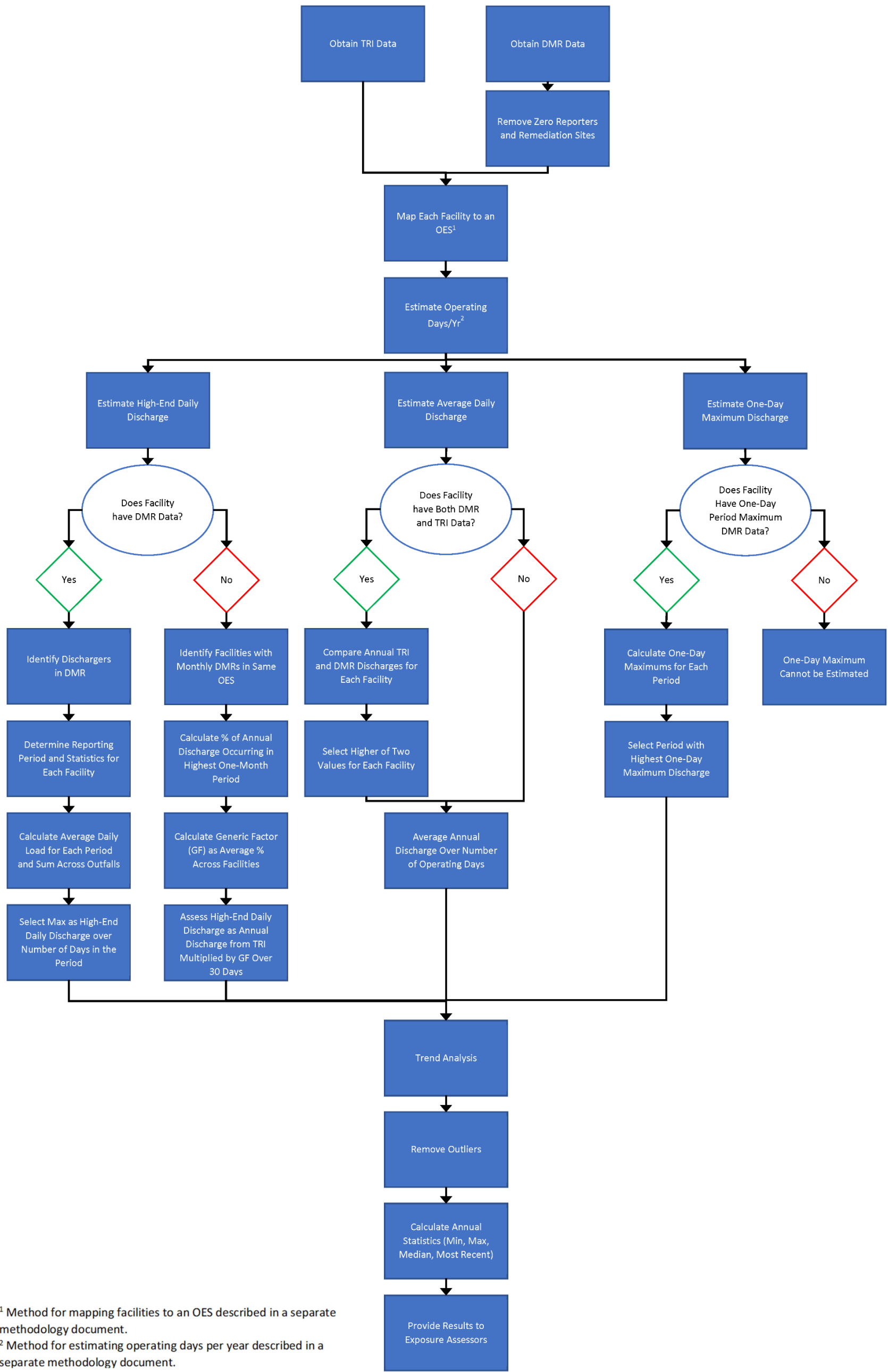
The interquartile rule for outliers states that if the distance between a data point and the first or third quartile is greater than 1.5 times the interquartile range (IQR), the data point is an outlier. The IQR is the difference between the third quartile (*i.e.*, 75th percentile) and first quartile (*i.e.*, 25th percentile) of a dataset. Therefore, any values less than 25th percentile minus 1.5 IQR or values exceeding the 75th percentile plus 1.5 IQR would be considered outliers.

After any outliers are removed, the following 5-year statistics should be determined for each facility:

1. minimum, maximum, median, and most recent (if different than the maximum) annual discharge;
2. minimum, maximum, median, and most recent (if different than the maximum) average chronic daily discharge;
3. minimum, maximum, median, and most recent (if different than the maximum) high-end chronic daily discharge; and
4. minimum, maximum, median, and most recent (if different than the maximum) acute 1-day discharge.

C.4.1 Decision Tree for DMR and TRI Wastewater Discharge Estimates

A Decision Tree for Wastewater Discharge Estimates Using TRI and/or DMR Data, provided as Figure_Apx C-1 below, helps visualize the process for estimating daily discharges.



Figure_Apx C-1. Decision Tree for Wastewater Discharge Estimates Using TRI and DMR Data

C.5 Example Facilities

This section illustrates how to calculate both high-end and average daily discharges for situations where a facility has both TRI and DMR data and where a facility only has TRI data. It also includes calculations for 1-day daily discharges from DMR data. The examples provided are for two facilities reporting for the pollutant 1,2-dichloroethane (“1,2-DCA”):

1. Westlake Vinyls in Calvert City, Kentucky – reports both DMR and TRI; and
2. Axiall LLC in Plaquemine, Louisiana – reports to TRI only.

For purposes of this example, only a single year for each database is presented.

Obtaining DMR Data

DMR data can be obtained through multiple methods; however, this method focuses on a single approach for simplicity. To query the loading tool for all pollutant data, the user should go to the following webpage: <https://echo.epa.gov/trends/loading-tool/get-data/custom-search> (accessed August 11, 2025), select the reporting year of interest and then enter a chemical CAS number as shown in Figure_Apx C-2.

Reporting Year 2019 ▼ Select reporting year

▼ Search Criteria

Facility Location

State
Select a State ▼

County
Select a State ▼

City
[Text Field]

ZIP Code (5-Digit)
[Text Field]

EPA Region (View EPA Regional Map)
Select an EPA Region ▼

Facility Latitude [Text Field] Facility Longitude [Text Field]

Radius (miles)
[Text Field] miles

Facility Outfall/Monitoring Locations

Permit Feature ID (outfall/pipe number)
[Text Field]

Monitoring Location Code
[Text Field]

Receiving Watershed

Hydrologic Units
HUC Region [Text Field]

Facility Characteristics

Facility Name
[Text Field]

Facility ID (NPDES, FRS, TRI, or CWNS)
[Text Field]

☐ Only include facilities that link to TRI ID(s)

Major/Non-Major Designation ☒ Any ☐ Major ☐ Non-Major

Permit Type
Select a Permit Type ▼

Facility Type
Select a Facility Type ▼

Treatment Technologies CWNS Data Dictionary
Select a Treatment Category ▼

Limit to facilities where technology is ☐ Present ☐ Not Present

☐ Facilities with an approved pretreatment program

☐ Facilities with one or more CSO outfalls

☐ Pesticide-producing establishments regulated under FIFRA

☐ Abandoned, inactive, or uncontrolled hazardous waste sites

☐ Facilities subject to SPCC/FRP to prevent and respond to oil spills

☐ Facilities with intermittent discharges

Pollutant

Chemical Abstract Service (CAS) Number
107062

Enter CAS number

Figure_Apx C-2. Loading Tool – Data Query

After clicking submit, the Loading Tool will present a list of data elements that can be selected or

deselected for the query. By default, all data elements will be selected and for this methodology, it is suggested to leave that unchanged to ensure all relevant data fields are downloaded. The user should then click “download,” as shown in Figure_Apx C-3. This will provide an Excel spreadsheet with all the facilities that are required to monitor for the pollutant for the selected year and their annual discharge calculated by the Loading Tool.

Data Elements

Select All

Deselect All

Basic Record Information – Required Fields

☐ Period: Year or Monitoring Date

☐ NPDES Permit Number

☐ Facility Name

Facility Information

☒ SIC Code

☒ NAICS Code

☒ FRS ID

☒ TRI ID(s)

☒ CWNS ID(s)

☒ Facility Type Indicator

☒ Permit Type

☒ Permit Effective Date

☒ Permit Expiration Date

☒ Street Address

☒ City

☒ State

☒ ZIP Code

☒ County

☒ EPA Region

☒ Congressional District

☒ Facility Latitude

☒ Facility Longitude

☒ Major/Non-Major Status

☒ 12-Digit WBD HUC (FRS Derived))

☒ WBD Subwatershed Name

☒ State Water Body Name (ICIS)

☒ Reach Code

☒ Listed for Impairment (ATTAINS)

☒ Impairment Class (ATTAINS)

☒ Number of Combined Sewer Overflow (CSO) Outfalls

☒ Total Facility Design Flow (MGD)

☒ Actual Average Facility Flow (MGD)

Discharge Identification Information

☐ Outfall Number

☐ Monitoring Location Code

☒ Permit Feature Latitude

☒ Permit Feature Longitude

☐ Parameter Code

☐ Parameter Description

☒ CAS Number

☒ Toxic Weighting Factor (TWF)

☒ Substance Registry System (SRS) ID

Permit and DMR Data

☒ Limit Quantity 1 (Avg, kg/day)

☒ Limit Quantity 2 (Max, kg/day)

☒ Limit Concentration 1 (Min, mg/L)

☒ Limit Concentration 2 (Avg, mg/L)

☒ Limit Concentration 3 (Max, mg/L)

Pollutant Loadings Data

☒ Pollutant Load (kg/yr)

☒ Max Allowable Load (kg/yr)

☒ Wastewater Flow (MGal/day)

☒ Average Daily Load (kg/day)

☒ Average Concentration (mg/L)

☒ Average Daily Flow (MGD)

☒ Average Wastewater Temp (°F)

☒ Average Wastewater pH

☒ Load Over Limit (Option 1) (kg/yr)

☒ Load Over Limit (Option 2) (kg/yr)

☐ Includes Non-detects

☐ Estimation Factor

☐ Potential Outlier

TRI Release Data

☒ Chemical Name

☒ TRI Direct Release

☒ TRI Indirect Release

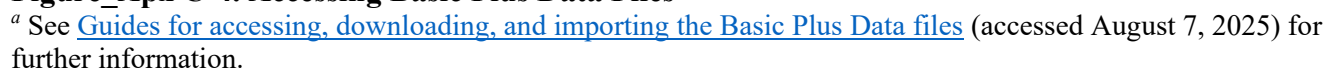
Download

New Search

Download data

Figure_Apx C-3. Loading Tool – Download Facility Discharges from Query Results

TRI data is available in several formats with various levels of detail depending on the type of information a user intends to use. For this analysis, the “Basic Plus Data Files” were used. This data can be obtained by going to the following website: <https://www.epa.gov/toxics-release-inventory-tri-program/tri-data-and-tools> (accessed August 11, 2025), selecting “Basic Plus Data Files,” then “Go” as shown in Figure Apx C-4.

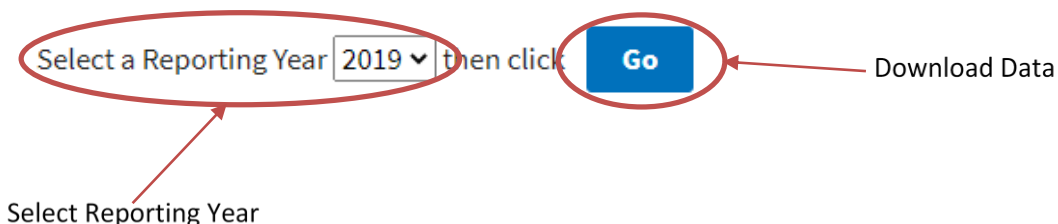


The subsequent webpage can then be used to select the reporting year of interest and download the data files as shown in Figure_Apx C-5. This will provide a zip file containing multiple tab-delimited.txt files, which can be imported into Excel Spreadsheets and contain all the 2019 TRI data for all chemicals, including annual direct and indirect wastewater discharges. The files can then be filtered for the

chemical of interest and facilities with non-zero discharges.²³ Table_Apx C-1 provides a list of key data fields and from which Basic Plus data file they can be obtained.

The ten file types of Basic Plus data files are:

- 1a: Facility, chemical, releases and other waste management summary information
- 1b: Chemical activities and uses
- 2a: On- and off-site disposal, energy recovery, recycling and treatment; non-production-related waste quantities; production/activity ratio; source reduction activities
- 2b: Detailed on-site waste treatment methods and efficiency
- 3a: Transfers off site for disposal and further waste management
- 3b: Transfers to Publicly Owned Treatment Works (POTWs) Reporting Years 1987 thru 2011
- 3c: Transfers to Publicly Owned Treatment Works (POTWs) Reporting Years 2012 and Later
- 4: Facility information
- 5: Optional information on source reduction, recycling and pollution control
- 6: Additional miscellaneous and optional information



Figure_Apx C-5. TRI – Downloading Basic Data Plus Files

²³ Facilities using a Form A rather than a Form R to report to TRI do not report any release information; therefore, the wastewater discharges for these facilities will be shown as “0” in the TRI data files. However, these may not be true zero discharges. Discharges from these facilities may need to be estimated separately and is outside the scope of this draft TSD.

13076 **Table Apx C-1. List of Key Data Fields from TRI Basic Plus Data**

TRI Basic Plus Data File	Field Name
US_1a_[Year]	1. FORM TYPE
US_1a_[Year]	2. REPORTING YEAR
US_1a_[Year]	9. TRIFD
US_1a_[Year]	10. FACILITY NAME
US_1a_[Year]	11. FACILITY STREET
US_1a_[Year]	12. FACILITY CITY
US_1a_[Year]	13. FACILITY COUNTY
US_1a_[Year]	14. FACILITY STATE
US_1a_[Year]	15. FACILITY ZIP CODE
US_1a_[Year]	41. PRIMARY NAICS CODE
US_1a_[Year]	47. LATITUDE
US_1a_[Year]	48. LONGITUDE
US_1a_[Year]	74. FRS FACILITY ID
US_1a_[Year]	76. CAS NUMBER
US_1a_[Year]	77. CHEMICAL NAME
US_1a_[Year]	81. UNIT OF MEASURE
US_1a_[Year]	112. DISCHARGES TO STREAM A – STREAM NAME
US_1a_[Year]	113. DISCHARGES TO STREAM A – RELEASE POUNDS
US_1a_[Year]	114. DISCHARGES TO STREAM A – RELEASE RANGE CODE
US_1a_[Year]	115. TOTAL DISCHARGES TO STREAM A
US_1a_[Year]	116. DISCHARGES TO STREAM A – BASIS OF ESTIMATE
US_1a_[Year]	117. DISCHARGES TO STREAM A – % FROM STORMWATER
US_1a_[Year]	118. DISCHARGES TO STREAM B – STREAM NAME
US_1a_[Year]	119. DISCHARGES TO STREAM B – RELEASE POUNDS
US_1a_[Year]	120. DISCHARGES TO STREAM B – RELEASE RANGE CODE
US_1a_[Year]	121. TOTAL DISCHARGES TO STREAM B
US_1a_[Year]	122. DISCHARGES TO STREAM B – BASIS OF ESTIMATE
US_1a_[Year]	123. DISCHARGES TO STREAM B – % FROM STORMWATER
US_1a_[Year]	124. DISCHARGES TO STREAM C – STREAM NAME
US_1a_[Year]	125. DISCHARGES TO STREAM C – RELEASE POUNDS
US_1a_[Year]	126. DISCHARGES TO STREAM C – RELEASE RANGE CODE
US_1a_[Year]	127. TOTAL DISCHARGES TO STREAM C
US_1a_[Year]	128. DISCHARGES TO STREAM C – BASIS OF ESTIMATE
US_1a_[Year]	129. DISCHARGES TO STREAM C – % FROM STORMWATER
US_1a_[Year]	130. DISCHARGES TO STREAM D – STREAM NAME
US_1a_[Year]	131. DISCHARGES TO STREAM D – RELEASE POUNDS
US_1a_[Year]	132. DISCHARGES TO STREAM D – RELEASE RANGE CODE

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TRI Basic Plus Data File	Field Name
US_1a_[Year]	133. TOTAL DISCHARGES TO STREAM D
US_1a_[Year]	134. DISCHARGES TO STREAM D – BASIS OF ESTIMATE
US_1a_[Year]	135. DISCHARGES TO STREAM D – % FROM STORMWATER
US_1a_[Year]	136. DISCHARGES TO STREAM E – STREAM NAME
US_1a_[Year]	137. DISCHARGES TO STREAM E – RELEASE POUNDS
US_1a_[Year]	138. DISCHARGES TO STREAM E – RELEASE RANGE CODE
US_1a_[Year]	139. TOTAL DISCHARGES TO STREAM E
US_1a_[Year]	140. DISCHARGES TO STREAM E – BASIS OF ESTIMATE
US_1a_[Year]	141. DISCHARGES TO STREAM E – % FROM STORMWATER
US_1a_[Year]	142. DISCHARGES TO STREAM F – STREAM NAME
US_1a_[Year]	143. DISCHARGES TO STREAM F – RELEASE POUNDS
US_1a_[Year]	144. DISCHARGES TO STREAM F – RELEASE RANGE CODE
US_1a_[Year]	145 TOTAL DISCHARGES TO STREAM F
US_1a_[Year]	146 DISCHARGES TO STREAM F – BASIS FOR ESTIMATE
US_1a_[Year]	147. DISCHARGES TO STREAM F – % FROM STORMWATER
US_1a_[Year]	148. DISCHARGES TO STREAM G – STREAM NAME
US_1a_[Year]	149. DISCHARGES TO STREAM G – RELEASE POUNDS
US_1a_[Year]	150. DISCHARGES TO STREAM G – RELEASE RANGE CODE
US_1a_[Year]	151. TOTAL DISCHARGES TO STREAM G
US_1a_[Year]	152. DISCHARGES TO STREAM G – BASIS FOR ESTIMATE
US_1a_[Year]	153. DISCHARGES TO STREAM G – % FROM STORMWATER
US_1a_[Year]	154. DISCHARGES TO STREAM H – STREAM NAME
US_1a_[Year]	155. DISCHARGES TO STREAM H – RELEASE POUNDS
US_1a_[Year]	156. DISCHARGES TO STREAM H – RELEASE RANGE CODE
US_1a_[Year]	157. TOTAL DISCHARGES TO STREAM H
US_1a_[Year]	158. DISCHARGES TO STREAM H – BASIS FOR ESTIMATE
US_1a_[Year]	159. DISCHARGES TO STREAM H – % FROM STORMWATER
US_1a_[Year]	160. DISCHARGES TO STREAM I – STREAM NAME
US_1a_[Year]	161. DISCHARGES TO STREAM I – RELEASE POUNDS
US_1a_[Year]	162. DISCHARGES TO STREAM I – RELEASE RANGE CODE
US_1a_[Year]	163. TOTAL DISCHARGES TO STREAM I
US_1a_[Year]	164. DISCHARGES TO STREAM I – BASIS FOR ESTIMATE
US_1a_[Year]	165. DISCHARGES TO STREAM I – % FROM STORMWATER
US_1a_[Year]	166. TOTAL NUMBER OF RECEIVING STREAMS
US_1a_[Year]	167. TOTAL SURFACE WATER DISCHARGE
US_1a_[Year]	217. OFF-SITE – POTW RELEASES 81C
US_1a_[Year]	218. OFF-SITE – POTW RELEASES 81D
US_1a_[Year]	219. OFF-SITE – POTW RELEASES

TRI Basic Plus Data File	Field Name
US_1a_[Year]	222. OFF-SITE – WASTEWATER TREATMENT RELEASE (EXCLUDING POTWs) – METALS AND METAL COMPOUNDS ONLY
US_1a_[Year]	224. OFF-SITE – WASTEWATER TREATMENT (EXCLUDING POTWS) METALS AND METAL COMPOUNDS ONLY
US_1a_[Year]	249. OFF-SITE – POTW TREATMENT
US_1a_[Year]	253. OFF-SITE – WASTEWATER TREATMENT (EXCLUDING POTWs) – NON-METALS ONLY
US_1a_[Year]	259. TOTAL POTW TRANSFER
US_1b_[Year]	1. FORM TYPE
US_1b_[Year]	2. REPORTING YEAR
US_1b_[Year]	3. TRADE SECRET INDICATOR
US_1b_[Year]	4. SANITIZED INDICATOR
US_1b_[Year]	5. TITLE OF CERTIFYING OFFICIAL
US_1b_[Year]	6. NAME OF CERTIFYING OFFICIAL
US_1b_[Year]	7. CERTIFYING OFFICIAL’S SIGNATURE INDICATOR
US_1b_[Year]	8. DATE SIGNED
US_1b_[Year]	9. TRIFD
US_1b_[Year]	10. FACILITY NAME
US_1b_[Year]	11. FACILITY STREET
US_1b_[Year]	12. FACILITY CITY
US_1b_[Year]	13. FACILITY COUNTY
US_1b_[Year]	14. FACILITY STATE
US_1b_[Year]	15. FACILITY ZIP CODE
US_1b_[Year]	16. BIA CODE
US_1b_[Year]	17. TRIBE NAME
US_1b_[Year]	18. MAILING NAME
US_1b_[Year]	19. MAILING STREET
US_1b_[Year]	20. MAILING CITY
US_1b_[Year]	21. MAILING STATE
US_1b_[Year]	22. MAILING PROVINCE
US_1b_[Year]	23. MAILING ZIP CODE
US_1b_[Year]	24. ENTIRE FACILITY IND
US_1b_[Year]	25. PARTIAL FACILITY IND
US_1b_[Year]	26. FEDERAL FACILITY IND
US_1b_[Year]	27. GOCO FACILITY IND
US_1b_[Year]	28. ASSIGNED FED FACILITY FLAG
US_1b_[Year]	29. ASSIGNED PARTIAL FACILITY FLAG
US_1b_[Year]	30. PUBLIC CONTACT NAME

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TRI Basic Plus Data File	Field Name
US_1b_[Year]	31. PUBLIC CONTACT PHONE
US_1b_[Year]	32. PUBLIC CONTACT PHONE EXT
US_1b_[Year]	33. PUBLIC CONTACT EMAIL
US_1b_[Year]	34. PRIMARY SIC CODE
US_1b_[Year]	35. SIC CODE 2
US_1b_[Year]	36. SIC CODE 3
US_1b_[Year]	37. SIC CODE 4
US_1b_[Year]	38. SIC CODE 5
US_1b_[Year]	39. SIC CODE 6
US_1b_[Year]	40. NAICS ORIGIN
US_1b_[Year]	41. PRIMARY NAICS CODE
US_1b_[Year]	42. NAICS CODE 2
US_1b_[Year]	43. NAICS CODE 3
US_1b_[Year]	44. NAICS CODE 4
US_1b_[Year]	45. NAICS CODE 5
US_1b_[Year]	46. NAICS CODE 6
US_1b_[Year]	47. LATITUDE
US_1b_[Year]	48. LONGITUDE
US_1b_[Year]	49. D and B NR A
US_1b_[Year]	50. D and B NR B
US_1b_[Year]	51. RCRA NR A
US_1b_[Year]	52. RCRA NR B
US_1b_[Year]	53. RCRA NR C
US_1b_[Year]	54. RCRA NR D
US_1b_[Year]	55. RCRA NR E
US_1b_[Year]	56. RCRA NR F
US_1b_[Year]	57. RCRA NR G
US_1b_[Year]	58. RCRA NR H
US_1b_[Year]	59. RCRA NR I
US_1b_[Year]	60. RCRA NR J
US_1b_[Year]	61. NPDES NR A
US_1b_[Year]	62. NPDES NR B
US_1b_[Year]	63. NPDES NR C
US_1b_[Year]	64. NPDES NR D
US_1b_[Year]	65. NPDES NR E
US_1b_[Year]	66. NPDES NR F
US_1b_[Year]	67. NPDES NR G
US_1b_[Year]	68. NPDES NR H

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TRI Basic Plus Data File	Field Name
US_1b_[Year]	69. NPDES NR I
US_1b_[Year]	70. NPDES NR J
US_1b_[Year]	71. PARENT COMPANY NAME
US_1b_[Year]	72. PARENT COMPANY D and B NR
US_1b_[Year]	73. STANDARDIZED PARENT COMPANY NAME
US_1b_[Year]	74. FRS FACILITY ID
US_1b_[Year]	75. DOCUMENT CONTROL NUMBER
US_1b_[Year]	76. CAS NUMBER
US_1b_[Year]	77. CHEMICAL NAME
US_1b_[Year]	78. MIXTURE NAME
US_1b_[Year]	79. ELEMENTAL METAL INCLUDED
US_1b_[Year]	80. CLASSIFICATION
US_1b_[Year]	81. UNIT OF MEASURE
US_1b_[Year]	82. METAL IND
US_1b_[Year]	83. REVISION CODE 1
US_1b_[Year]	84. REVISION CODE 2
US_1b_[Year]	85. PRODUCE THE CHEMICAL
US_1b_[Year]	86. IMPORT THE CHEMICAL
US_1b_[Year]	87. ON-SITE USE OF THE CHEMICAL
US_1b_[Year]	88. SALE OR DISTRIBUTION OF THE CHEMICAL
US_1b_[Year]	89. AS A BYPRODUCT
US_1b_[Year]	90. AS A MANUFACTURED IMPURITY
US_1b_[Year]	91. USED AS A REACTANT
US_1b_[Year]	92. P101 FEEDSTOCKS
US_1b_[Year]	93. P102 RAW MATERIALS
US_1b_[Year]	94. P103 INTERMEDIATES
US_1b_[Year]	95. P104 INITIATORS
US_1b_[Year]	96. P199 OTHER
US_1b_[Year]	97. ADDED AS A FORMULATION COMPONENT
US_1b_[Year]	98. P201 ADDITIVES
US_1b_[Year]	99. P202 DYES
US_1b_[Year]	100. P203 REACTION DILUENTS
US_1b_[Year]	101. P204 INITIATORS
US_1b_[Year]	102. P205 SOLVENTS
US_1b_[Year]	103. P206 INHIBITORS
US_1b_[Year]	104. P207 EMULSIFIERS
US_1b_[Year]	105. P208 SURFACTANTS
US_1b_[Year]	106. P209 LUBRICANTS

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TRI Basic Plus Data File	Field Name
US_1b_[Year]	107. P210 FLAME RETARDANTS
US_1b_[Year]	108. P211 RHEOLOGICAL MODIFIERS
US_1b_[Year]	109. P299 OTHER
US_1b_[Year]	110. USED AS AN ARTICLE COMPONENT
US_1b_[Year]	111. REPACKAGING
US_1b_[Year]	112. AS A PROCESS IMPURITY
US_1b_[Year]	113. PROCESSED / RECYCLING
US_1b_[Year]	114. USED AS A CHEMICAL PROCESSING AID
US_1b_[Year]	115. Z101 PROCESS SOLVENTS
US_1b_[Year]	116. Z102 CATALYSTS
US_1b_[Year]	117. Z103 INHIBITORS
US_1b_[Year]	118. Z104 INITIATORS
US_1b_[Year]	119. Z105 REACTION TERMINATORS
US_1b_[Year]	120. Z106 SOLUTION BUFFERS
US_1b_[Year]	121. Z199 OTHER
US_1b_[Year]	122. USED AS A MANUFACTURING AID
US_1b_[Year]	123. Z201 PROCESS LUBRICANTS
US_1b_[Year]	124. Z202 METALWORKING FLUIDS
US_1b_[Year]	125. Z203 COOLANTS
US_1b_[Year]	126. Z204 REFRIGERANTS
US_1b_[Year]	127. Z205 HYDRAULIC FLUIDS
US_1b_[Year]	128. Z299 OTHER
US_1b_[Year]	129. ANCILLARY OR OTHER USE
US_1b_[Year]	130. Z301 CLEANER
US_1b_[Year]	131. Z302 DEGREASER
US_1b_[Year]	132. Z303 LUBRICANT
US_1b_[Year]	133. Z304 FUEL
US_1b_[Year]	134. Z305 FLAME RETARDANT
US_1b_[Year]	135. Z306 WASTE TREATMENT
US_1b_[Year]	136. Z307 WATER TREATMENT
US_1b_[Year]	137. Z308 CONSTRUCTION MATERIALS
US_1b_[Year]	138. Z399 OTHER
US_3c_[Year]	1. FORM TYPE
US_3c_[Year]	2. TRIFID
US_3c_[Year]	3. DOCUMENT CONTROL NUMBER
US_3c_[Year]	4. CAS NUMBER
US_3c_[Year]	5. CHEMICAL NAME
US_3c_[Year]	7. MIXTURE NAME

TRI Basic Plus Data File	Field Name
US_3c_[Year]	6. ELEMENTAL METAL INCLUDED
US_3c_[Year]	8. CLASSIFICATION
US_3c_[Year]	9. UNIT OF MEASURE
US_3c_[Year]	10. METAL INDICATOR
US_3c_[Year]	11. REVISION CODE 1
US_3c_[Year]	12. REVISION CODE 2
US_3c_[Year]	13. REPORTING YEAR
US_3c_[Year]	14. TRADE SECRET INDICATOR
US_3c_[Year]	15. FACILITY NAME
US_3c_[Year]	16. FACILITY STREET
US_3c_[Year]	17. FACILITY CITY
US_3c_[Year]	18. FACILITY COUNTY
US_3c_[Year]	19. FACILITY STATE
US_3c_[Year]	20. FACILITY ZIP CODE
US_3c_[Year]	21. ASSIGNED FED FACILITY FLAG
US_3c_[Year]	22. ASSIGNED PARTIAL FACILITY FLAG
US_3c_[Year]	23. BIA CODE
US_3c_[Year]	24. TRIBE NAME
US_3c_[Year]	25. ENTIRE FACILITY IND
US_3c_[Year]	26. PARTIAL FACILITY IND
US_3c_[Year]	27. FEDERAL FACILITY IND
US_3c_[Year]	28. GOCO FACILITY IND
US_3c_[Year]	29. PUBLIC CONTACT NAME
US_3c_[Year]	30. PUBLIC CONTACT PHONE
US_3c_[Year]	31. PUBLIC CONTACT PHONE EXT
US_3c_[Year]	32. PUBLIC CONTACT EMAIL
US_3c_[Year]	33. PRIMARY SIC CODE
US_3c_[Year]	34. SIC CODE 2
US_3c_[Year]	35. SIC CODE 3
US_3c_[Year]	36. SIC CODE 4
US_3c_[Year]	37. SIC CODE 5
US_3c_[Year]	38. SIC CODE 6
US_3c_[Year]	39. NAICS ORIGIN
US_3c_[Year]	40. PRIMARY NAICS CODE
US_3c_[Year]	41. NAICS CODE 2
US_3c_[Year]	42. NAICS CODE 3
US_3c_[Year]	43. NAICS CODE 4
US_3c_[Year]	44. NAICS CODE 5

TRI Basic Plus Data File	Field Name
US_3c_[Year]	45. NAICS CODE 6
US_3c_[Year]	46. LATITUDE
US_3c_[Year]	47. LONGITUDE
US_3c_[Year]	48. DB NR A
US_3c_[Year]	49. DB NR B
US_3c_[Year]	50. RCRA NR A
US_3c_[Year]	51. RCRA NR B
US_3c_[Year]	52. RCRA NR C
US_3c_[Year]	53. RCRA NR D
US_3c_[Year]	54. RCRA NR E
US_3c_[Year]	55. RCRA NR F
US_3c_[Year]	56. RCRA NR G
US_3c_[Year]	57. RCRA NR H
US_3c_[Year]	58. RCRA NR I
US_3c_[Year]	59. RCRA NR J
US_3c_[Year]	60. NPDES NR A
US_3c_[Year]	61. NPDES NR B
US_3c_[Year]	62. NPDES NR C
US_3c_[Year]	63. NPDES NR D
US_3c_[Year]	64. NPDES NR E
US_3c_[Year]	65. NPDES NR F
US_3c_[Year]	66. NPDES NR G
US_3c_[Year]	67. NPDES NR H
US_3c_[Year]	68. NPDES NR I
US_3c_[Year]	69. NPDES NR J
US_3c_[Year]	70. PARENT COMPANY NAME
US_3c_[Year]	71. PARENT COMPANY DB NR
US_3c_[Year]	72. STANDARDIZED PARENT COMPANY NAME
US_3c_[Year]	73. FRS FACILITY ID
US_3c_[Year]	74. POTW NAME
US_3c_[Year]	75. POTW ADDRESS
US_3c_[Year]	76. POTW CITY
US_3c_[Year]	77. POTW STATE
US_3c_[Year]	78. POTW COUNTY
US_3c_[Year]	79. POTW ZIP
US_3c_[Year]	80. POTW REGISTRY ID
US_3c_[Year]	81. QUANTITY TRANSFERRED
US_3c_[Year]	82. BASIS OF ESTIMATE

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TRI Basic Plus Data File	Field Name
US_3c_[Year]	83. DISCHARGES TO WATER STREAMS
US_3c_[Year]	84. DISCHARGES TO WATER STREAMS – BASIS OF ESTIMATE
US_3c_[Year]	85. DISCHARGES TO OTHER ACTIVITIES
US_3c_[Year]	86. DISCHARGES TO OTHER ACTIVITIES – BASIS OF ESTIMATE
US_3c_[Year]	87. RELEASED TO AIR
US_3c_[Year]	88. RELEASED TO AIR – BASIS OF ESTIMATE
US_3c_[Year]	89. SLUDGE TO DISPOSAL
US_3c_[Year]	90. SLUDGE TO DISPOSAL – BASIS OF ESTIMATE
US_3c_[Year]	91. SLUDGE TO INCINERATION – METALS
US_3c_[Year]	92. SLUDGE TO INCINERATION – METALS – BASIS OF ESTIMATE
US_3c_[Year]	93. SLUDGE TO AGRICULTURAL APPLICATIONS
US_3c_[Year]	94. SLUDGE TO AGRICULTURAL APPLICATIONS – BASIS OF ESTIMATE
US_3c_[Year]	95. OTHER OR UNKNOWN DISPOSAL
US_3c_[Year]	96. OTHER OR UNKNOWN DISPOSAL – BASIS OF ESTIMATE
US_3c_[Year]	97. OFF-SITE POTW RELEASES – 8.1C
US_3c_[Year]	98. OFF-SITE POTW RELEASES – 8.1D
US_3c_[Year]	99. OFF-SITE – POTW RELEASES
US_3c_[Year]	100. OTHER OR UNKNOWN TREATMENT
US_3c_[Year]	101. OTHER OR UNKNOWN TREATMENT – BASIS OF ESTIMATE
US_3c_[Year]	102. SLUDGE TO INCINERATION – NONMETALS
US_3c_[Year]	103. SLUDGE TO INCINERATION – NONMETALS – BASIS OF ESTIMATE
US_3c_[Year]	104. EXPERIMENTAL AND ESTIMATED TREATMENT
US_3c_[Year]	105. EXPERIMENTAL AND ESTIMATED TREATMENT – BASIS OF ESTIMATE
US_3c_[Year]	106. TOTAL TREATED

Mapping Facilities to an OES and Selecting the Number of Operating Days per Year

Both facilities used in this example reported to the 2016 CDR as domestic manufacturers of 1,2-dichloroethane. Therefore, they are mapped to the manufacturing OES. Because 1,2-dichloroethane is a commodity chemical, each facility is assumed to operate 350 days/year.

Annual Facility Discharges

Annual facility discharges can be obtained directly from the Loading Tool and TRI data file downloads for each facility. The 2019 annual discharges for the two facilities in this example are provided in Table_Apx C-2.

Table_Apx C-2. Example Facilities' 2019 Annual Discharges

Facility	Annual Surface Water Discharge from Loading Tool (kg)	Annual Reported Discharge from TRI (kg)
Westlake Vinyls in Calvert City, KY	209 kg ^a	212 kg to surface water 0 kg to POTW and non-POTW WWT
Axiall LLC in Plaquemine, LA	N/A – No DMR data for this facility	10 kg to surface water 0 kg to POTW and non-POTW WWT
POTW = publicly owned treatment works; TRI = Toxics Release Inventory; WWT = wastewater treatment ^a The Loading Tool estimates this discharge a 495 lb (or 224 kg) as the sum of outfalls 001, 002, and 009. However, the NPDES permit for this facility indicates that 002 and 009 are internal outfalls that discharge into 001. Therefore, discharges from 001 includes those from 002 and 009 and the total annual discharge shown in the table is equal to the Loading Tool's estimate for outfall 001 only (461 lb or 209 kg). Review of NPDES permits is generally outside the scope of this methodology document; however, permit information for Westlake Vinyls can be obtained at https://dep.gateway.ky.gov/eSearch/agencydetails?agencyid=2967http://dep.gateway.ky.gov/eSearch/search_ai_detail.aspx?AgencyID=2967 (accessed August 11, 2025).		

Average Daily Discharges

To calculate average daily discharges at each facility, the annual discharge is averaged over the number of operating as shown in the calculations below:

Equation_Apx C-1.

$$ADR = \frac{YR}{OD}$$

Where:

$$\begin{aligned} ADR &= \text{Average daily discharge (kg/day)} \\ YR &= \text{Annual discharge (kg/year)} \\ OD &= \text{Operating days (days/year)} \end{aligned}$$

For Westlake Vinyls the annual discharge of 209 kg/year is averaged over 350 days/year (operating days for manufacturers) to calculate the daily discharge using DMR as:

Equation_Apx C-2.

$$ADR = \frac{YR}{OD} = \frac{209 \text{ kg/yr}}{350 \text{ days/yr}} = 0.6 \text{ kg/day}$$

Similarly, for Westlake Vinyls the average daily discharge using TRI is calculated as the 212 kg/year annual discharge over 350 days/year, as shown below:

Equation_Apx C-3.

$$ADR = \frac{YR}{OD} = \frac{212 \text{ kg/yr}}{350 \text{ days/yr}} = 0.6 \text{ kg/day}$$

For Axiall LLC, the average daily discharge is calculated as the annual discharge of 10 kg/year over 350 days/year:

Equation_Apx C-4.

$$ADR = \frac{YR}{OD} = \frac{10 \text{ kg/yr}}{350 \text{ days/yr}} = 0.03 \text{ kg/day}$$

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High-End Daily Discharges for Facilities with DMRs

To estimate high-end daily discharge for sites with DMRs, the reporting frequency and pollutant load for each reporting period throughout the year must be determined. This information can be obtained from the Loading Tool by going to the “Top Facility Discharges” table in the query results and clicking on the desired facility name as shown in Figure_Apx C-6.²⁴ This will open the details of the facility’s DMR.

Select facility of interest

Top Facility Discharges (2019)										
NPDES ID	Facility Name	City, State	Report	SIC Code	HUC-12 Code	Avg Conc (mg/L)	Max Conc (mg/L)	Total Pounds (lb/yr)	Total TWPE (lb-eq/yr)	Avg Flow (MGD)
KY0003484	WESTLAKE VINYL	CALVERT CITY, KY	LE CP	2812	060400060502	0.0191	0.2320	495	4.95	1.68
MI0000868	DOW CHEMICAL-MIDLAND	MIDLAND, MI	LE CP	2869	040802010604	0.0019	0.0167	415	4.15	5.52
TX0085570	FORMOSA PLASTICS CORPORATION, TEXAS	POINT COMFORT, TX	LE CP	2821	121004010100	0.0008	0.0445	244	2.44	19.92
LA0002933	OCCIDENTAL CHEMICAL CORP GEISMAR PLANT	GEISMAR, LA	LE CP	2869	080702040101	0.0029	0.0351	164	1.64	0.9016
TX0007412	OXY VINYL LP - DEER PARK PVC	DEER PARK, TX	LE CP	2812	120401040703	0.0076	0.0320	143	1.43	4.27
KY0003603	ARKEMA INC	CALVERT CITY, KY	LE CP	2819	060400060502	0.0083	0.0192	137	1.37	0.9300
LA0000761	EAGLE US 2 LLC - LAKE CHARLES COMPLEX	LAKE CHARLES, LA	LE CP	2869	080802060301	0.1138	0.3830	78.97	0.7897	40.72
LA0000281	WESTLAKE VINYL CO	GEISMAR, LA	LE CP	2869	080702040103	0.0020	0.0097	25.74	0.2574	0.8815
KY0023540	CENTRAL CITY STP	CENTRAL CITY, KY	LE CP	4952	051100030505	0.0050	0.0050	25.01	0.2501	1.28
NJ0005100	CHEMOURS CHAMBERS WORKS	DEEPWATER, NJ	LE CP	2869	020402060103	0.0017	0.0066	22.87	0.2287	3.67

Download All Data Browse All Facilities

Figure_Apx C-6. Loading Tool – Accessing Facility-Specific Data

From the facility’s DMR, the user can select the “View Permit Limits and Monitoring Requirements” to determine the reporting frequency and the “View NPDES Monitoring Data Download” to obtain the facility’s DMRs for each pollutant at each outfall for each reporting period and the reporting period’s corresponding wastewater flowrate in an Excel Spreadsheet, as shown in Figure_Apx C-7 and Figure_Apx C-8.

²⁴ If the facility of interest is not listed in this table, the user can select “browse all facilities” to bring up a list of all facilities monitoring for the chemical of interest.

WESTLAKE VINYL, CALVERT CITY, 42029

NPDES ID: KY0003484
FRS ID: 110027373072
Other NPDES IDs associated with this FRS ID: None
TRI ID(s): 42029WSTLK2468I
Facility Type: NON-POTW
Permit Type: NPDES Individual Permit
Permit Effective Date: 10/01/2018
Permit Expiration Date: 09/30/2023
Major/Non-Major Indicator: Major
Permit Issuance: STATE OF KENTUCKY
Approved Pretreatment Program: N/A
Combined Sewer Overflow (CSO) Outfall: N/A
County: MARSHALL
Congressional District: Kentucky's 1st District

Latitude: 37.051111
Longitude: -88.334167
Facility Design Flow (Permit Application) (MGD): 4.65
Actual Average Facility Flow (Permit Application) (MGD): 3.83
Average Facility Flow in 2019 (MGD): 1.68
4-Digit SIC Code: 2812 - ALKALIES AND CHLORINE
6-Digit NAICS Code: --
Likely Point Source Category: 415 - Inorganic chemicals manufacturing

[View Detailed Facility Report](#)
[View Effluent Charts](#)
[View Permit Limits and Monitoring Requirements](#)
[View NPDES Monitoring Data Download](#)
[View DMR and TRI Multi-Year Loading Report](#)

Select Reporting Year: 2019 ⚠

[Top Pollutants](#) | [Facility Loading Calculations](#) ⓘ

View Permit Limits to Obtain Reporting Frequency

Download DMRs

Figure_Apx C-7. Loading Tool – Accessing Monitoring Requirements and Reporting Period Discharge Data

Select Reporting Year: 2019

Pollutant Name	Parameter Code	Permit Feature Number	Monitoring Period Date Range	Limit Set Designator	Monitoring Frequency	Limit Season ID	Limit Qty 1 (kg/day)	Limit Qty 2 (kg/day)	Limit Conc 1 (mg/L)	Limit Conc 2 (mg/L)	Limit Conc 3 (mg/L)
1,2-Dichloroethane	32103	1	10/01/2018 09/30/2023	1	monthly	0	--	--	--	monitoring only average	monitoring only maximum
1,2-Dichloroethane	32103	2	10/01/2018 09/30/2023	1	monthly	0	0.2395 average	0.7433 maximum	--	--	--
1,2-Dichloroethane	32103	9	10/01/2018 09/30/2023	1	monthly	0	1.03 average	3.28 maximum	--	--	--

Outfall Number

Reporting Frequency

Figure_Apx C-8. Loading Tool – Reviewing Facility Reporting Frequency for Each Outfall

Westlake Vinyls is required to report 1,2-dichloroethane monthly for three outfalls; however, review of Westlake Vinyl's NPDES permit indicates outfalls 002 and 009 are internal outfalls that discharge into outfall 001, and, therefore, are not included for further analysis.²⁵ For 1,2-dichloroethane, Westlake Vinyls reports a monthly average concentration and a maximum daily concentration. Westlake Vinyls must also report a monthly average wastewater flow rate and a maximum daily wastewater flow rate. The reporting period load is then calculated by multiplying the monthly average concentration by the monthly average wastewater flow and multiplying by the number of days in the period as shown in the

²⁵ Review of NPDES permits is generally outside the scope of this methodology document; however, searchable [here](#) (accessed August 11, 2025).

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equation below.

Equation_Apx C-5.

$$PR = C \times FR \times 3.785 \frac{L}{gal} \times 1 \times 10^{-6} \frac{kg}{mg} \times PD$$

Where:

PR	=	Period discharge (kg/period)
C	=	Pollutant concentration (mg/L)
FR	=	Wastewater flowrate (gal/day)
PD	=	Number of days in the period (days/period)

The results from these calculations for Westlake Vinyl for 1,2-dichloroethane in 2019 are presented in Table_Apx C-3.

Table_Apx C-3. Westlake Vinyl Total Period Discharge Results

Reporting Period End Date	Monthly Average Concentration (mg/L)	Monthly Average Wastewater Flow (MGD)	Days per Period	Period Discharge (kg/period)
01/31/2019	0.014	3.3756	31	5.5
02/28/2019	0.004	3.6760	28	1.6
03/31/2019	0.232	3.6855	31	100
04/30/2019	0.015	3.5123	30	6.0
05/31/2019	0.007	3.3281	31	2.7
06/30/2019	0.122	3.2704	30	45
07/31/2019	0.060	3.0358	31	21
08/31/2019	0.013	3.0535	31	4.7
09/30/2019	0.027	3.1075	30	9.5
10/31/2019	0.012	2.5449	31	3.6
11/30/2019	0.012	3.1966	30	4.3
12/31/2019	0.010	3.6309	31	4.3
MGD = million gallons per day				

As shown in Table_Apx the period ending March 31, 2019, has the highest total discharge for Westlake Vinyls. Using the highest period discharge, the high-end daily discharge can be calculated using the following equation:

Equation_Apx C-6.

$$HDR = \frac{MPR}{PD} = \frac{100 \text{ kg/period}}{31 \text{ day/period}} = 3.2 \text{ kg/day}$$

Equation_Apx C-7.

$$HDR = \frac{MPR}{PD} = \frac{100 \text{ kg/period}}{31 \text{ day/period}} = 3.2 \text{ kg/day}$$

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Where:

HDR = High-end daily discharge (kg/day)
 MPR = Maximum period discharge (kg/period)
 PD = Number of days in the period (days/period)

High-End Daily Discharges for Facilities Without DMRs

To estimate the high-end daily discharge for TRI facilities without DMRs, a generic factor developed using data from facilities mapped to the same OES with DMRs should be applied to the discharge from facilities without DMRs. The first step is to identify facilities with DMRs for the same chemical, same year, and same OES as the TRI facility and report DMRs monthly. For purposes of this example, only the Westlake Vinyl's facility will be considered; however, in many instances data from multiple facilities will be considered.

After identifying the relevant facility, the percentage of the total annual discharge that occurred in the highest 1-month period should be calculated using the equation below and values from Westlake Vinyls:

Equation_Apx C-8.

$$GF = \frac{MPR}{YR} = \frac{100 \text{ kg/period}}{209 \text{ kg/yr}} \times 100 = 48\%$$

Where:

GF = Generic factor (year/period)
 MPR = Maximum period discharge (kg/period)
 YR = Annual discharge (kg/year)

If multiple facilities are included in the analysis, the GF used in the next steps should be the average of the factors calculated for each facility. For this example, the factor of 48 % will be used.

To calculate the high-end daily discharge from TRI sites without DMRs, the reported annual discharge should be multiplied by the generic factor and divide by the number of days in a month (30 days) as shown in the equation below using values for Axiall LLC:

Equation_Apx C-9.

$$HDR = \frac{GF \times YR}{30 \text{ days}} = 48\% \times 10 \text{ kg} = 0.2 \text{ kg/day}$$

Where:

HDR = High-end daily discharge (kg/day)
 GF = Generic factor (unitless)
 YR = Annual discharge (kg/year)

This value is assessed over 30 days/period to approximate the high-end period of 1 month the results are based on. Note, the GF calculated in this example is based on a facility with monthly reporting periods which is the preferred method for estimating the GF and hence assesses over 30 days. *In situations* where the GF is calculated using data from facilities with longer reporting periods, the number of days should be adjusted accordingly.

1-Day Discharges

Data to estimate 1-day discharges can be obtained using a similar method as the high-end daily discharges from DMR except concentration and flowrate values reported for the daily maximum for each period should be used. The daily discharge is simply the daily maximum concentration multiplied

by the daily maximum flowrate (with proper unit conversions) as shown in the equation below.

Equation_Apx C-10.

$$ODR = C \times FR \times 3.785 \frac{L}{gal} \times 1 \times 10^{-6} \frac{kg}{mg}$$

Where:

<i>ODR</i>	=	1-Day discharge (kg/day)
<i>C</i>	=	Pollutant concentration (mg/L)
<i>FR</i>	=	Wastewater flowrate (gal/day)

The daily maximum for each period for Westlake Vinyls is provided in Table_Apx C-4

Table_Apx C-4. Westlake Vinyl 1-Day Discharges

Reporting Period End Date	Daily Maximum Concentration (mg/L)	Daily Maximum Wastewater Flow (MGD)	Period Discharge (kg/day)
01/31/2019	0.014	4.0153	0.2
02/28/2019	0.004	5.6582	0.1
03/31/2019	0.232	3.9410	3.5
04/30/2019	0.015	3.7962	0.2
05/31/2019	0.007	3.6638	0.1
06/30/2019	0.122	3.5840	1.7
07/31/2019	0.060	3.4168	0.8
08/31/2019	0.013	3.9349	0.2
09/30/2019	0.027	3.6647	0.4
10/31/2019	0.012	2.7171	0.1
11/30/2019	0.012	3.9522	0.2
12/31/2019	0.010	3.7360	0.1
MGD = million gallons per day			

Summary of Results

The detailed results from each facility are provided in the accompanying spreadsheet; however, an overview of the results for each facility are provided in Table_Apx C-5.

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Table Apx C-5. Summary of Discharge Estimates for 2019 Example Facilities

Facility	Annual Surface Water Discharge from Loading Tool (kg)	Annual Reported Discharge from TRI (kg)	Average Daily Discharge (kg/day)	Release Days for Average Daily Discharge (days/yr)	High-End Daily Discharge (kg/day)	Release Days for High-End Daily Discharge (days/period)	Maximum 1-Day Discharge (kg/day)
Westlake Vinyls in Calvert City, KY	209 kg	212 kg to surface water 0 kg to POTW and non-POTW WWT	0.6 (DMR) 0.6 (TRI)	350	3.2	31	3.5
Axiall LLC in Plaquemine, LA	N/A – No DMR data for this facility	10 kg to surface water 0 kg to POTW and non-POTW WWT	0.03	350	0.2	30	N/A – data not available to estimate 1-day discharge

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Appendix D GUIDANCE FOR USING THE NATIONAL EMISSIONS INVENTORY AND TOXIC RELEASE INVENTORY FOR ESTIMATING AIR RELEASES

This appendix provides guidance for using EPA's NEI and TRI data to estimate air releases for certain chemicals undergoing risk evaluation under TSCA. These estimates will be used as inputs to air modeling for the purposes of estimating ambient air concentrations.

D.1 Background

EPA's NEI and TRI programs require individual facilities, as well as SLT air agencies, to report information on airborne chemical releases to the Agency. Although the chemicals reported under each program differ, both inventories include data for some of the chemicals undergoing TSCA risk evaluation. When available, the NEI and TRI data include information on the sources, magnitude, and nature (e.g., stack vs. fugitive, stack height, stack gas velocity/temperature) of airborne releases from industrial/commercial facilities and other smaller emissions sources. Thus, these databases may provide useful information for estimating air releases of TRI- and/or NEI-covered chemicals, for certain OESs.

As the NEI and TRI programs operate under separate regulatory frameworks, the data reported under these programs do not always overlap. For example, in 2017, approximately 745,000 lb of perchloroethylene (PERC) air emissions were reported to TRI, whereas approximately 16.6 million lb of PERC air emissions were reported to NEI. This appendix describes an approach for using NEI data, in combination with TRI data, to estimate air emissions.

D.2 Obtaining Air Emissions Data

D.2.1 Obtaining NEI Data

NEI emissions data is categorized into (1) point source data, (2) area or nonpoint source data, (3) onroad mobile source data, and (4) nonroad mobile source data. EPA included only point source data categories in the assessment of environmental releases in this risk evaluation. Point sources are stationary sources of air emissions from facilities with operating permits under Title V of the CAA, also called "major sources." Major sources are defined as having actual or potential emissions at or above the major source thresholds. Although thresholds can vary for certain chemicals in NAAQS non-attainment areas, the default threshold is 100 tons/year for non-HAPs, 10 tons per year for a single HAP, or 25 tons per year for any combination of HAPs. Point source facilities include large energy and industrial sites and are reported at the emission unit- and release point-level.

Area or nonpoint sources are stationary sources that do not qualify as major sources. The nonpoint data are aggregated and reported at the county-level and include emissions from smaller facilities as well as agricultural emissions, construction dust, and open burning. Industrial and commercial/institutional fuel combustion, gasoline distribution, oil and gas production and extraction, publicly owned treatment works, and solvent emissions may be reported in the point or nonpoint source categories depending upon source size. EPA targeted its review of environmental releases to point sources and did not review the road, nonroad, and other automotive exhaust information identified.

Onroad mobile sources include emissions from onroad vehicles that combust liquid fuels during operation, including passenger cars, motorcycles, trucks, and buses. The nonroad mobiles sources data include emissions from other mobile sources that are not typically operated on public roadways, such as locomotives, aircraft, commercial marine vessels, recreational equipment, and landscaping equipment.

Onroad and nonroad mobile data is reported in the same format as nonpoint data; however, it is not available for every chemical. EPA did not include area or nonpoint sources in the assessment of environmental releases in this risk evaluation. Further details on EPA's approach to using NEI data for estimating releases are described in Section 4.1.2.3 and Appendix B.

The first step in using NEI data to estimate air releases is to obtain the NEI data in a workable format that provides the requisite data for release estimation and modeling. The NEI data are available on EPA's public website as downloadable zip files, divided into onroad, nonroad, nonpoint, and point source data files.²⁶ The zipped point source data files are extremely large and require specialized database experience to query and manipulate. As an alternative, EPA's EIS Gateway allows registered EPA users, registered SLT users, and approved contractors to query and download NEI data and associated reporting code descriptions. As a result, this methodology uses the EIS Gateway to query point source data. Following download, the point and nonpoint emissions data for the chemical of interest will be imported into an Excel spreadsheet (or using an alternative tool, if the data exceeds Excel's size threshold), to be filtered and manipulated. At this point, EPA will use the EIS lookup tables to populate field descriptions for data fields reported as numerical codes (*e.g.*, NAICS code).

D.2.2 Obtaining TRI Data

TRI data may be downloaded from EPA's public TRI Program, TRI Data and Tools website.²⁷ Once the .csv file(s) has (have) been downloaded, the data are filtered by the chemical of interest using the CASRN and/or chemical name. Relevant NEI data fields include reporting year, facility identifying information (*e.g.*, name, address, FRS ID, and TRIFID), chemical information (chemical name, CASRN), primary NAICS codes, fugitive air releases, and stack air releases.

D.3 Mapping NEI and TRI DATA to Occupational Exposure Scenarios

Once TRI and NEI data is obtained, the next step is to map the data to OESs. For procedures for mapping facilities from TRI and NEI to occupational exposure scenarios, refer to Appendix B.

D.4 Estimating Air Releases Using NEI and TRI Data

EPA will use the mapped NEI and TRI data to develop facility- and/or release-point-specific emissions estimates for chemicals undergoing TSCA risk evaluation. The data summary will include pertinent information for risk evaluation and emission modeling, such as facility location, annual releases, daily releases, operating information, release type (*i.e.*, stack vs. fugitive), and stack parameters.

D.4.1 Linking NEI and TRI Data

Although NEI and TRI have different reporting requirements, some major sources are expected to report to both databases. The most reliable way to link the datasets is with a common identifier. NEI reports EIS Facility Identifier and Facility Registry Identifier (FRSID), though the latter is not reliably populated for all NEI records. TRI reports TRI Facility ID and FRSID. EPA will use its database of EIS Alternate Facility Identifiers ("EISAltFacilityIdentifiers_20211221.acddb") to link TRIFID to an EIS Facility Identifier. Linkages may be confirmed and/or refined using facility names and addresses, if necessary.

Following linkage, EPA will review the linked NEI/TRI data to ensure that facilities with records in

²⁶ See <https://www.epa.gov/air-emissions-inventories/2017-national-emissions-inventory-nei-data#datas> (accessed August 11, 2025).

²⁷ See <https://www.epa.gov/toxics-release-inventory-tri-program/tri-toolbox> (accessed August 11, 2025).

both databases are assigned to a consistent OES. When discrepancies arise, EPA will resolve these discrepancies using the dataset with the greatest level of detail. In general, NEI provides more detailed air emissions data than TRI. For example, NEI reports SCC levels 1 to 4, which provide insight into the specific operations and/or process units associated with NEI-reported air emissions. For example, “Chemical Evaporation Organic Solvent Evaporation Degreasing Entire Unit: Open-top Vapor Degreasing” is a SCC description used in the NEI. This SCC description identifies the emission unit, not only as a degreaser, but as a specific type of degreaser. NEI also includes free text fields where reporters can include additional information about a particular facility and/or emission unit. TRI does not provide this level of detail.

Following a review of OES assignments, the TRI and NEI data will be divided into separate tables by OES code, which may be linked using the EIS Facility Identifier.

D.4.2 Evaluation of Sub-Annual Emissions

As air emissions data in TRI and NEI are reported as annual values, sub-annual (*e.g.*, daily) emissions must be calculated from information on release duration, release days, and release pattern. While TRI does not report information on release duration or pattern, this information may be estimated from operating data reported to the NEI.²⁸ Other sources of release duration and pattern information include GSs and ESDs, literature sources, process information, and standard engineering methodology for estimating number of release days. These sources are described in further detail below, in order of preference.

Sources for Estimating Release Duration

1. *NEI Data:* The NEI dataset includes facility-specific air emissions estimates for major sources and often includes data on the number of hours of operation per day for these facilities. The number of operating hours from NEI can be used to inform release duration for the specific facilities being assessed. Hours of operation for one facility in NEI are typically not used for a different facility; however, engineers may consider conducting an analysis of operating hours for multiple facilities in NEI that are a part of the same OES to develop a broader estimate of release duration at the OES-level. EPA has previously used this approach to inform development of GSs/ESDs, but it is dependent on the amount of data and time available and should be discussed on a chemical-specific basis.
2. *Models:* Models used to estimate air emissions and associated inhalation exposures (*e.g.*, Tank Truck and Railcar Loading and Unloading Release and Inhalation Exposure Model, Open-Top Vapor Degreasing Near-Field/Far-Field Inhalation Exposure Model, Spot Cleaning Near-Field/Far-Field Inhalation Exposure Model, models from GSs/ESDs) sometimes include data on release duration—which are usually either cited from literature or based on generic assumptions about the activity being modeled. Release duration information from models may be presented with non-modeled air emission data from NEI or TRI, if the model is applicable and expected to represent the primary release source for the OES (*e.g.*, release duration from the Tank Truck and Railcar Loading and Unloading Release and Inhalation Exposure Model may be used with estimates of air emissions for a facility in the Repackaging OES). For models that calculate release duration as a distribution, such as from Monte Carlo simulations, the mean and range of release durations from the model should be presented with the air emission estimate.
3. *Literature:* Literature sources from systematic review, including GSs/ESDs, are another source of information for release duration. Often, release duration information from literature sources

²⁸ Note that the NEI operating hours fields are not populated for all, or in the case of ethylene dibromide, most NEI entries.

may be broad, such as a range of durations for a given operation. Alternatively, literature sources may describe release duration qualitatively, such as “on and off throughout the day” or “over half the day.” Therefore, literature sources may inform release duration at the OES-level, as opposed to at the facility-level. All details from literature sources on release duration, including qualitative descriptions, should be presented with air emission estimates if they are available and there is no other source of this data.

4. *List as “Unknown”*: Often, no information on release duration is available at either the facility or OES-level from the above sources. In these cases, engineers should list that the release duration is unknown.

Sources for Estimating Release Pattern

1. *NEI Data*: The NEI dataset includes facility-specific air emissions estimates for major sources and often includes data on the number of days of operation per week and number of weeks of operation per year for these facilities. NEI does not indicate if the number of days per week or weeks per year of operation are consecutive or intermittent throughout the week/year; however, these data are still useful and should be provided by engineers with air emission estimates to help inform release patterns. Data on operational days per week and weeks per year for one facility in NEI is typically not used for a different facility; however, engineers may consider conducting an analysis of these data for multiple facilities in NEI that are a part of the same OES to develop a broader estimate of release pattern at the OES-level. EPA has previously used this approach to inform development of GSs/ESDs, but it is dependent on the amount of data and time available and should be discussed on a chemical-specific basis.
2. *Models*: Models used to estimate air emissions (e.g., Tank Truck and Railcar Loading and Unloading Release and Inhalation Exposure Model, Open-Top Vapor Degreasing Near-Field/Far-Field Inhalation Exposure Model, Spot Cleaning Near-Field/Far-Field Inhalation Exposure Model, models from GSs/ESDs) sometimes, albeit rarely, include data on release pattern from the underlying data sources. Release pattern information from models may be presented with non-modeled air emission data (e.g., NEI, TRI) if the model is applicable and expected to represent the primary release source for the OES (e.g., release pattern from the Tank Truck and Railcar Loading and Unloading Release and Inhalation Exposure Model may be used with estimates of air emissions for a facility in the Repackaging OES).
3. *Literature*: Literature sources from systematic review, including GSs/ESDs, are another source of information for release pattern. Often, literature sources provide general release pattern information for a given operation. Therefore, literature sources may inform release pattern at the OES-level, as opposed to at the facility-level. All details from literature sources on release pattern, even if general and/or limited, should be presented with air emission estimates, if they are available and there is no other source of this information.
4. *List as “Unknown” and Provide Operating Days*: Often, no information on release pattern is available at either the facility or OES-level from the above sources. In these cases, engineers should do the following:
 - a. List that the release pattern is unknown.
 - b. Provide the number of operating days for the facility based on project-level engineering methodology, which is summarized below.
 - c. Provide any information based on process knowledge (e.g., commercial aerosol degreasing using cans may occur on/off throughout a day and year).

Estimating Number of Operating Days for Point Sources

For major sources that report operating data to NEI, EPA will use these data to calculate operating hours

on a days per year basis. For major sources that do not report operating data in NEI (including facilities that only report to TRI), the Agency will estimate operating hours using the other data sources described above. A hierarchical approach for estimating the number of facility operating days per year is described below.

1. *Facility-Specific Data:* Use facility-specific data, if available. NEI reports operating data as hours per year, hours per day, days per week, and weeks per year.
 - a. If possible, calculate operating days per years ($\text{days/year} = \text{hours per year} \div \text{hours per day}$).
 - b. If hours per year and/or hours per day are not reported, calculate days per year ($\text{days/year} = \text{days per week} \times \text{weeks per year}$).
2. *Facility-Specific Use Rates:* If information on facility-specific use rates is available, estimate days/year using one of the following approaches:
 - a. If facilities have known or estimated average daily use rates, calculate the days/year ($\text{days/year} = \text{estimated annual use rate for the site [kg/year]} \div \text{average daily use rate from sites with available data [kg/day]}$).
 - b. If sites without days/year data do not have known or estimated average daily use rates, use the average number of days/year from the sites with such data.
3. *Industry-Specific Data:* Industry-specific data may be available in the form of GSs, ESDs, trade publications, or other relevant literature. In such cases, these estimates should take precedent over other approaches, unless facility-specific data are available.
4. *Manufacture of Large-Production Volume (PV) Commodity Chemicals:* For the manufacture of the large-PV commodity chemicals, a value of 350 days/year should be used. This assumes the plant runs 7 day/week and 50 week/year (with 2 weeks down for turnaround) and assumes that the plant is always producing the chemical.
5. *Manufacture of Lower-PV Specialty Chemicals:* For the manufacture of lower-PV specialty chemicals, it is unlikely the chemical is being manufactured continuously throughout the year. Therefore, a value of 250 days/year should be used. This assumes the plant manufactures the chemical 5 days/week and 50 weeks/year (with 2 weeks down for turnaround).
6. *Processing as Reactant (Intermediate Use) in the Manufacture of Commodity Chemicals:* As noted above, the manufacture of commodity chemicals is assumed to occur 350 days/year such that the use of a chemical as a reactant to manufacture a commodity chemical will also occur 350 days/year.
7. *Processing as Reactant (Intermediate Use) in the Manufacture of Specialty Chemicals:* As noted above, the manufacture of specialty chemicals is not likely to occur continuously throughout the year. Therefore, a value of 250 days/year can be used.
8. *Other Chemical Plant OES (e.g., Processing into Formulation and Use of Industrial Processing Aids):* For these OES, it is reasonable to assume that the chemical of interest is not always in use at the facility, even if the facility operates 24/7. Therefore, a value of 300 days/year can be used, based on the European Solvent Industry Group's "SpERC fact sheet – Formulation & (re)packing of substances and mixtures – Industrial (Solvent-borne)" default of 300 days/year for the chemical industry. However, in instances where the OES uses a low volume of the chemical of interest, 250 days/year can be used as a lower estimate for the days/year.

- 13451 9. *All Other OESs*: Regardless of facility operating schedule, other OES are unlikely to use the
13452 chemical of interest every day. Therefore, a value of 250 days/year should be used for these
13453 OES.

13454 ***Estimating Number of Operating Days for Area Sources***

13455 For area sources, EPA will also estimate operating days per year using information such as NEI
13456 operating data for major source facilities within the same OES, general information about the OES, and
13457 values from literature.

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13459 Facility operating days per year will be used to calculate daily emissions from the NEI and TRI annual
13460 emissions data, as follows:

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$$\text{Daily emissions (kg/day)} = \text{Annual emissions (kg/year)} \div \text{Operating days per year (days/year)}$$

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Appendix E ESTIMATING NUMBER OF WORKERS AND OCCUPATIONAL NON-USERS

This appendix summarizes the methods that EPA/OPPT used to estimate the number of workers who are potentially exposed to 1,1,2-trichloroethane in each of its OES under TSCA. The method consists of the following steps:

1. Check relevant emission scenario documents (ESDs) and generic scenarios (GSs) for estimates on the number of workers potentially exposed.
2. Identify the NAICS codes for the industry sectors associated with each COU.
3. Estimate total employment by industry/occupation combination using the Bureau of Labor Statistics' Occupational Employment Statistics data ([BLS, 2023](#)).
4. Refine the Occupational Employment Statistics estimates where they are not sufficiently granular by using the U.S. Census' ([U.S. Census Bureau, 2017](#)) Statistics of U.S. Businesses (SUSB) data on total employment by 6-digit NAICS.
5. Estimate the percentage of employees likely to be using 1,1,2-trichloroethane instead of other chemicals (*i.e.*, the market penetration of 1,1,2-trichloroethane in the COU).
6. Estimate the number of sites and number of potentially exposed employees per site.
7. Estimate the number of potentially exposed employees within the COU.

Step 1: Identifying Affected NAICS Codes

As a first step, EPA/OPPT identified NAICS industry codes associated with each COU. EPA/OPPT generally identified NAICS industry codes for a COU by:

- Querying the U.S. Census Bureau's NAICS Search tool ([U.S. Census Bureau, 2022](#)) using keywords associated with each COU to identify NAICS codes with descriptions that match the condition of use.
- Referencing EPA/OPPT GS's and Organisation for Economic Co-operation and Development (OECD) ESDs for a COU to identify NAICS codes cited by the GS or ESD.
- Reviewing CDR data for the chemical, identifying the industrial sector codes reported for downstream industrial uses, and matching those industrial sector codes to NAICS codes using Table D-2 provided in the [CDR reporting instructions](#) ([U.S. EPA, 2016](#)).

Each COU section in the main body of this draft TSD identifies the NAICS codes EPA/OPPT identified for the respective COU.

Step 2: Estimating Total Employment by Industry and Occupation

BLS's Occupational Employment Statistics data provide employment data for workers in specific industries and occupations ([BLS, 2023](#)). The industries are classified by NAICS codes that were previously identified and occupations are classified by Standard Occupational Classification (SOC) codes ([BLS, 2018](#)).

Among the relevant NAICS codes (identified previously), EPA/OPPT reviewed the occupation description and identified those occupations (SOC codes) where workers are potentially exposed to 1,2-dichloroethane. Table_Apx shows the SOC codes by NAICS codes EPA/OPPT classified as occupations potentially exposed to 1,1,2-trichloroethane for an example associated with 4-digit NAICS code 221300 Water, Sewage and Other Systems. These occupations are classified as workers (W) and occupational non-users (O) by NAICS code. All relevant SOC codes by NAICS codes combinations can be found in supplemental file *Draft Estimates of Number of Workers and ONUs for 1,1,2-*

Trichloroethane ([U.S. EPA, 2026i](#)) on sheet “Affected SOC codes by NAICS codes combinations are assumed to represent occupations where exposure is unlikely.

After identifying relevant NAICS and SOC codes, EPA/OPPT used BLS data to determine total employment by industry and by occupation based on the NAICS and SOC combinations. For example, there are 1,520 employees associated with 4-digit NAICS 221300 (Water, Sewage and Other Systems) and SOC 49-9040 (Industrial Machinery Installation, Repair, and Maintenance Workers).

Using a combination of NAICS and SOC codes to estimate total employment provides more accurate estimates for the number of workers than using NAICS codes alone. Using only NAICS codes to estimate number of workers typically result in an overestimate, because not all workers employed in that industry sector will be exposed. However, in some cases, BLS only provide employment data at the 4-digit or 5-digit NAICS level; therefore, further refinement of this approach may be needed (see next step).

Step 3: Refining Employment Estimates to Account for Lack of NAICS Granularity

The third step in EPA/OPPT’s methodology was to further refine the employment estimates by using total employment data in the U.S. Census Bureau’s SUSB ([U.S. Census Bureau, 2017](#)). In some cases, BLS Occupational Employment Statistics’ occupation-specific data are only available at the 4- or 5-digit NAICS level, whereas the SUSB data are available at the 6-digit level (but are not occupation-specific). Identifying specific 6-digit NAICS will ensure that only industries with potential 1,2-dichloroethane exposure are included. As an example, Occupational Employment Statistics data are available for the 4-digit NAICS 221300 Water, Sewage and Other Systems, which includes several 6-digit NAICS:

- NAICS 221310 Water Supply and Irrigation Systems; and
- NAICS 221320 Sewage Treatment Facilities; and
- NAICS 221330 Steam and Air-Conditioning Supply.

In this example, only NAICS 221320 Sewage Treatment Facilities is of interest. The Census data allow EPA/OPPT to calculate employment in the specific 6-digit NAICS of interest as a percentage of employment in the BLS 4-digit NAICS.

The 6-digit NAICS 221320 comprises 13.2 % of total employment under the 4-digit NAICS 2213. This percentage can be multiplied by the occupation-specific employment estimates given in the BLS Occupational Employment Statistics data to further refine the Agency’s estimates of the number of employees with potential exposure. Table_Apx E-1 illustrates this granularity adjustment for NAICS 221320.

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Table_Apx E-1. Estimated Number of Potentially Exposed Workers and ONUs Under NAICS 221320

NAICS	SOC CODE	SOC Description	Occupation Designation	Employment by SOC at 4-Digit NAICS Level	% of Total Employment	Estimated Employment by SOC at 6-Digit NAICS Level
221300	11-9020	Construction Managers	O	130	13.20%	17
221300	11-9040	Architectural and Engineering Managers	O	70	13.20%	9
221300	17-2000	Engineers	O	620	13.20%	82
221300	17-3010	Drafters	O	70	13.20%	9
221300	17-3020	Engineering Technologists and Technicians, Except Drafters	O	**	**	0
221300	17-3030	Surveying and Mapping Technicians	O	**	**	0
221300	19-2031	Chemists	O	50	13.20%	7
221300	19-2041	Environmental Scientists and Specialists, Including Health	O	120	13.20%	16
221300	19-4000	Life, Physical, and Social Science Technicians	O	250	13.20%	33
221300	47-4070	Septic Tank Servicers and Sewer Pipe Cleaners	W	120	13.20%	16
221300	49-9040	Industrial Machinery Installation, Repair, and Maintenance Workers	W	1,520	13.20%	200
Total Potentially Exposed Employees				2,950		389
Total Workers						216
Total ONUs						173
W = worker; O = occupational non-user						
Note: numbers may not sum exactly due to rounding. ** Not reported for this NAICS code.						
Source: U.S. Census, 2017 (U.S. Census Bureau, 2017); U.S. BLS, 2023 (BLS, 2023).						

Step 4: Estimating the Percentage of Workers Using 1,2-Dichloroethane Instead of Other Chemicals

In the final step, EPA/OPPT accounted for the market share by applying a factor to the number of workers determined in Step 3. This accounts for the fact that 1,2-dichloroethane may be only one of multiple chemicals used for the applications of interest. EPA/OPPT did not identify market penetration data for any COU. In the absence of market penetration data for a given COU, EPA/OPPT assumed 1,2-dichloroethane may be used at up to all sites and by up to all workers calculated in this method as a bounding estimate. This assumes a market penetration of 100 %.

Step 5: Estimating the Number of Workers and Occupational Non-Users (ONUs) per Site

EPA/OPPT calculated the number of workers and ONUs in each industry/occupation combination using the formula below (granularity adjustment is only applicable where SOC data are not available at the 6-digit NAICS level):

*Number of Workers or ONUs in NAICS/SOC (Step 2) × Granularity Adjustment Percentage (Step 3) =
Number of Workers or ONUs in the Industry/Occupation Combination*

EPA/OPPT then estimated the total number of establishments by obtaining the number of establishments reported in the U.S. Census Bureau's SUSB ([U.S. Census Bureau, 2017](#)) data at the 6-digit NAICS level. In this example, there are 652 establishments associated with 6-digit NAICS code 221320 *Sewage Treatment Facilities*.

EPA/OPPT then summed the number of workers and ONUs over all occupations within a NAICS code and divided these sums by the number of establishments in the NAICS code to calculate the average number of workers and ONUs per site.

Step 6: Estimating the Number of Workers and ONUs, and Sites for a COU

EPA/OPPT estimated the number of workers and ONUs potentially exposed to 1,2-dichloroethane and the number of sites that use 1,2-dichloroethane in a given COU through the following steps:

- 6.A. Obtaining the total number of establishments by:
 - i. Obtaining the number of establishments from SUSB at the 6-digit NAICS level (Step 5) for each NAICS code in the COU and summing these values; or
 - ii. Obtaining the number of establishments from the TRI, DMR, NEI, or literature for the COU.
- 6.B. Estimating the number of establishments that use 1,2-dichloroethane by taking the total number of establishments from Step 6.A and multiplying it by the market penetration factor from Step 4.
- 6.C. Estimating the number of workers and ONUs potentially exposed to 1,2-dichloroethane by taking the number of establishments calculated in Step 6.B and multiplying it by the average number of workers and ONUs per site from Step 5.

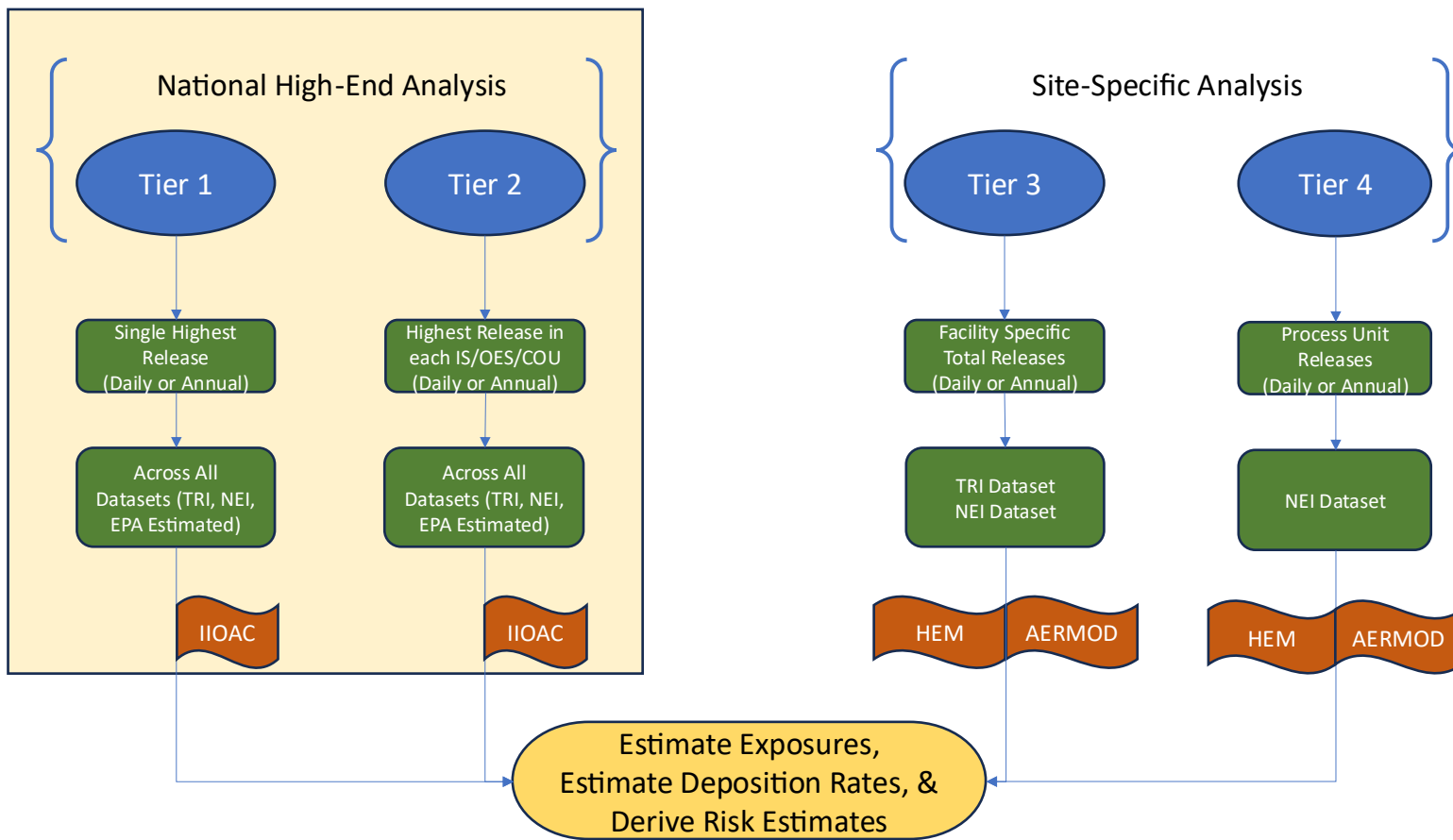
Appendix F GENERAL POPULATION AMBIENT AIR EXPOSURE ASSESSMENT

F.1 Ambient Air Pathway

EPA considers both modeled and monitored concentrations of 1,1,2-trichloroethane for the ambient air pathway exposure assessment. EPA's modeling estimates both short-term and long-term concentrations of 1,1,2-trichloroethane in the ambient air. EPA considers monitoring data from a variety of sources including published literature, state databases, EPA's Ambient Monitoring Technology Information Center (AMTIC) archive database, and EPA's Air Toxics Screening Tool (AirToxScreen) when available to contextualize measured ambient air concentrations of 1,1,2-trichloroethane relative to modeled concentrations of 1,1,2-trichloroethane.

F.2 Modeling Approach for Estimating Concentrations in Ambient Air

EPA applies a tiered approach for estimating concentrations of 1,1,2-trichloroethane in ambient air for the ambient air exposure assessment. A visual depiction of this tiered approach is presented in Figure_Apx F-1 with a description of each tier following. While multiple tiers are presented in Figure_Apx F-1, the specific needs of the 1,1,2-trichloroethane ambient air exposure assessment and draft risk evaluation for 1,1,2-trichloroethane dictate which tiers are applied and how each is applied and are described in F.2. All the approaches, methodologies, and models presented in Figure_Apx F-1 have undergone public comment and peer review by EPA's Scientific Advisory Committee on Chemicals (SACC) for TSCA purposes and integrate relevant comments and peer review recommendations received during those reviews.



Figure_Apx F-1. Tiered Approach for Estimating Concentrations of 1,1,2-Trichloroethane in Ambient Air

F.2.1 Tier 1

The Tier 1 analysis uses EPA's Integrated Indoor/Outdoor Air Calculator (IIOAC)²⁹ model to estimate both high-end, and mean-daily and annual average concentrations of a chemical in the ambient air at two finite distances (100 and 1,000 m) and one area distance (between 100 and 1,000 m) from the releasing facility. The IIOAC model also estimates high-end and mean total, dry, and wet annual deposition rates at those same distances. The IIOAC model outputs are based on results from a suite of pre-run scenarios within the American Meteorological Society/Environmental Protection Agency Regulatory Model (AERMOD) using a variety of meteorological and land-use settings. Additional information on IIOAC can be found in the user guide ([U.S. EPA, 2019e](https://www.epa.gov/tsca-screening-tools/iioac-integrated-indoor-outdoor-air-calculator)).

The Tier 1 analysis utilizes the single highest fugitive and stack release value identified from the release assessment discussed in Section 4 across all datasets and reporting years considered (EPA estimated releases, TRI, and NEI) as direct inputs to the IIOAC model. The release inputs are accompanied by a series of default and conservative user defined inputs to define the release and exposure scenarios to be modeled.

The purpose of the Tier 1 analysis is to evaluate and identify upper-end, bounding concentrations, exposures, and associated calculated risk estimates to determine if additional, more refined investigation and analyses are necessary or warranted for a given hazard effect. If calculated risk estimates (MOEs) for acute or chronic non-cancer effects are below relative benchmarks, then EPA will move forward with a refined Tier 2 analysis. If calculated risk estimates (cancer risk) for cancer effects are above relative benchmarks, the EPA will similarly move forward with a refined Tier 2 analysis. If there are no calculated risk estimates below (non-cancer) or above (cancer) the respective, relative benchmark, then EPA may elect to not further evaluate exposures or risks via the ambient air pathway for that hazard effect. Since the Tier 1 analysis results are highly conservative, upper-end/bounding estimates, if there are no exposures which lead to associated, calculated risk estimates which are below/above relative benchmarks at these highly conservative levels, then other combinations involving lower releases or exposures will not result in associated risk estimates below/above relative benchmarks. Therefore, EPA can conclude with high confidence, further evaluation is not necessary or warranted.

F.2.1.1 Strengths, Limitations, and Uncertainties for Tier 1 Analyses

There are several assumptions, strengths, limitations, and uncertainties associated with the Tier 1 analysis. To begin, the Tier 1 analysis is a highly conservative analysis which provides highly conservative/upper-bounding exposures and associated risk estimates. Since the Tier 1 analysis models the single highest fugitive and stack release (reported or EPA estimated) across all releases and years considered, the results are not differentiated by industry sector, OES, or COU. Additionally, the highest fugitive and stack releases across all datasets evaluated will rarely occur from the same facility and may not occur in the same year across all release years considered. Therefore, the releases, exposures, and associated risk estimates from a Tier 1 analysis do not align either temporally or spatially (since they do not occur at the same time or same location). This results in low confidence in the exposure scenario modeled.

Modeling the highest release across all datasets evaluated gives EPA high confidence the highest exposures (and associated risk estimates) are not missed and ensures the findings are health protective. If the Tier 1 analysis results show exposures do not lead to associated, calculated risk estimates

²⁹ <https://www.epa.gov/tsca-screening-tools/iioac-integrated-indoor-outdoor-air-calculator>

below/above relative benchmarks, EPA can have high confidence that exposures (and associated risk estimates) via the ambient air pathway do not pose an identified exposure or risk for the associated hazard effect to the general population. However, if the Tier 1 analysis results show exposures do lead to associated, calculated risk estimates below/above relative benchmarks, EPA has low confidence in the exposure scenario and low confidence the results are representative of real exposures to the general population. This indicates additional, more refined analyses are warranted to provide higher confidence in the exposure findings and representativeness of the results.

F.2.2 Tier 2

This analysis mirrors the Tier 1 analysis, including: model used (IIOAC), approaches/methodologies described, and the assumptions, strengths, limitations, and uncertainties. However, the refinement of the Tier 2 analysis utilizes the single highest fugitive and stack release value within a set of categorical releases for each industry sector/OES/COU identified in the release assessment discussed in Section 4. More specifically, instead of using a single highest fugitive and stack release across all industry sectors/OES/COU (*i.e.*, manufacturing, disposal, processing, etc.), the Tier 2 analysis uses the single highest fugitive and stack release within each industry sector/OES/COU captured in the release assessment (*e.g.*, highest releases within manufacturing industry sector/OES/COU, highest releases within disposal industry sector/OES/COU, highest release within processing industry sector/OES/COU, etc.). This results in the evaluation of multiple releases across multiple industry sectors/OES/COU. The Tier 2 analysis still considers the single highest fugitive and stack releases across all datasets and reporting years considered (EPA estimated releases, TRI, and NEI), but broadens the releases to the industry sector/OES/COU level.

The purpose of this Tier 2 analysis is to evaluate and identify an upper-end, bounding concentration, exposure, and associated calculated risk estimates within each industry sector/OES/COU to determine if additional, more refined investigation and analyses are necessary or warranted for a given hazard effect for one or more industry sectors/OES/COUs. If calculated risk estimates (MOEs) for acute or chronic non-cancer effects are below relative benchmarks, then EPA will move forward with a further refined Tier 2 analysis or a Tier 3 analysis. If calculated risk estimates (cancer risk) for cancer effects are above relative benchmarks, the EPA will similarly move forward with a further refined Tier 2 analysis or a Tier 3 analysis. If there are no calculated risk estimates below (non-cancer) or above (cancer) the respective, relative benchmark, then EPA may elect to not further evaluate exposures or risks via the ambient air pathway for that hazard effect. Since the Tier 2 analysis results remain highly conservative, upper-end/bounding estimates, if there are no exposures which lead to associated, calculated risk estimates which are below/above relative benchmarks at these highly conservative levels, then other combinations involving lower releases or exposures will not result in associated risk estimates below/above relative benchmarks within a given industry sector/OES/COU. Therefore, EPA can conclude with high confidence, further evaluation is not necessary or warranted.

F.2.2.1 Strengths, Limitations, and Uncertainties for Tier 2 Analyses

Since this Tier 2 analysis considers the single highest releases within each industry sector across all datasets and reporting years considered, the releases, exposures, and associated risk estimates still may not align either temporally or spatially. Therefore, the assumptions and uncertainties associated with the Tier 1 analysis carry into this Tier 2 analysis (*e.g.*, low confidence in scenario, but high confidence results are health protective).

Depending on the needs of the exposure assessment and risk evaluation, a strength of the Tier 2 analysis is that it provides flexibility to apply additional refinements which can provide more temporally or spatially aligned results within each industry sector/OES/COU. For example, the Tier 2 analysis can be

used to evaluate site-specific releases within one or more industry sectors which can better align exposures (and associated risk estimates) spatially. The Tier 2 analysis can also be used for multi-year analyses of releases (with the TRI dataset) within each industry sector which can better align results temporally (at either the industry sector level, or site-specific level). An added benefit of a multi-year analysis is it provides an opportunity for a trends analysis which can inform TSCA REs whether exposures/risk estimates by industry sector/OES/COU trend upwards, downwards, remain about the same, or had a single year of a higher or lower release which may have resulted from a unique circumstance which is not representative of yearly impacts. Since the Tier 2 analysis is at the industry sector/OES/COU level, an additional strength is the results can be compared across datasets (TRI and NEI) by industry sector/OES/COU to identify similarities and differences across the datasets. However, since there are several differences in reporting requirements between TRI and NEI, comparisons across datasets may be limited or in some cases prohibitive. This primarily stems from the fact that some facilities (or industry sectors) may report to one or the other database but not both. This poses a difficulty when trying to compare as there are often data gaps which prevent a full comparison of everything, although some overlap does occur.

Tier 1 and Tier 2

As identified in Figure_Apx F-1, both the Tier 1 and Tier 2 analyses are designed to represent a national, high-end analyses. Both tiers use the highest releases reported accompanied by conservative assumptions and conservative default inputs into the IIOAC model. The results may not align temporally or spatially, resulting in low confidence in the exposure scenario but high confidence that the results are protective. The Tier 1 and Tier 2 analysis results can be relied upon when characterizing exposures and associated risks, specifically when preliminary results indicate no exposures (or associated risk estimates) of concern. Additionally, because Tier 1 and Tier 2 are highly conservative estimates of exposures and associated risks, the results can be used to screen out the ambient air pathway from further evaluation (Tier 1) or screen out one or more industry sectors/OES/COUs from further evaluation for the ambient air pathway (Tier 2). When considering EPA estimated releases for generic scenarios (e.g., where there are no industry reported air releases for a chemical/industry sector/OES/COU in TRI or NEI) the Tier 1 and Tier 2 analyses are the highest tiers of analysis which can be conducted. Although both are conservative in nature, these represent the best available science in the absence of site-specific information needed to inform higher tiers of analysis and models. In such situations, the Tier 1 and Tier 2 results can be relied upon for risk characterization and risk determination but there is more uncertainty and lower confidence associated with the results.

Neither the Tier 1 or Tier 2 analyses are designed to consider aggregate exposure or risk. However, additional refinements within the Tier 2 analysis (in particular when facility-specific releases are evaluated in a temporally aligned multi-year analysis across multiple industry sectors/OES/COUs) can be, and have been, used to provide a conservative estimate of multi-facility aggregate exposures. In summary, this conservative multi-facility aggregate exposure approach identifies multiple facilities within proximity and places each facility on top of the other facilities in proximity. The modeled concentrations at each distance modeled, for each facility in proximity are added together as if they are emitting from the same release point at the same time. This approach provides a highly conservative, multi-facility aggregate exposure (and associated risk estimate) at each distance modeled. This highly conservative multi-facility aggregate approach has also undergone public comment and peer review by SACC.

While the additional refinements within the Tier 2 analyses do allow for consideration of site specific releases (including 14 different regional meteorological settings within IIOAC) within one or more industry sectors/OES/COU and highly conservative multi-facility aggregate exposures/risks, more

representative consideration of site specific releases and multi-facility aggregate exposures/risks can be achieved through more refined, Tier 3 and Tier 4 analyses. Tier 3 and Tier 4 analyses shift the focus of the ambient air analyses from a national high-end analysis to site-specific analyses (Tier 3) and even more specific process-level analyses (Tier 4).

F.2.3 Tier 3

This analysis uses either EPA's Human Exposure Model (HEM)³⁰ or EPA's American Meteorological Society/Environmental Protection Agency Regulatory Model (AERMOD)³¹ to estimate daily and annual average concentrations of a chemical in ambient air at multiple user-defined radial distances from a release point within the modeling domain of the models (which is 50,000 meters for both the HEM and AERMOD). Although either the HEM or AERMOD can be used for a Tier 3 analysis, recent exposure assessments and risk evaluations under the TSCA program, including 1,1,2-trichloroethane, have used the HEM for Tier 3 analyses. The advantage of the HEM, relative to the IIOAC model used in Tier 1 and Tier 2 analyses, is that it can estimate concentrations at multiple user defined radial distances from release points. The HEM can also estimate total, dry, and wet annual deposition rates at the same multiple user defined radial distances selected for air concentrations. The HEM has an additional benefit in that its development includes demographic and population-based analyses which can further inform exposure/risk characterization, risk determination, and regulatory decision-making.

The purpose of the Tier 3 analysis is to evaluate and identify facility-specific modeled concentrations, exposures, and associated risk estimates at multiple radial distances from release points where individuals making up the general population (including PESS) may live or frequent. The findings for each facility are then categorized by OES/COU to inform exposure and risk characterization as well as risk determination, and regulatory decision-making.

The Tier 3 analysis also evaluates and identifies multi-facility aggregate concentrations, exposures, and associated risks at the Census block level. However, the results from this Tier 3 aggregate analysis are not attributable to a single OES/COU because the analysis is multi-facility and each individual facility in proximity may be categorized to different OES/COUs.

The Model and Radial Distance Analyses

The HEM runs EPA's regulatory model AERMOD as a fully compiled executable file based on several user created input files which define all aspects of the exposure scenario, facilities, releases, emissions variance, distances, meteorological data, and other components to be evaluated. The refinements of the Tier 3 analysis stem from these input files and include multiple (and expanded) user defined distances, use of local meteorological data (based on facility latitude and longitude and acquired from AERMOD's AERMET module), capability to consider emission variability across months, weeks, days, and hours of operation (as reported to TRI and NEI) as well as seasonal variability if desired for specific needs of the risk evaluation. The HEM is also capable of providing single user defined statistical output values of interest across the distribution of modeled concentrations for each radial distance and each facility modeled (e.g. maximum, 95th percentile, or 50th percentile, etc.). Although the HEM is capable of providing whichever output values the user defines, if two or more statistically specific output values are desired (e.g., 95th percentile and 50th percentile), the user must run the HEM twice (once for each output value).

The Tier 3 analysis utilizes facility-specific fugitive and stack reported total facility release values from

³⁰ <https://www.epa.gov/fera/risk-assessment-and-modeling-human-exposure-model-hem>

³¹ <https://www.epa.gov/scram/air-quality-dispersion-modeling-preferred-and-recommended-models>

the TRI and NEI datasets identified within the release assessment discussed in Section 4. Since the Tier 3 analysis models facility-wide (total facility) reported releases, the series of default and conservative stack parameters and fugitive area assumptions from the Tier 1 and Tier 2 analyses are carried into the Tier 3 analysis to define those parts of the release and exposure scenarios to be modeled using the HEM.

The HEM (V5.0) Meteorological Files library includes over 800 meteorological stations, spanning the entire United States, as well as Puerto Rico and the US Virgin Islands. The HEM (V5.0) uses the calendar year 2019 Integrated Surface Hourly Data processed through a previous version of the AERMOD meteorological processor, AERMET, and its supporting modeling system (AERSURFACE and AERMINUTE). The meteorological data includes both hourly surface weather observations and the full twice-daily upper air soundings. The surface and upper air stations are paired to produce the required input data for AERMOD to run within the HEM. Detailed information on the HEM, input files, meteorological data, processing, and other considerations can be found in the user guide ([SC&A, 2025](#)).

Aggregate Analyses

The HEM model estimates population exposures and human health risks across the United States within the modeling domain (50,000 meters) of each facility using census data. The HEM (V5.0), uses 2020 census data for this purpose. The HEM multi-facility aggregate concentrations, exposures, and associated risks are determined at the centroid of each census block within the model domain of each facility. The HEM models each facility's contributing exposures at the respective distance each Census block centroid is from each facility, considering the directional variability of the local meteorological data for each facility relative to the centroid location. This results in a spatially, temporally, and meteorologically aligned aggregate analysis.

The Census block results provide estimated exposures and associated risks at the centroid (a single point) of each Census block and does not capture exposures or associated risks of every receptor/residence household within that Census block. The HEM applies the total Census block population from the census data as the total population exposed at the centroid of each Census block. While this is representative of total Census block population exposures in smaller Census blocks (where most individuals are not far from the centroid), as Census blocks become larger (*i.e.*, increase in dimensions), the representativeness of the actual concentrations, exposures, and risks modeled at the centroid of that Census block populations can shift to either higher or lower values depending on where exposed individuals may live relative to the centroid (*e.g.*, closer to the release point than the centroid, farther away, or directionally either side of a given census block centroid). However, the impact of this shift can be reduced by considering both the radial distance and Census block concentrations, exposures, and risk estimates for each facility, accompanied by a visual investigation into land use around those facilities with the highest concentrations to better characterize the actual exposures and risks to the general population.

F.2.3.1 Strengths, Limitations, and Uncertainties of Tier 3 Analyses

Tier 3 Analyses

There are several assumptions, strengths, limitations, and uncertainties associated with this Tier 3 analysis. The use of site-specific release data, local meteorological data, local census data, and multi-facility aggregate capabilities all provide strengths to the Tier 3 analysis. These strengths shift the exposures (and associated risk estimates) from highly conservative to conservative in nature since they eliminate some conservative assumptions associated with Tier 1 and Tier 2 analyses. The use of local data also causes the modeled concentrations to be less "bounding" estimates relative to the Tier 1 and Tier 2 analyses. There are still some assumptions on stack and fugitive area source parameters and use

of 95th percentile modeled concentrations which retain conservatism within the Tier 3 analyses. Therefore, modeled results remain high-end estimates.

TRI and NEI Release Datasets

There are several strengths associated with the TRI release dataset. To begin, TRI releases are industry reported releases which are required by statute and submitted annually. Since TRI releases are reported directly by industry, the submissions are provided by individuals most familiar with the processes and releases which can avoid the need for certain assumptions required when releases are estimated from an outside individual or party. When considering five or six years of TRI release data in a Tier 3 analysis, the annual reporting requirements of TRI provide greater confidence that higher years of release are not missed and maintains a high level of health protection. The annual reporting requirements for TRI also provide the ability to consider annual trends of releases, exposures, and associated risks across the multiple reporting years evaluated as described in Section F.2.2, providing additional strength to the Tier 3 analyses. Finally, the TRI reported releases generally capture the highest releasing facilities across the nation due to certain reporting requirements within the statute and applicable regulations. This adds confidence the Tier 3 analysis using the TRI dataset considers the facilities with the greatest impact on ambient concentrations, exposures, and risks and thus is health protective.

Unlike TRI reported releases, NEI releases may be reported by industry or by States. This introduces an additional step of review, or submittal which could add some uncertainty because releases may not be directly reported by industry. Furthermore, if there is a gap in the NEI data, either the States or EPA may utilize TRI reported release information to backfill the NEI dataset. While both NEI and TRI are reported releases, when TRI data is used to backfill for NEI data, the process level specificity for which the raw NEI data are reported is lost. Since the NEI release data are reported on a 3-year cycle annual trends analyses cannot be conducted for the NEI datasets. Since the NEI release data is not annual, there is uncertainty associated with what year the reported releases occur (or if the reported releases are three-year average releases, etc.). Additionally, efforts to align release years across the TRI and NEI datasets (for comparability) or use of the most recent years of release data tend to limit the comparable NEI release data to a single NEI reporting year (*e.g.*, 2017 or 2020). Finally, since the NEI dataset is reported on a 3-year cycle, the final release dataset numbers are not available until several years after the reporting year concludes due to the need to validate and QC the reported numbers. This limits EPA's ability to use the most recent NEI release numbers under the current 3-year statutory deadlines for TSCA REs. Even when final numbers are available for a specific NEI reporting year, that data is already several years old and some may argue such releases are not representative of current year operations or releases. As an example, while EPA may consider two NEI reporting year cycles (*e.g.*, 2017 and 2020), the 2017 data is already nine years old (as of the date of this assessment). This introduces a level of uncertainty since the 2017 release data may be outdated and a lot can change at a facility (*e.g.*, a process, formulation, use of a chemical, process shutdown, discontinued use of a chemical, etc.). None-the-less, the added benefits provided by the NEI dataset (in particular when used in conjunction with the TRI dataset) remains the best available science at the time. As such, the results from the Tier 3 analyses which use the TRI and NEI datasets can be relied upon for exposure and risk characterization, risk determination, and regulatory decision-making.

While there are multiple strengths associated with the TRI and NEI release datasets, there are also several limitations and uncertainties associated with the datasets and their use in a Tier 3 analysis. Although the Tier 3 analysis uses site specific and local data, the representativeness of that data is heavily reliant on specific information reported to the TRI and NEI datasets like the actual reported release numbers, the reported days of operation, and the latitude and longitude of the facility (or release point). For example, reported releases in the TRI dataset may be changed by a facility at any time.

Therefore, some release numbers from previous reporting years evaluated and modeled in a Tier 3 analysis may change within a year or two after the data is pulled and analyzed. Due to statutory limitations in completing the TSCA risk evaluations, it is not feasible to continuously and completely rerun the Tier 3 analysis, redevelop all the input files, run the models, and synthesize results (multiple times) and still meet the statutory deadlines for publishing final TSCA risk evaluations. This creates some uncertainty regarding the release numbers reported but still relies on the best available science and information available at the time of the data pull. The consideration of multiple reporting years of releases (both TRI and NEI) can help reduce this uncertainty since this approach considers fluctuations in releases across years and still captures high-end release years.

Another uncertainty associated with both the TRI and NEI datasets is the accuracy and precision of the latitude and longitude reported for either a facility (TRI), or a facility or process unit (NEI). This uncertainty impacts both facility-specific Tier 3 analyses as well as multi-facility aggregate analyses and occurs because the Tier 3 census block analyses are highly dependent on the actual distance from a release point. A small shift in the actual location of the release point (latitude/longitude) can change the modeled concentrations at the centroid of each Census block. Larger shifts can change the actual census blocks impacted by the facility releases. Depending on the predominant wind direction, the direction of a release point shift, and the distance of the actual release point shift; the changes to modeled concentrations at the centroid of a Census block from any given facility can be significant. The difference can be even greater if multiple facilities impacting a single Census block had shifts in the release point latitude/longitude. In some visual investigations of maps, a rough measurement of the reported latitude/longitude of a release point reported to TRI or NEI relative to the location of a likely process unit which could be the release point showed shifts ranging from tens of meters to hundreds or thousands of meters in a variety of directions. The impact of this uncertainty can be minimized by conducting select visual investigations or land use analyses to confirm the accuracy and precision of the latitude and longitude reported. Impacts can be further minimized when facilities report to both TRI and NEI datasets and the reported latitude and longitude reported to each dataset are compared. If the same facility reports different latitude and longitude to each dataset, a visual investigation using readily available tools can be conducted to identify the most representative latitude and longitude to be used for modeling the associated release.

When considering aggregate exposures in the Tier 3 analysis, TRI and NEI total facility reported releases are tied to a specific facility (with a latitude and longitude). This provides strength to the assessment because both the fugitive and stack reported releases for an aggregate assessment are spatially aligned. However, when the highest single fugitive and stack release reported for each facility is modeled in a Tier 3 analysis, the fugitive and stack releases may not align temporally (if they occur in different years). This decreases confidence in the exposure scenario but maintains confidence the modeled releases are health protective. If time and resources allow, a Tier 3 analysis could evaluate each facility release across each year of release evaluated, to temporally align the release data (and resulting concentrations, exposures and risk estimates). This provides high confidence the exposure scenario evaluated is representative of actual concentrations, exposures, and risk estimates associated with the general population (since releases align both spatially and temporally) but a slightly lower confidence that such results are the most health protective (*e.g.*, for a high-end screening analysis).

Another limitation when considering aggregate exposure (and associated risk estimates) in the Tier 3 analysis using HEM is the removal of the TSCA COU specific exposures and risks at each census block. This is an unavoidable outcome when using the HEM aggregate analysis within the TSCA RE context because it considers the impact of each facility releasing the chemical being evaluated in proximity to each census block (which gives a representative aggregate exposure), but all facilities impacting a given

census block are rarely associated with the same OES/COU. Therefore, while results from the HEM may provide a more representative “multi-facility aggregate” exposure and risk estimation, it cannot be tied to a single OES/COU.

Finally, while NEI often captures more facilities than TRI (due to the absence of reporting thresholds for NEI), the additional facilities in NEI are often smaller facilities which contribute much less to the overall exposure and risk profiles relative to TRI reported releases. Additionally, past experience using the NEI dataset for a Tier 3 analysis found the overall conclusions reached with the NEI dataset do not change relative to the overall conclusions reached using the TRI dataset. Considering the additional time needed to develop input files and run HEM using the often much larger NEI datasets for a Tier 3 analysis without the need for an added refinement to the TRI-based Tier 3 analyses may be viewed as a limitation. At the same time, some facility releases are reported to NEI but not reported to TRI. This can lead to the NEI dataset capturing more COUs than the TRI dataset. From this perspective, using the NEI dataset in a limited and focused manner for a Tier 3 analysis to further inform/support results found with the TRI dataset can be a benefit and add strength and confidence to the TRI-based results. While evaluating both TRI and NEI data sets with the Tier 3 analysis allows a more direct comparison of exposures (and associated risk estimates) across datasets at the facility level, the inconsistencies across facilities and reported releases between TRI and NEI due to different reporting requirements, thresholds, and other factors can significantly limit the added benefits of such a comparison.

F.2.4 Tier 4

This analysis is nearly identical to the Tier 3 analysis except for a couple distinct differences which define the refinement of the Tier 4 analysis. The primary difference is the Tier 4 analysis is a process level analysis, rather than the facility-wide analysis (Tier 3). As such, the Tier 4 analysis only uses the reported releases from the NEI dataset as direct inputs to the HEM (or AERMOD, if used) because only the NEI dataset has releases reported at the process level. This process level aspect of the NEI dataset also incorporates several other inputs that are (often, but not always) directly reported to NEI, including process level-specific stack parameters and fugitive parameters as well as process unit locations/coordinates (via latitude and longitude). The process level aspect of the Tier 4 therefore provides refinement to the Tier 3 analysis and avoids default/conservative assumptions around certain inputs (like stack height, diameter, exit temperature, etc.), when available at the process level in the NEI dataset. The process unit locations (via latitude and longitude) provide more spatially resolved release points for each process within a single facility rather than assuming a single release point for all facility releases in the Tier 3 analysis.

The Tier 4 analysis can be further refined by considering additional process level or facility level parameters like building downwash effects, release type (puff, line, etc.), plume type, variable releases, and other highly site specific and process specific parameters and factors. While both HEM and AERMOD have the capability of considering building effects, to properly consider such effects requires a large amount of information that is not readily available and not submitted by industry to EPA for consideration. Since these additional parameters and factors are not readily available these additional Tier 4 refinements are not applied in TSCA REs or other programmatic office risk evaluations. None-the-less, the potential for this level of refinement with a Tier 4 analysis, when specifically warranted, is described here for application in a highly specific, single facility, single process unit evaluation.

The consideration of building or landscape effects like downwash requires GIS measured heights, widths, diameters, etc. of every single building (or landscape) around every process to be evaluated. Such measurements are required from multiple locations both on the ground and on the roof, possibly outcroppings in the middle of a building, and other locations which taken together may raise safety

concerns for gathering such data. Additionally, if a process is near the fenceline of a facility and there are buildings off-site that can impact releases, access to those buildings for GIS measurements may be limited or prohibited.

Other factors that can be considered for these additional Tier 4 refinements may be more readily available, like release type (puff, line, etc.) but would only be considered on a case-by-case, facility-by-facility, process unit-by-process unit basis, where applicable. However, such unique considerations are highly specific and not readily applicable to national level assessments for existing chemicals TSCA RE purposes.

F.2.4.1 Strengths, Limitations, and Uncertainties for Tier 4 Analyses

Outside of the refinements and inputs described above, the Tier 4 analyses have the same assumptions, strengths, limitations, and uncertainties for the NEI dataset used as discussed in detail in Sections F.2.1.1, F.2.2.1, and F.2.3.1. The expansion of the Tier 4 analysis to process level often adds thousands of additional release points to the modeling input files, which in turn can add significantly more time and require significantly more resources to complete relative to a Tier 3 analysis. The lack of readily available information for additional Tier 4 refinements like GIS coordinates, building dimensions, etc. also create limitations of a Tier 4 analysis. As with the Tier 3 analysis, the Tier 4 analysis relies on process level location information (latitude and longitude) to define the release point. This location information is subject to the same limitation as described in the Tier 3 analysis where slight shifts in one or more actual process unit locations relative to the location reported in NEI, can have significant impacts on the overall modeled concentrations at both the facility level and multi-facility aggregate levels (census blocks).

Other factors that can be considered for these additional Tier 4 refinements may be more readily available, like release type (puff, line, etc.) but would only be considered on a case-by-case, facility-by-facility, process unit-by-process unit basis, where applicable. However, such unique considerations are highly specific and not readily applicable to national level assessments for existing chemicals TSCA RE purposes.

F.3 Similarities and Differences across Divisions and other EPA Programmatic Offices

The tiered methodologies and approaches applied to the ambient air exposure assessment for TSCA purposes are described in Sections F.2.1 through F.2.4. These approaches are generally similar to methodologies and approaches used in other Divisions within OCSPP and by other EPA Programmatic Offices like OAR. However, each Division and Programmatic Office have different statutory goals or requirements which result in some differences across the risk evaluations conducted. This section provides some similarities and differences associated with assessing general population inhalation exposures via ambient air, but limits descriptions to more general categories or approaches taken and are not all inclusive of all similarities and differences. Regardless of specific approaches taken, models used, or other factors there is a general commonality that for nearly all ambient air exposure assessments the underlying model used or baseline for an office specific model is AERMOD which is EPA's regulatory model.

OCSPP/OPPT/ New Chemicals Division (NCD) and Existing Chemicals Division (ECD)

Similarities between the approaches used by NCD and ECD generally align with the Tier 1 and Tier 2 analyses. Both NCD and ECD use the IIOAC model to estimate daily and annual average ambient concentrations at three distances. Both divisions also use IIOAC as a screening level model. However, based on statutory requirements and limited data availability for assessing new chemicals, NCD uses

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IIOAC to screen as a general necessity. This primarily stems from NCD's evaluation of new chemicals (yet to be produced) and therefore NCD rarely has facility-specific information, facility reported releases, facility locations, stack parameters, or local meteorological data. Releases are often EPA estimated releases only and based on production volume and generic exposure scenarios. NCD also operates under a short statutory timeline to assess exposures and risks from new chemicals and therefore needs a quick but effective means to screen exposures and associated risks. The use of IIOAC for this purpose provides the efficiency needed to meet NCD statutory requirements and exposure/risk results which can be relied upon for new chemical risk determination and regulatory decision-making. The limited data typically available for NCD risk assessments also makes the use of higher tier models or approaches for refinement prohibitive.

In contrast, ECDs use of IIOAC to screen general population exposures (and associated risk estimates) is a choice implemented as part of a Tiered approach for evaluating existing chemicals which have often been in production and use for years. The ECD often has facility-specific information, releases, and locations. Certain datasets have additional facility-specific information like stack parameters and specific facility locations which allows ECD to consider local meteorological data in higher tiered analyses. That is not to say ECD does not have certain chemicals with limited or no release data, or facility location data where existing chemical risk assessments need to rely on EPA estimated releases. However, under such circumstances, ECD applies the Tier 1 and Tier 2 approaches similar to NCD, therefore maintaining similarity between the divisions.

OAR and OCSPP/OPPT/ECD

Similarities between the approaches used by EPA's Office of Air and Radiation (OAR) and EPA's OCSPP/OPPT/ECD generally align across Tier 3 and Tier 4. While many similarities in methodologies and approaches exist across these two offices, the descriptions below focus on OAR risk reviews conducted under the Clean Air Act Section 112 and OCSPP TSCA Risk assessments for existing chemicals conducted under TSCA Section 6.

Similarities across the offices include using the same models (the HEM and AERMOD), same release datasets, considering exposures at both radial distances and aggregated by census block, and similar refinements when risks are found at lower tiers of analysis. Both offices also consider similar flagpole heights, distances from release sources, fugitive and stack releases, facility-specific and process level specific exposures and associated risks, other factors like emission variances for acute exposures as well as chronic and cancer exposures, and present findings relative to a range of cancer benchmarks (1E-06, 1E-05, and 1E-04). Furthermore, both OAR RTRs and OPPT/ECD REs integrate available monitoring data obtained through various federal monitoring programs, information requests, data gathering authorities, etc. as well as state and local monitoring programs into their risk evaluations. Both offices also utilize monitoring data to further contextualize ambient concentrations of chemicals in ambient air relative to modeled concentrations but typically do not derive risk estimates or make risk determinations based on the monitoring data. Finally, neither office integrates highly site-specific analysis considering building downwash effects or other factors identified in a further refined Tier 4 analysis for the national level assessments statutorily conducted. Both offices acknowledge, however, the capabilities of both the HEM and AERMOD to consider such factors, and acknowledge such factors can be considered in unique, site-specific analyses when appropriate.

Even with the numerous similarities described above, there are statutory requirements and goals which differ between the offices which lead to some differences between how the methodologies and approaches are applied. For example, OAR's RTRs are associated with a specific source category for which a regulation applies. While the source category approach is similar to OPPT/ECD's industry

sector approach they are not identical. Specifically, OPPT/ECD REs evaluate risks attributable to a COU which can be more granular than broader source category/industry sector approaches. Additionally, many COUs carry across multiple industry sectors or source categories which in turn expands the OPPT/ECD REs beyond a single source category/industry sector.

Another difference is the chemical(s) for which assessments are conducted. OAR RTRs generally assesses all hazardous air pollutants (HAP) (multiple chemicals) released from facilities within a given source category (not all facilities across the country). In contrast, OPPT/ECD REs assess a single chemical released and all facilities releasing that chemical across the country (not limited to facilities in a single source category). While the OAR RTRs do evaluate releases of each chemical, the overall exposure and risk conclusions are generally at the source category level and at the total HAP level. In contrast, for OPPT/ECD REs the overall exposure and risk conclusions are generally at the COU level and at a single chemical level.

To summarize, the general Tiered methodologies and approaches described in Sections F.2.1 through F.2.4 used for TSCA REs are similar to methodologies and approaches used by other divisions and programmatic offices, where applicable. This maintains some consistency across risk assessments. However, due to different statutory and regulatory goals and requirements, data availability, different exposure scenarios, and other factors, some differences persist. This is due to necessary modifications applied to meet the programmatic goals and specific design needs of the risk assessments. These similarities and differences do not determine whether one particular assessment approach is better or worse than another or has more or less confidence. They do, however, require those considering different risk assessments or associated findings to understand the context and regulatory framework under which the risk assessments are conducted. Additionally, while results are not exactly the same across all risk assessments, if multiple risk assessments are available and conducted under different statutory frameworks, using multiple or different datasets, but result in similar findings based on the weight of scientific evidence, then the findings under either risk assessment can provide a higher confidence in those findings because even under different statutory frameworks the conclusions are the similar.

F.4 Measured Concentrations in Ambient Air

EPA considers monitoring data from a variety of sources to contextualize measured ambient air concentrations of a chemical evaluated relative to modeled concentrations of that same chemical. These sources include published literature, state databases, EPA's Ambient Monitoring Technology Information Center (AMTIC) archive database, and EPA's Air Toxics Screening Tool (AirToxScreen) when available.

Published literature is identified through EPA's systematic review process which is described in detail in the Draft Systematic Review Protocols for the chemical evaluated and published as part of the chemicals risk evaluation package. In summary, EPA conducts literature searches through a variety of available databases (online and otherwise) identifying published studies within a pre-defined time-period where the chemical being evaluated is mentioned or referenced in relation to ambient air. This can include studies measuring concentrations of the chemical in the environment, modeling concentrations in the environment where environmental or human species may be exposed, exposure assessments evaluating exposure to the general population, studies which contextualize/compare modeled to monitored concentrations, or other similar studies or published research. Although such studies can be informative for contextualizing concentrations of a chemical in the ambient air, use of direct study data in a TSCA exposure/risk assessment is limited because such studies rarely are associated with a specific COU. As such, published studies can inform the representativeness of modeled ambient concentrations, but are

typically not used to characterize exposures/risks, derive risk estimates, or relied upon for risk determination or regulatory decision-making.

State monitoring databases are sometimes available with monitored concentrations of a chemical under evaluation. These databases often are associated with State agencies which operate an ambient monitoring program either maintaining stationary monitoring sites, mobile labs, or grab samples when a specific chemical is investigated or in response to public comments/complaints. Many of the methods used by State agencies to monitor concentrations use EPA reference methods to measure chemical concentrations in ambient air. Additionally, often States maintain an independent, internal database of all the monitoring projects it conducts across the years. In several instances, states may report the monitored values to EPA monitoring databases like AMTIC or other electronic reporting databases. When the monitoring data is only maintained in independent, internal state databases, EPA may not be aware of the available data without being informed by a given state such data is available. While outreach is encouraged and frequently pursued by EPA to state agencies, time limitations on turning around exposure assessments and risk evaluations under TSCA may limit EPA's ability to obtain the relevant monitoring data from State databases prior to publishing draft or final documents.

EPA's AMTIC archive database is an online database maintained by EPA and readily available to the public through internet access. The data in the AMTIC archive database is obtained from EPA's ambient monitoring network and, as mentioned above, may include state monitoring data which is submitted electronically to EPA for inclusion. The AMTIC archive database includes over 800 ambient monitoring stations located across the United States, and various U.S. territories (U.S. Virgin Islands, Puerto Rico, etc.). The database includes monitored concentrations of over 200 pollutants (including hazardous air pollutants and criteria pollutants), monitoring station locations (latitude/longitude, elevation), summary statistics and a variety of other monitoring information like percent non-detects, number of zero measured concentrations, etc. Although there is monitoring data on the AMTIC archive dataset going back to around 1990, for TSCA exposure assessments and risk evaluations, EPA typically pulls the latest five years of monitoring data published by AMTIC. Currently, at the time of this publication, calendar year 2022 is the latest year of monitoring data available on the AMTIC database. Additional information on the AMTIC archive and associated data available can be found at <https://www.epa.gov/amtic>.

F.5 Evidence Integration for Ambient Air

Evidence integration for the ambient air pathway brings together the multiple lines of evidence available from the modeled and measured concentrations of a chemical being evaluated (Sections F.2 and F.4) to arrive at an overall conclusion around the findings and exposure characterization. Strengths, limitations, uncertainties, and other factors described in the methodology sections are considered together as part of the weight of scientific evidence (WoSE) in support of the overall conclusions reached. Additional consideration of the WoSE around the ambient air pathway and other lines of evidence (like fate/physical and chemical properties, releases, etc.) are considered and brought together providing EPA an overall confidence around the conclusions reached and the results relied upon for exposure/risk characterization and deriving risk estimates to inform risk determination and regulatory decision-making.

F.6 Tier 2 Analysis for 1,1,2-Trichloroethane

14191 Table_Apx F-1. Maximum Single Release by Industry Sector and Release Dataset

Industry Sector	Number of Facilities in Industry Sector			TRI (Kg/yr)		NEI (2017) (Kg/yr)		NEI (2020) (Kg/yr)	
	TRI	NEI (2017)	NEI (2020)	Fugitive	Stack	Fugitive	Stack	Fugitive	Stack
Administration of Air and Water Resource and Solid Waste Management Programs	-	1	-			10	0		
Aircraft Manufacturing	-	1	2			0	1.0E-02	0	5.0E-03
All Other Basic Organic Chemical Manufacturing	9	7	7	860	830	3,400	1.80	4,200	550
All Other Miscellaneous Chemical Product and Preparation Manufacturing	-	2	2			510	0.2	410	8.0E-02
All Other Miscellaneous Wood Product Manufacturing	-	-	1					0	23
All Other Miscellaneous Crop Farming	-	1	-			4.0E-03	0		
All Other Petroleum and Coal Products Manufacturing	-	1	1			0	0.2	0	0.2
Aluminum Sheet, Plate, and Foil Manufacturing	-	1	1			4	0	4	0
Automatic Environmental Control Manufacturing for Residential, Commercial, and Appliance Use	-	1	-			0	2.0E-06		
Audio and Video Equipment Manufacturing	-	-	1					0	0.9
Cement Manufacturing	3	1	4	64	3	0	34	0.9	36
Cheese Manufacturing	-	-	1					0	0.1
Clay Building Material and Refractories Manufacturing	-	1	2			0	0.2	0	0.3
Colleges, Universities, and Professional Schools	-	-	1					2.0E-02	0
Correctional Institutions	-	1	1			8	0	5	0

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Industry Sector	Number of Facilities in Industry Sector			TRI (Kg/yr)		NEI (2017) (Kg/yr)		NEI (2020) (Kg/yr)	
	TRI	NEI (2017)	NEI (2020)	Fugitive	Stack	Fugitive	Stack	Fugitive	Stack
Custom Compounding of Purchased Resins	-	1	1			0	4.0E-02	0	4.0E-02
Engineering Services	-	1	-			2.0E-04	0		
Fossil Fuel Electric Power Generation	-	1	3			0.9	0	110	0
Ground or Treated Mineral and Earth Manufacturing	1	-	-	44	0.7				
Guided Missile and Space Vehicle Propulsion Unit and Propulsion Unit Parts Manufacturing	-	1	1			2.0E-05	0	2.0E-05	0
Hardwood Veneer and Plywood Manufacturing	-	1	-			0	0.6		
Hazardous Waste Collection	-	1	1			0.3	0.2	0.8	0.2
Hazardous Waste Treatment and Disposal	7	10	11	160	4	1	4	5	4
Lime Manufacturing	-	2	2			6	0.9	0.3	1
Line-Haul Railroads	-	1	1			0	0	0	0
Machine Shops	1	1	-	300	3,600	820	7,200		
Medicinal and Botanical Manufacturing	-	1	1			1.0E-02	0	2.0E-02	0
Metal Window and Door Manufacturing	-	-	1					5	0
Motor Home Manufacturing	-	1	1			45	0	18	0
Motor Vehicle Transmission and Power Train Parts Manufacturing	-	1	-			0.1	0		
National Security	-	4	6			2	2.0E-03	5	0.9
Natural Gas Extraction	-	5	6			0	0.9	9.0E-02	0.6
Nonferrous Metal Die-Casting Foundries	-	-	1					1.0E-03	0
Other Basic Inorganic Chemical Manufacturing	2	4	4	4,300	2,400	120	2	240	6
Other Electric Power Generation	-	3	1			0	1	0	2

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Industry Sector	Number of Facilities in Industry Sector			TRI (Kg/yr)		NEI (2017) (Kg/yr)		NEI (2020) (Kg/yr)	
	TRI	NEI (2017)	NEI (2020)	Fugitive	Stack	Fugitive	Stack	Fugitive	Stack
Other General Government Support	-	2	1			5.0E-02		2.0E-05	0
Other Metal Valve and Pipe Fitting Manufacturing	-	-	1					0.5	0
Other Nonhazardous Waste Treatment and Disposal	-	3	2			14	340	14	0
Other Nonmetallic Mineral Mining and Quarrying	-	-	1						1,600
Paper Bag and Coated and Treated Paper Manufacturing	-	-	2					0	3
Paper Mills	-	30	30			1,900	600	910	250
Paperboard Mills	-	13	12			2,000	1,700	2.0E04	1.2E04
Perishable Prepared Food Manufacturing	-	1	1			2.0E-03	0	1.0E-03	0
Petrochemical Manufacturing	1	7	7	1,300	0			820	850
Petroleum Refineries	-	3	6			2.0E-02	0.7	9	0.3
Pharmaceutical Preparation Manufacturing	-	-	1					0.1	0
Photographic Film, Paper, Plate, Chemical, and Copy Toner Manufacturing	-	1	2			0	9	0.5	3
Pipeline Transportation of Natural Gas	-	4	1			0	12	0	6.0E-02
Plastics Material and Resin Manufacturing	5	6	6	320	720	320	2,800	110	630
Pulp Mills	-	8	10			900	260	440	220
Reconstituted Wood Product Manufacturing	-	8	2			0.2	76	0.3	77
Regulation and Administration of Communications, Electric, Gas, and Other Utilities	-	1	-			0	5.0E-03		
Remediation Services	-	2	2			400	0.84	220	77
Research and Development in the	-	1	-			0.9	0		

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Industry Sector	Number of Facilities in Industry Sector			TRI (Kg/yr)		NEI (2017) (Kg/yr)		NEI (2020) (Kg/yr)	
	TRI	NEI (2017)	NEI (2020)	Fugitive	Stack	Fugitive	Stack	Fugitive	Stack
Physical, Engineering, and Life Sciences (except Nanotechnology and Biotechnology)									
Sawmills	-	2	1			2,500	5	2,800	0
Scheduled Passenger Air Transportation	-	1	-			0	5.0E04		
Semiconductor and Related Device Manufacturing	-	-	1					0	0
Sewage Treatment Facilities	-	220	226			12	180	20	49
Solid Waste Combustors and Incinerators	1	2	2	0.8	0.2	0.3	3.0E-05	0.3	2.0E-04
Solid Waste Landfill	-	44	49			73	260	73	140
Support Activities for Oil and Gas Operations	-	-	1					0	2
Tire Manufacturing (except Retreading)	-	1	1			0	4.0E-03	0	0
Water Supply and Irrigation Systems	-	1	-			17	0		
Wet Corn Milling and Starch Manufacturing	-	1	1			0	23	0	23

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Appendix G GENERAL POPULATION AMBIENT WATER EXPOSURE ASSESSMENT

G.1 Surface Water Tier 1 Analyses

For evaluation of exposures to both environmental and general human populations, Tier 1 surface water concentrations are shown for each evaluated OES based on facility-specific releases. Table_Apx G-1 shows concentrations based on the 7Q10 flow metric while Table_Apx G-2 presents concentrations for the 30Q5 and harmonic mean flow metrics.

G.1.1 Surface Water Concentrations

Table_Apx G-1. Facilities with Highest Modeled 7Q10 Flow Surface Water Concentrations per Occupational Exposure Scenario (OES) for TRI and DMR Releases 2019–2023 for Tier 1 Surface Water Evaluation

OES (NPDES) ^a	Annual Release (kg/yr)	Operating Days	Daily Release Estimate (kg/d)	7Q10 Flow (mld)	7Q10 Conc. (µg/L)
Manufacturing as a byproduct (LAJ660151) ^b	38	21	1.8	0.75	2,415
		350	0.11		145
Not Mapped to an OES (NV0022888 ^b ; NV0024239 ^c) ^e	0.76	21	3.6E–02	3.3	11
	0.04	250	1.6E–04	NA	7.9
Processing as a Reactant (PA0080594) ^b	216	21	10	0.97	1.1E04
		350	0.62		632
Repackaging (IL0005126) ^b	428	21	20	438	46
		250	1.7		3.9
Use of Laboratory Chemicals (CO0001511) ^d	5.9E–02	21	2.8E–03	0.15	18
		260	2.3E–04		1.5
Waste Handling, Disposal and Treatment (Incineration) (CA0030210) ^b	2.3E–02	21	1.1E–03	0.16	6.6
		250	9.0E–05		0.56
Waste Handling, Disposal and Treatment (Landfill) (KY0099660) ^b	0.64	21	3.0E–02	3.1	9.7
		250	2.6E–03		0.81
Waste Handling, Disposal and Treatment (non-POTW WWT) (CA0057827) ^b	1.1	21	5.3E–02	0.33	161
		250	4.4E–03		13
Waste Handling, Disposal and Treatment (POTW) (PA0046426) ^b	295	21	14	57	247
		365	0.81		14
Waste Handling, Disposal and Treatment (Remediation) (RI0022942 ^b ; VAG830596 ^c) ^e	0.23	21	1.1E–02	0.52	21
	5.4E–03	250	2.1E–05	NA	5

7Q10 = the modeled 7Q10 flow, in MLD (million liters per day); NPDES = National Pollutant Discharge Elimination System facility permit number

^a See Table 4-2 for crosswalk between Occupational Exposures Scenarios (OES) and Conditions of Use (COU) History Online Dataset (ECHO)

^b Concentrations based on flows from NHDPlus EROM dataset

^c Concentrations based on effluent flow concentrations for representative facility extracted from Enforcement and Compliance History Online Dataset (ECHO)

^d Concentrations based on plant flow for representative facility extracted from Enforcement and Compliance

^e Not Mapped to an OES and Waste Handling, Disposal and Treatment (Remediation) OES had different facilities

OES (NPDES) ^a	Annual Release (kg/yr)	Operating Days	Daily Release Estimate (kg/d)	7Q10 Flow (mld)	7Q10 Conc. (µg/L)
representing the highest 7Q10 flow surface water concentrations for the 21 and 250 operating day scenarios.					

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Table_Apx G-2. Facilities with Highest Modeled 30Q5 and Harmonic Mean (HM) Flow Instream Concentrations per Occupational Exposure Scenario (OES) for TRI and DMR Releases 2019–2023 for Tier 1 Evaluation

OES (NPDES) ^a	Annual Release (kg/yr)	Operating Days	Daily Release Estimate (kg/d)	30Q5 Flow (mld)	HM Flow (mld)	30Q5 Conc. (µg/L)	HM Conc. (µg /L)
Manufacturing as a Byproduct (LAJ660151) ^b	38	350	0.11	1.4	2.5	78	43
Not Mapped to an OES (NV0024239 ^c)	0.04	250	1.6E–04	NA	NA	7.9	7.9
Processing as a Reactant (PA0080594) ^{b e}	216	350	0.62	1.8	2	344	315
Processing as a Reactant (IL0000141) ^{b d e}	7.1	350	0.02	0.06	0.10	354	195
Repackaging (IL0005126) ^b	428	250	1.7	654	949	2.6	1.8
Use of laboratory chemicals (CO0001511) ^d	5.9E–02	260	2.3E–04	0.15	0.15	1.5	1.5
Waste Handling, Disposal and Treatment (Incineration) (CA0030210) ^b	2.3E–02	250	9.0E–05	0.32	0.92	0.28	9.8E–02
Waste Handling, Disposal and Treatment (Landfill) (KY0099660) ^b	0.64	250	2.6E–03	5.6	9	0.46	0.28
Waste Handling, Disposal and Treatment (non-POTW WWT) (NN0030343) ^d	0.11	250	4.5E–04	0.05	0.05	9.1	9.1
Waste Handling, Disposal and Treatment (POTW) (PA0046426) ^b	295	365	0.81	91	187	8.9	4.3
Waste Handling, Disposal and Treatment (Remediation) (VAG830596) ^c	5.4E–03	250	2.1E–05	NA	NA	5	5
30Q5 = the lowest monthly average flow from NHD, in MLD; NPDES = National Pollutant Discharge Elimination System facility permit number ^a See Table 4-2 for crosswalk between Occupational Exposures Scenarios OES) and Conditions of Use (COU) ^b Concentrations based on flows from NHDPlus EROM dataset ^c Concentrations based on effluent flow concentrations for representative facility extracted from Enforcement and Compliance History Online Dataset (ECHO) ^d Concentrations based on plant flow for representative facility extracted from Enforcement and Compliance History Online Dataset (ECHO) ^e Processing as a Reactant OES had different facilities representing the highest 30Q5 and HM surface water concentrations for the 250 operating day scenario							

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G.1.2 Environmental Exposure Evaluation

Based on the estimated Tier 1 surface water concentrations (Table_Apx G-1), EPA screened for preliminary risk to aquatic species including invertebrates, vertebrates and algae. Table_Apx G-3 summarizes the calculated acute and chronic risk quotients and highlights where chronic preliminary risk is identified for aquatic vertebrates with a calculated risk quotient greater than 1.

Table_Apx G-3. Risk Quotients from Facilities with Highest Modeled Instream Concentration per OES for TRI and DMR Releases 2019 – 2023 for Tier 1 Evaluation

OES (NPDES) ^a	Annual Release (kg/yr)	Operating Days	Release Estimate (kg/d)	7Q10 Flow (mld)	7Q10 Conc. (µg/L)	Risk Quotient		
						Acute Animals	Chronic Vertebrates	Algae
Manufacturing as a Byproduct (LAJ660151) ^b	38	21	1.8	0.75	2,415	9.5E-02	0.9	4.2E-02
		350	0.11		145	5.7E-03	5.4E-02	2.5E-03
Not Mapped to an OES (NV0022888 ^b ; NV0024239 ^c) ^e	0.76	21	3.6E-02	3.3	11	4.4E-04	4.1E-03	1.9E-04
	0.04	250	1.6E-04	NA	7.9	3.1E-04	3.0E-03	1.4E-04
Processing as a Reactant (PA0080594) ^b	216	21	10	0.97	1.1E04	0.42	3.9	0.18
		350	0.62		632	2.5E-02	0.24	1.1E-02
Repackaging (IL0005126) ^b	428	21	20	438	46	1.8E-03	1.7E-02	8.2E-04
		250	1.7		3.9	1.5E-04	1.5E-03	6.9E-05
Use of Laboratory Chemicals (CO0001511) ^d	5.9E-02	21	2.8E-03	0.15	18	7.3E-04	6.9E-03	3.2E-04
		260	2.3E-04		1.5	5.9E-05	5.6E-04	2.6E-05
Waste Handling, Disposal and Treatment (Incineration) (CA0030210) ^b	2.3E-02	21	1.1E-03	0.16	6.6	2.6E-04	2.5E-03	1.2E-04
		250	9.0E-05		0.56	2.2E-05	2.1E-04	9.7E-06
Waste Handling, Disposal and Treatment (Landfill) (KY0099660) ^b	0.64	21	3.0E-02	3.1	9.7	3.8E-04	3.6E-03	1.7E-04
		250	2.6E-03		0.81	3.2E-05	3.1E-04	1.4E-05
Waste Handling, Disposal and Treatment (POTW) (PA0046426) ^b	295	21	14	57	247	9.7E-03	9.2E-02	4.3E-03
		365	0.81		14	5.6E-04	5.3E-03	2.5E-04
Waste Handling, Disposal and Treatment (non-POTW WWT) (CA0057827) ^b	1.1	21	5.3E-02	0.33	161	6.3E-03	6.0E-02	2.8E-03
		250	4.4E-03		13	5.3E-04	5.1E-03	2.4E-04
Waste Handling, Disposal and Treatment (Remediation) (RI0022942 ^b ; VAG830596 ^c) ^e	0.23	21	1.1E-02	0.52	21	8.4E-04	8.0E-03	3.7E-04
	5.4E-03	250	2.1E-05	NA	5	2.0E-04	1.9E-03	8.8E-05

7Q10 = the modeled 7Q10 flow, in MLD (million liters per day); NPDES = National Pollutant Discharge Elimination System facility permit number

^a See BLAH for crosswalk between Occupational Exposures Scenarios OES) and Conditions of Use (COU) Dataset (ECHO)

^b Concentrations based on flows from NHDPlus EROM dataset

^c Concentrations based on effluent flow concentrations for representative facility extracted from Enforcement and Compliance History Online Dataset (ECHO)

^d Concentrations based on plant flow for representative facility extracted from Enforcement and Compliance History Online

^e OES had different facilities representing the highest 7Q10 flow surface water concentrations for the 21 and 250 operating day scenarios.

Values identifying preliminary risk are bolded.

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G.1.3 Incidental Dermal Evaluation

Based on the estimated dermal doses in Table_Apx G-4. Calculated from Tier 1 surface water concentrations in Table_Apx G-2, EPA screened for risk to adults (21+ years), youth (11–15 years), and children (6–10 years). Table_Apx G-5 summarizes the acute MOEs based on the dermal doses. Using the total acute dose based on the highest modeled 95th percentile, the MOEs are greater than the benchmark of 30. Based on the conservative modeling parameters for surface water concentration and exposure factors parameters, preliminary risk for non-cancer health effects for dermal absorption through swimming is not expected.

Table_Apx G-4. Facility-Specific Incidental Dermal (Swimming) Acute Doses across Adult, Youth and Child Lifestages by Occupational Exposure Scenario (OES) (Tier I)

OES ^a	Modeled Surface Water Concentrations		Adult (21+ years)	Youth (11-15 years)	Child (6-10 years)
	30Q5 Conc. (µg/L)	HM Conc. (µg /L)	ADR _{POT} (mg/kg-day)	ADR _{POT} (mg/kg-day)	ADR _{POT} (mg/kg-day)
Manufacturing as a Byproduct	78	43	3.2E-04	2.5E-04	1.5E-04
Not Mapped to an OES	7.9	7.9	3.3E-05	2.5E-05	1.5E-05
Processing as a Reactant ^b	354	195	1.5E-03	1.1E-03	6.8E-04
Repackaging	2.6	1.8	1.1E-05	8.3E-06	5.0E-06
Use of Laboratory Chemicals	1.5	1.5	6.2E-06	4.7E-06	2.9E-06
Waste Handling, Disposal and Treatment (Incineration)	0.28	9.8E-02	1.2E-06	9.0E-07	5.5E-07
Waste Handling, Disposal and Treatment (Landfill)	0.46	0.28	1.9E-06	1.5E-06	8.9E-07
Waste Handling, Disposal and Treatment (non-POTW WWT)	9.1	9.1	3.8E-05	2.9E-05	1.7E-05
Waste Handling, Disposal and Treatment (POTW)	8.9	4.3	3.7E-05	2.8E-05	1.7E-05
Waste Handling, Disposal and Treatment (Remediation)	5	5	2.1E-05	1.6E-05	9.6E-06
30Q5 = 30 consecutive days of lowest flow over a 5-year period; HM = Harmonic mean; ADR = Acute dose rate; POT = Potential					
^a Each OES is represented by the facility within that OES with the highest estimated surface water concentration for that OES as described in Section 6.2.1.1.					
^b Processing as a Reactant OES had two different facilities with the highest 30Q5 and HM concentrations. Only the facility with the highest 30Q5 concentration is shown here since that flow metric is used for calculation of incidental exposures as described in Section 6.4.1.					

Table_Apx G-5. Facility-Specific Incidental Dermal (Swimming) Acute Risk across Adult, Youth and Child Lifestages by Occupational Exposure Scenario (OES) (Tier I)

OES ^a	Modeled Surface Water Concentrations		Acute MOE ^b (BM = 30)		
	30Q5 Conc. (µg/L)	HM Conc. (µg/L)	Adult (21+ years)	Youth (11-15 years)	Child (6-10 years)
Manufacturing as a Byproduct	78	43	3.9E04	5.1E04	8.4E04
Not Mapped to an OES	7.9	7.9	3.8E05	5.0E05	8.3E05

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OES ^a	Modeled Surface Water Concentrations		Acute MOE ^b (BM = 30)		
	30Q5 Conc. (µg/L)	HM Conc. (µg/L)	Adult (21+ years)	Youth (11-15 years)	Child (6-10 years)
Processing as a Reactant ^c	354	195	8,563	1.1E04	1.8E04
Repackaging	2.6	1.8	1.2E06	1.5E06	2.5E06
Use of Laboratory Chemicals	1.5	1.5	2.0E06	2.7E06	4.4E06
Waste Handling, Disposal and Treatment (Incineration)	0.28	9.8E-02	1.1E07	1.4E07	2.3E07
Waste Handling, Disposal and Treatment (Landfill)	0.46	0.28	6.6E06	8.6E06	1.4E07
Waste Handling, Disposal and Treatment (non-POTW WWT)	9.1	9.1	3.3E05	4.4E05	7.2E05
Waste Handling, Disposal and Treatment (POTW)	8.9	4.3	3.4E05	4.5E05	7.4E05
Waste Handling, Disposal and Treatment (Remediation)	5	5	6.1E05	7.9E05	1.3E06
30Q5 = 30 consecutive days of lowest flow over a 5-year period; HM = Harmonic Mean; MOE = Margin of exposure; BM = Benchmark					
^a Each OES is represented by the facility within that OES with the highest estimated surface water concentration for that OES as described in Section 6.2.1.1.					
^b MOEs calculated based on doses presented in Table_Apx G-4					
^c Processing as a Reactant OES had two different facilities with the highest 30Q5 and HM concentrations. Only the facility with the highest 30Q5 concentration is shown here since that flow metric is used for calculation of incidental exposures as described in Section 6.4.1.					

G.1.4 Incidental Oral Evaluation

Based on the estimated dermal doses in Table_Apx G-6. Calculated from Tier 1 surface water concentrations in Table_Apx G-2, EPA screened for risk to adults (21+ years), youth (11–15 years), and children (6–10 years). Table_Apx G-7 summarizes the acute MOEs based on the oral ingestion doses. Using the total acute dose, the MOEs are greater than the benchmark of 30. Based on the conservative modeling parameters for surface water concentration and exposure factors parameters, preliminary risk for non-cancer health effects for oral ingestion through swimming is not expected.

Table_Apx G-6. Facility-Specific Incidental Oral (Swimming) Acute Doses across Adult, Youth, and Child Lifestages by Occupational Exposure Scenario (OES) (Tier I)

OES ^a	Modeled Surface Water Concentrations		Adult (21+ years)	Youth (11-15 years)	Child (6-10 years)
	30Q5 Conc. (µg/L)	HM Conc. (µg/L)	ADR _{POT} (mg/kg-day)	ADR _{POT} (mg/kg-day)	ADR _{POT} (mg/kg-day)
Manufacturing as a Byproduct	78	43	2.7E-04	4.2E-04	2.4E-04
Not Mapped to an OES	7.9	7.9	2.7E-05	4.2E-05	2.4E-05
Processing as a Reactant ^b	354	195	1.2E-03	1.9E-03	1.1E-03
Repackaging	2.6	1.8	9.0E-06	1.4E-05	7.9E-06
Use of Laboratory Chemicals	1.5	1.5	5.1E-06	8.0E-06	4.5E-06
Waste Handling, Disposal and Treatment (Incineration)	0.28	9.8E-02	9.8E-07	1.5E-06	8.6E-07

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OES ^a	Modeled Surface Water Concentrations		Adult (21+ years)	Youth (11-15 years)	Child (6-10 years)
	30Q5 Conc. (µg/L)	HM Conc. (µg/L)	ADR _{POT} (mg/kg-day)	ADR _{POT} (mg/kg-day)	ADR _{POT} (mg/kg-day)
Waste Handling, Disposal and Treatment (Landfill)	0.46	0.28	1.6E-06	2.5E-06	1.4E-06
Waste Handling, Disposal and Treatment (non-POTW WWT)	9.1	9.1	3.1E-05	4.9E-05	2.7E-05
Waste Handling, Disposal and Treatment (POTW)	8.9	4.3	3.1E-05	4.7E-05	2.7E-05
Waste Handling, Disposal and Treatment (Remediation)	5	5	1.7E-05	2.7E-05	1.5E-05
30Q5 = 30 consecutive days of lowest flow over a 5-year period; HM = Harmonic Mean; ADR = acute dose rate; POT = potential					
^a Each OES is represented by the facility within that OES with the highest estimated surface water concentration for that OES as described in Section 6.2.1.1					
^b Processing as a Reactant OES had two different facilities with the highest 30Q5 and HM concentrations. Only the facility with the highest 30Q5 concentration is shown here since that flow metric is used for calculation of incidental exposures as described in Section 6.4.2					

Table_Apx G-7. Facility-Specific Incidental Oral (Swimming) Acute Risk across Adult, Youth, and Child Lifestages by Occupational Exposure Scenario (OES) (Tier 1)

OES ^a	Modeled Surface Water Concentrations		Acute MOE ^b (BM = 30)		
	30Q5 Conc. (µg/L)	HM Conc. (µg/L)	Adult (21+ years)	Youth (11-15 years)	Child (6-10 years)
Manufacturing as a Byproduct	78	43	4.7E04	3.0E04	5.3E04
Not Mapped to an OES	7.9	7.9	4.6E05	3.0E05	5.3E05
Processing as a Reactant	354	195	1.0E04	6,645	1.2E04
Repackaging	2.6	1.8	1.4E06	9.0E05	1.6E06
Use of Laboratory Chemicals	1.5	1.5	2.5E06	1.6E06	2.8E06
Waste Handling, Disposal and Treatment (Incineration)	0.28	9.8E-02	1.3E07	8.3E06	1.5E07
Waste Handling, Disposal and Treatment (Landfill)	0.46	0.28	7.9E06	5.1E06	9.1E06
Waste Handling, Disposal and Treatment (non-POTW WWT)	9.1	9.1	4.0E05	2.6E05	4.6E05
Waste Handling, Disposal and Treatment (POTW)	8.9	4.3	4.1E05	2.7E05	4.7E05
Waste Handling, Disposal and Treatment (Remediation)	5	5	7.3E05	4.7E05	8.3E05
30Q5 = 30 consecutive days of lowest flow over a 5-year period; HM = Harmonic Mean; MOE = Margin of exposure; BM = Benchmark					
^a Each OES is represented by the facility within that OES with the highest estimated surface water concentration for that OES as described in Section 6.2.1.1					
^b MOEs calculated based on doses presented in Table_Apx G-6					
^c Processing as a Reactant OES had two different facilities with the highest 30Q5 and HM concentrations. Only the					

OES ^a	Modeled Surface Water Concentrations		Acute MOE ^b (BM = 30)		
	30Q5 Conc. (µg/L)	HM Conc. (µg/L)	Adult (21+ years)	Youth (11-15 years)	Child (6-10 years)
facility with the highest 30Q5 concentration is shown here since that flow metric is used for calculation of incidental exposures as described in Section 6.4.2					

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G.1.5 Drinking Water Evaluation

Based on the estimated drinking water doses in Table_Apx G-8 calculated from Tier 1 surface water concentrations in Table_Apx G-2, EPA screened for preliminary risk to adults (21+ years), toddlers (1–5 years), and infants (birth to <1 year). Table_Apx G-9 summarizes the acute and chronic non-cancer MOEs and chronic cancer lifetime preliminary risk. MOEs are below the benchmark of 300 for chronic non-cancer health effects and greater than the benchmark of 1.0×10^{-6} for lifetime cancer risk identifying preliminary risk for drinking water exposure.

Table_Apx G-8. Facility-Specific Drinking Water Doses Across Adult, Infant, and Toddler Lifestages by Occupational Exposure Scenario (OES) Based on Tier 1 Modeled Surface Water Concentrations

OES ^a	Modeled Surface Water Concentrations		Adult (21+ years)			Infant (birth to <1 year)			Toddler (1–5 years)		
	30Q5 Conc. (µg/L)	HM Conc. (µg/L)	ADRPOT (mg/kg-day)	ADD (mg/kg-day)	LADDPOT (mg/kg-day)	ADRPOT (mg/kg-day)	ADD (mg/kg-day)	LADDPOT (mg/kg-day)	ADRPOT (mg/kg-day)	ADD (mg/kg-day)	LADDPOT (mg/kg-day)
Manufacturing as a Byproduct	78	43	3.1E-03	4.6E-04	3.3E-04	1.1E-02	1.2E-03	1.5E-05	3.9E-03	5.0E-04	3.2E-05
Not Mapped to an OES	7.9	7.9	3.2E-04	5.9E-05	4.3E-05	1.1E-03	1.5E-04	1.9E-06	4.0E-04	6.5E-05	4.2E-06
Processing as a Reactant ^b	344	315	1.4E-02	3.3E-03	2.4E-03	4.9E-02	8.5E-03	1.1E-04	1.7E-02	3.6E-03	2.3E-04
Processing as a Reactant ^b	354	195	1.4E-02	2.1E-03	1.5E-03	5.0E-02	5.3E-03	6.7E-05	1.8E-02	2.3E-03	1.4E-04
Repackaging	2.6	1.8	1.1E-04	1.4E-05	9.9E-06	3.7E-04	3.5E-05	4.4E-07	1.3E-04	1.5E-05	9.5E-07
Use of Laboratory Chemicals	1.5	1.5	6.0E-05	1.2E-05	8.5E-06	2.1E-04	3.0E-05	3.8E-07	7.5E-05	1.3E-05	8.2E-07
Waste Handling, Disposal and Treatment (Incineration)	0.28	9.8E-02	1.1E-05	7.4E-07	5.4E-07	4.0E-05	1.9E-06	2.4E-08	1.4E-05	8.1E-07	5.2E-08
Waste Handling, Disposal and Treatment (Landfill)	0.46	0.28	1.9E-05	2.1E-06	1.6E-06	6.5E-05	5.4E-06	7.0E-08	2.3E-05	2.3E-06	1.5E-07
Waste Handling, Disposal and Treatment (Non-POTW WWT)	9.1	9.1	3.6E-04	6.8E-05	5.0E-05	1.3E-03	1.7E-04	2.2E-06	4.6E-04	7.5E-05	4.8E-06
Waste Handling, Disposal and Treatment (POTW)	8.9	4.3	3.6E-04	4.7E-05	3.5E-05	1.3E-03	1.2E-04	1.6E-06	4.4E-04	5.2E-05	3.3E-06

OES ^a	Modeled Surface Water Concentrations		Adult (21+ years)			Infant (birth to <1 year)			Toddler (1–5 years)		
	30Q5 Conc. (µg/L)	HM Conc. (µg/L)	ADR _{POT} (mg/kg-day)	ADD (mg/kg-day)	LADD _{POT} (mg/kg-day)	ADR _{POT} (mg/kg-day)	ADD (mg/kg-day)	LADD _{POT} (mg/kg-day)	ADR _{POT} (mg/kg-day)	ADD (mg/kg-day)	LADD _{POT} (mg/kg-day)
Waste Handling, Disposal and Treatment (Remediation)	5	5	2.0E-04	3.8E-05	2.8E-05	7.1E-04	9.6E-05	1.2E-06	2.5E-04	4.1E-05	2.6E-06

30Q5 = 30 consecutive days of lowest flow over a 5-year period; HM = Harmonic mean; ADR = Acute dose rate; ADD = Average daily dose; LADD = Lifetime average daily dose; POT = Potential

^a Each OES is represented by the facility within that OES with the highest estimated surface water concentration for that OES as described in Section 6.2.1.1

^b Processing as a Reactant OES had two different facilities with the highest 30Q5 and HM concentrations. Both are presented here as different flow metrics are used for calculation of acute vs. chronic exposures as described in Section 6.4.3

Table_Apx G-9. Facility-Specific Drinking Water Risks across Adult, Infant and Toddler Lifestages by Occupational Exposure Scenario (OES) Based on Tier 1 Modeled Surface Water Concentrations

OES ^a	Modeled Surface Water Concentrations		Lifetime Cancer Risk Value (BM = 1.0E-06)	Adult (21+ years)		Infant (birth to < 1 year)		Toddler (1–5 years)	
	30Q5 Conc. (µg/L)	HM Conc. (µg/L)		Acute Non-cancer MOE (BM = 30)	Chronic Non-cancer MOE (BM = 300)	Acute Non-cancer MOE (BM = 30)	Chronic Non-cancer MOE (BM = 300)	Acute Non-cancer MOE (BM = 30)	Chronic Non-cancer MOE (BM = 300)
Manufacturing as a Byproduct	78	43	1.2E-05	4,008	1,142	1,142	447	3,213	1,043
Not Mapped to an OES	7.9	7.9	1.5E-06	4.0E04	8,740	1.1E04	3,422	3.2E04	7,984
Processing as a Reactant ^b	344	315	8.4E-05	910	157	259	61	730	143
Processing as a Reactant ^b	354	195	5.2E-05	884	253	252	99	708	231
Repackaging	2.6	1.8	3.5E-07	1.2E05	3.8E04	3.4E04	1.5E04	9.6E04	3.5E04
Use of Laboratory Chemicals	1.5	1.5	3.0E-07	2.1E05	4.5E04	6.0E04	1.7E04	1.7E05	4.1E04
Waste Handling, Disposal and Treatment (Incineration)	0.28	9.8E-02	1.9E-08	1.1E06	7.0E05	3.1E05	2.7E05	8.8E05	6.4E05
Waste Handling, Disposal and Treatment (Landfill)	0.46	0.28	5.4E-08	6.8E05	2.4E05	1.9E05	9.5E04	5.4E05	2.2E05
Waste Handling, Disposal and Treatment (non-POTW WWT)	9.1	9.1	1.7E-06	3.5E04	7,618	9,846	2,983	2.8E04	6,959
Waste Handling, Disposal and Treatment (POTW)	8.9	4.3	1.2E-06	3.5E04	1.1E04	1.0E04	4,290	2.8E04	1.0E04
Waste Handling, Disposal and Treatment (Remediation)	5	5	9.6E-07	6.3E04	1.4E04	1.8E04	5,406	5.0E04	1.3E04

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OES ^a	Modeled Surface Water Concentrations		Lifetime Cancer Risk Value (BM = 1.0E–06)	Adult (21+ years)		Infant (birth to < 1 year)		Toddler (1–5 years)	
	30Q5 Conc. (µg/L)	HM Conc. (µg/L)		Acute Non-cancer MOE (BM = 30)	Chronic Non-cancer MOE (BM = 300)	Acute Non-cancer MOE (BM = 30)	Chronic Non-cancer MOE (BM = 300)	Acute Non-cancer MOE (BM = 30)	Chronic Non-cancer MOE (BM = 300)
HM = Harmonic mean; 30Q5 = 30 consecutive days of lowest flow over a 5-year period; MOE = Margin of exposure; BM = Benchmark									
^a Each OES is represented by the facility within that OES with the highest estimated surface water concentration for that OES as described in Section 6.2.1.1									
^b Processing as a Reactant OES had two different facilities with the highest 30Q5 and HM concentrations. Both are presented here as different flow metrics are used for calculation of acute vs. chronic exposures as described in Section 6.4.3									
Values identifying preliminary risk are bolded.									

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G.2 Surface Water Tier 2 Analyses

Facilities identified for possible Tier 2 refinement are identified in H10 based on Tier 1 surface water concentrations and evaluation of preliminary risk for environmental and general populations. Refinements are based off available effluent monitoring data of 1,1,2-trichloroethane as reported in the ECHO database for the specific facility.

G.2.1 Surface Water Concentrations

Table_Apx G-10. Identified Facilities Able to Undergo Refinement based on Reported Effluent Monitoring Information

Facility (max year)	OES	Operating Days	Initial Concentration (µg/L)			Refined Conc. ^c (µg/L)
			7Q10	30Q5	HM	
Equistar Chemicals LP Tuscola Plant (2020)	Proc. as a Reactant	21	5904.8 ^a	5904.8	3250.4	5.0
		350	354.3	354.3	195.0 ^b	
North Amer Pipe Corp/Leola (2021)	Proc. as a Reactant	21	1.0E04 ^a	5732.8	5249.3	1.0
		350	632.4	344.0	315.0 ^b	
Franklin Twp Sew Auth STP (2022)	Waste Handling, Disposal and Treatment (POTW)	21	246.6	154.0	75.0	0.66
		365	14.2	8.86	4.32 ^b	
Pearl Harbor Naval Shipyard and Int. Maint. Fac. (2021)	Waste Handling, Disposal and Treatment (non- POTW WWT)	21	83.3	83.3	83.3	1.0
		250	7.0	7.0	7.0 ^b	
7Q10 flow concentrations used for evaluation of environmental exposures; 30Q5 and HM concentrations used for evaluation of general population exposures						
^a Identified preliminary risk with risk quotient greater than 1 for environmental exposure						
^b Identified preliminary risk relative to benchmark for general population exposures						
^c Refined concentration is based on reported effluent concentrations of 1,1,2-trichloroethane as reported in the ECHO database for the specific facility.						

G.2.2 Drinking Water Evaluation

Based on the estimated drinking water doses for facility-specific releases in Table_Apx G-11 calculated from Tier 2 surface water concentrations in Table 6-5 and for generic scenario doses in Table 6-22 calculated from surface water concentrations in Table 6-11, EPA screened for preliminary risk to adults (21+ years), toddlers (1–5 years), and infants (birth–<1 year). Table_Apx G-12 and Table_Apx G-13 summarizes the acute and chronic non-cancer MOEs and chronic cancer lifetime preliminary risk for facility-specific releases and generic scenario releases respectively. Acute and chronic non-cancer health effects are all greater than their benchmarks of 30 and 300 respectively, indicating preliminary risk is not identified for both facility-specific and generic scenario releases. Lifetime cancer risks are identified for scenarios greater than the benchmark of 1.0×10^{-6} indicating preliminary risk for chronic cancer drinking water exposure for facility-specific releases.

Table_Apx G-11. Facility-Specific Drinking Water Doses across Adult, Infant, and Toddler Lifestages by Occupational Exposure Scenario (OES) Based on Tier 2 Modeled Surface Water Concentrations

OES ¹	Modeled Surface Water Concentrations		Adult (21+ years)			Infant (birth to < 1 year)			Toddler (1-5 years)		
	30Q5 Conc. (µg/L)	HM Conc. (µg/L)	ADR _{POT} (mg/kg-day)	ADD (mg/kg-day)	LADD _{POT} (mg/kg-day)	ADR _{POT} (mg/kg-day)	ADD (mg/kg-day)	LADD _{POT} (mg/kg-day)	ADR _{POT} (mg/kg-day)	ADD (mg/kg-day)	LADD _{POT} (mg/kg-day)
Manufacturing as a Byproduct	78	43	3.1E-03	4.6E-04	3.3E-04	1.1E-02	1.2E-03	1.5E-05	3.9E-03	5.0E-04	3.2E-05
Not Mapped to an OES	7.9	7.9	3.2E-04	5.9E-05	4.3E-05	1.1E-03	1.5E-04	1.9E-06	4.0E-04	6.5E-05	4.2E-06
Processing as a Reactant	12	12	4.7E-04	1.2E-04	9.1E-05	1.7E-03	3.2E-04	4.1E-06	5.9E-04	1.4E-04	8.7E-06
Repackaging	2.6	1.8	1.1E-04	1.4E-05	9.9E-06	3.7E-04	3.5E-05	4.4E-07	1.3E-04	1.5E-05	9.5E-07
Use of Laboratory Chemicals	1.5	1.5	6.0E-05	1.2E-05	8.5E-06	2.1E-04	3.0E-05	3.8E-07	7.5E-05	1.3E-05	8.2E-07
Waste Handling, Disposal and Treatment (Incineration)	0.28	9.8E-02	1.1E-05	7.4E-07	5.4E-07	4.0E-05	1.9E-06	2.4E-08	1.4E-05	8.1E-07	5.2E-08
Waste Handling, Disposal and Treatment (Landfill)	0.46	0.28	1.9E-05	2.1E-06	1.6E-06	6.5E-05	5.4E-06	7.0E-08	2.3E-05	2.3E-06	1.5E-07
Waste Handling, Disposal and Treatment (non-POTW WWT)	9.1	9.1	3.6E-04	6.8E-05	5.0E-05	1.3E-03	1.7E-04	2.2E-06	4.6E-04	7.5E-05	4.8E-06
Waste Handling, Disposal and Treatment (POTW)	4.9	4.1	2.0E-04	4.5E-05	3.3E-05	6.9E-04	1.1E-04	1.5E-06	2.4E-04	4.9E-05	3.1E-06
Waste Handling, Disposal and Treatment (Remediation)	5	5	2.0E-04	3.8E-05	2.8E-05	7.1E-04	9.6E-05	1.2E-06	2.5E-04	4.1E-05	2.6E-06

30Q5 = 30 consecutive days of lowest flow over a 5-year period; HM = Harmonic mean; ADR = Acute dose rate; ADD = Average daily dose; LADD = Lifetime average daily dose; POT = Potential

^a Each OES is represented by the facility within that OES with the highest estimated surface water concentration for that OES as described in Section 6.2.1.1

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Table_Apx G-12. Facility-Specific Drinking Water Risks across Adult, Infant and Toddler Lifestages by Occupational Exposure Scenario (OES) Based on Tier 2 Modeled Surface Water Concentrations

OES ^a	Surface Water Concentrations		Adult Lifetime Cancer Risk (BM = 1.0E-06)	Adult (21+ years)		Infant (birth to < 1 year)		Toddler (1-5 years)	
	30Q5 Conc. (µg/L)	HM Conc. (µg/L)		Acute Non-Cancer MOE (BM = 30)	Chronic Non-Cancer MOE (BM = 300)	Acute Non-Cancer MOE (BM = 30)	Chronic Non-Cancer MOE (BM = 300)	Acute Non-Cancer MOE (BM = 30)	Chronic Non-Cancer MOE (BM = 300)
Manufacturing as a Byproduct	78	43	1.2E-05	4,008	1,142	1,142	447	3,213	1,043
Not Mapped to an OES	7.9	7.9	1.5E-06	4.0E04	8,740	1.1E04	3,422	3.2E04	7,984
Processing as a Reactant	12	12	3.2E-06	2.7E04	4,194	7,589	1,642	2.1E04	3,831
Repackaging	2.6	1.8	3.5E-07	1.2E05	3.8E04	3.4E04	1.5E04	9.6E04	3.5E04
Use of Laboratory Chemicals	1.5	1.5	3.0E-07	2.1E05	4.5E04	6.0E04	1.7E04	1.7E05	4.1E04
Waste Handling, Disposal and Treatment (Incineration)	0.28	9.8E-02	1.9E-08	1.1E06	7.0E05	3.1E05	2.7E05	8.8E05	6.4E05
Waste Handling, Disposal and Treatment (Landfill)	0.46	0.28	5.4E-08	6.8E05	2.4E05	1.9E05	9.5E04	5.4E05	2.2E05
Waste Handling, Disposal and Treatment (non-POTW WWT)	9.1	9.1	1.7E-06	3.5E04	7,618	9,846	2,983	2.8E04	6,959
Waste Handling, Disposal and Treatment (POTW)	4.9	4.1	1.1E-06	6.4E04	1.2E04	1.8E04	4,561	5.1E04	1.1E04
Waste Handling, Disposal and Treatment (Remediation)	5	5	9.6E-07	6.3E04	1.4E04	1.8E04	5,406	5.0E04	1.3E04
30Q5 = 30 consecutive days of lowest flow over a 5-year period; HM = Harmonic mean; MOE = Margin of exposure; BM = Benchmark									
^a Each OES is represented by the facility within that OES with the highest estimated surface water concentration for that OES as described in Section 6.2.1.1									
Values identifying preliminary risk are bolded.									

Table_Apx G-13. Generic Scenario Drinking Water Risk across Adult, Infant, and Toddler Lifestages by Occupational Exposure Scenario (OES)

OES ^a	Flow Percentile	Modeled Surface Water Concentrations		Adult Lifetime Cancer (BM = 1.0E-06)	Adult (21+ years)		Infant (birth to < 1 year)		Toddler (1-5 years)	
		30Q5 Conc. (µg/L)	HM Conc. (ug/L)		Acute Non-Cancer MOE (BM = 30)	Chronic Non-Cancer MOE (BM = 300)	Acute Non-Cancer MOE (BM = 30)	Chronic Non-Cancer MOE (BM = 300)	Acute Non-Cancer MOE (BM = 30)	Chronic Non-Cancer MOE (BM = 300)
Formulation of Adhesives and Sealants	P10	2.4	2.0	5.7E-07	1.3E05	2.3E04	3.8E04	9,106	1.1E05	2.1E04
Use of Cleaning and Degreasing Solvents	P10	3.5 E-03	3.5 E-03	7.9 E-10	8.9E07	1.7E07	2.5E07	6.5E06	7.1E07	1.5E07
Use of Adhesives and Sealants	P10	3.3 E-03	3.0 E-03	6.1 E-10	9.4E07	2.2E07	2.7E07	8.6E06	7.6E07	2.0E07
30Q5 = 30 consecutive days of lowest flow over a 5-year period; HM = Harmonic mean flow; MOE = Margin of exposure; BM = Benchmark										
^a Each OES represented in table by the high-end release scenario for that OES as described in Section 6.2.1.2 and Table 6-11										

G.3 Exposure Factors

Table_Apx G-14. Body Weight by Age Group

Age Group ^a	Mean Body Weight (kg) ^b
Infant (<1 year)	7.83
Young toddler (1 to <2 years)	11.4
Toddler (2 to <3 years)	13.8
Small child (3 to <6 years)	18.6
Child (6 to <11 years)	31.8
Teen (11 to <16 years)	56.8
Adult (16+ years)	80.0
^a Age group weighted average	
^b See Table 8-1 of U.S. EPA (2011)	

Table_Apx G-15. Fish Ingestion Rates by Age Group

Age Group	Fish Ingestion Rate (g/kg-day) ^a	
	50th Percentile	90th Percentile
Infant (<1 year) ^b	N/A	N/A
Young toddler (1 to <2 years) ^b	0.053	0.412
Toddler (2 to <3 years) ^b	0.043	0.341
Small child (3 to <6 years) ^b	0.038	0.312
Child (6 to <11 years) ^b	0.035	0.242
Teen (11 to <16 years) ^b	0.019	0.146
Adult (16+ years) ^c	0.063	0.277
Subsistence fisher (adult) ^d	1.78	

^a Age group-weighted average using body weight from Table_Apx

^b See Table 20a of [U.S. EPA \(2014a\)](#)

^c See Table 9a of [U.S. EPA \(2014a\)](#)

^d [U.S. EPA \(2000\)](#)

Table_Apx G-16. Recommended Default Values for Common Exposure Factors

Symbol	Definition	Recommended Default Value	Recommended Default Value	Source
		Occupational	Residential	
ED	Exposure duration (hours/day)	8	24	
EF	Exposure frequency (days/year)	250	365	
EY	Exposure years (years)	40	Varies for Adult (chronic non-cancer)	Number of years in age group.

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Symbol	Definition	Recommended Default Value	Recommended Default Value	Source
		Occupational	Residential	
			78 → (Lifetime) 1 → Infant (birth to <1 year) 5 → Toddler (1–5 years) 5 → Child (6–10 years) 5 → Youth (11–15 years) 5 → Youth (16–20 years)	Note: These age bins may vary for different measurements and sources
AT	Averaging time non-cancer	Equal to total exposure duration or 365 days/yr × EY; whichever is greater	Equal to total exposure duration or 365 days/yr × EY; whichever is greater	See pg. 6–23 of Risk assessment guidance for superfund, volume I: Human health evaluation manual (Part A). (U.S. EPA, 1989)
	Averaging time cancer	78 years (28,470 days)	78 years (28,470 days)	See Table 18-1 of the <i>Exposure Factors Handbook</i> (U.S. EPA, 2011)
BW	Body weight (kg)	80	80 → Adult 7.83 → Infant (birth to <1 year) 16.2 → Toddler (1–5 years) 31.8 → Child (6–10 years) 56.8 → Youth (11–15 years) 71.6 → Youth (16–20 years) 65.9 → Adolescent woman of childbearing age (16 to <21) – apply to all developmental exposure scenarios	See Table 8-1 of the <i>Exposure Factors Handbook</i> (U.S. EPA, 2011) (Refer to Figure 31 for age-specific BW) Note: These age bins may vary for different measurements and sources See Table 8-5 of the <i>Exposure Factors Handbook</i> (U.S. EPA, 2011)
IR _{dw-acute}	Drinking water ingestion rate (L/day) – acute	3.219 Adult	3.219 → Adult 1.106 → Infant (birth to <1 year) 0.813 → Toddler (1–5 years) 1.258 → Child (6–10 years) 1.761 → Youth (11–15 years) 2.214 → Youth (16–20 years)	See Tables 3-15 and 3-33; weighted average of 90th percentile consumer-only ingestion of drinking water (birth to <6 years) (U.S. EPA, 2011)
IR _{dw-chronic}	Drinking water ingestion rate (L/day) – chronic	0.880 Adult	0.880 → Adult 0.220 → Infant (birth to <1 year) 0.195 → Toddler (1–5 years) 0.294 → Child (6–10 years) 0.315 → Youth (11–15 years) 0.436 → Youth (16–20 years)	Chapter 3 of the <i>Exposure Factors Handbook</i> (U.S. EPA, 2011), Table 3-9 per capita mean values; weighted averages for adults (years 21–49 and 50+), for toddlers (years 1–2, 2–3, and 3 to <6).
IR _{inc}	Incidental water ingestion rate (L/hr)		0.025 → Adult 0.05 → Child (6 to < 16 years)	Evaluation of Swimmer Exposures Using the SWIMODEL Algorithms and Assumptions (U.S. EPA, 2015b)
IR _{fish}	Fish ingestion rate (g/day)		22 → Adult	Estimated Fish Consumption Rates for the U.S. Population and Selected Subpopulations (U.S. EPA, 2014a) This represents the 90th percentile consumption rate of fish and shellfish from inland

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Symbol	Definition	Recommended Default Value	Recommended Default Value	Source
		Occupational	Residential	
				and nearshore waters for the U.S. adult population 21 years of age and older, based on NHANES data from 2003–2010
IR _{soil}	Soil ingestion rate (mg/day)	50 Indoor workers 100 Outdoor workers	100 → Infant (<6 months) 200 → Infant to Youth (6 months to <12 years) 100 → Youth to adult (12+ years) 1,000 → Soil pica infant to youth (1 to <12 years) 50,000 → Geophagy (all ages)	U.S. EPA Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (1991) Chapter 5 of the <i>Exposure Factors Handbook</i> (U.S. EPA, 2011), Table 5-1, Upper percentile daily soil and dust ingestion
SA _{water}	Skin surface area exposed (cm ²) used for incidental water dermal contact		19,500 → Adult 7,600 → Child (3 to <6 years) 10,800 → Child (6 to <11 years) 15,900 → Youth (11 to <16 years)	Chapter 7 of the <i>Exposure Factors Handbook</i> (U.S. EPA, 2011), Table 7-1, Recommended Mean Values for Total Body Surface Area, for Children (sexes combined) and Adults by Sex
K _p	Permeability constant (cm/hr) used for incidental water dermal contact		0.001 Or calculated using K _p equation with chemical specific K _{ow} and MW (see exposure formulas)	EPA Dermal Exposure Assessment: Principles and Applications (U.S. EPA, 1992a), Table 5-7, “Predicted K _p Estimates for Common Pollutants”
SA _{soil}	Skin surface area exposed (cm ²) used for soil dermal contact	3,300 Adult	5,800 → Adult 2,700 → Child	EPA Risk Assessment Guidance for Superfund RAGS Part E for Dermal Exposure (U.S. EPA, 2004)
AF _{soil}	Adherence factor (mg/cm ²) used for soil dermal contact	0.2 Adult	0.07 → Adult 0.2 → Child	EPA Risk Assessment Guidance for Superfund RAGS Part E for Dermal Exposure (U.S. EPA, 2004)

Table Apx G-17. Mean and Upper Milk Ingestion Rates by Age

Age Group	Milk Ingestion (mL/kg day)	
	Mean	Upper (95th Percentile)
Birth to <1 month	150	220
1 to <3 month	140	190
3 to <6 month	110	150
6 to <12 month	83	130
Birth to <1 year	104.8	152.5

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Age Group	Milk Ingestion (mL/kg day)	
	Mean	Upper (95th Percentile)
^a Values converted from Table 15-1 of U.S. EPA (2011) using the density of human milk of 1.03 g/mL		

G.4 Surface Water Exposure Activity Parameters

Table Apx G-18. Incidental Dermal (Swimming) Modeling Parameters

Input	Description (Units)	Adult (21+ years)	Youth (11–15 years)	Child (6–10 years)	Notes	Reference
BW	Body weight (kg)	80	56.8	31.8	Mean body weight. Chapter 8 of the <i>Exposure Factors Handbook</i> , Table 8-1	U.S. EPA (2021a)
SA	Skin surface area exposed (cm ²)	19,500	15,900	10,800	U.S. EPA Swimmer Exposure Assessment Model (SWIMODEL)	U.S. EPA (2015b)
ET	Exposure time (hr/day)	3	2	1	High-end default short-term duration from U.S. EPA Swimmer Exposure Assessment Model (SWIMODEL)	U.S. EPA (2015b)
ED	Exposure duration (years for ADD)	57	5	5	Number of years in age group,	U.S. EPA (2021a)
AT	Averaging time (years for ADD)	57	5	5	Number of years in age group,	U.S. EPA (2021a)
K _p	Permeability coefficient (cm/hr)	5.68E-03			Tested permeability coefficient	(Labcorp Early Development, 2023)

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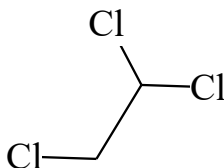
Table Apx G-19. Incidental Oral Ingestion (Swimming) Modeling Parameters

Input	Description (Units)	Adult (21+ years)	Youth (11–15 years)	Child (6–10 years)	Notes	Reference
IR _{inc}	Ingestion rate (L/hr)	0.092	0.152	0.096	Upper percentile ingestion while swimming. Chapter 3 of the <i>Exposure Factors Handbook</i> , Table 3-7.	U.S. EPA (2019c)
BW	Body weight (kg)	80	56.8	31.8	Mean body weight. Chapter 8 of the <i>Exposure Factors Handbook</i> , Table 8-1.	U.S. EPA (2021a)
ET	Exposure time (hr/day)	3	2	1	High-end default short-term duration from U.S. EPA Swimmer Exposure Assessment Model (SWIMODEL); based on competitive swimmers in the age class	U.S. EPA (2015b)
IR _{inc-daily}	Incidental daily ingestion rate (L/day)	0.276	0.304	0.096	Calculation: ingestion rate × exposure time	
IR/BW	Weighted incidental daily ingestion rate (L/kg-day)	0.0035	0.0054	0.0030	Calculation: ingestion rate/body weight	
ED	Exposure duration (years for ADD)	57	5	5	Number of years in age group,	U.S. EPA (2021a)
AT	Averaging time (years for ADD)	57	5	5	Number of years in age group,	U.S. EPA (2021a)
CF1	Conversion factor (mg/μg)	1.00E-03				
CF2	Conversion factor (days/year)	365				

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Appendix H EPI SUITE™ RESULTS USING SELECTED PHYSICAL AND CHEMICAL PROPERTIES

EPI Suite Results For CAS 000079-00-5



SMILES : CLCC(CL)CL

CHEM : Ethane, 1,1,2-trichloro-

MOL FOR: C2 H3 CL3

MOL WT : 133.41

----- EPI SUMMARY (v4.11) -----

Physical Property Inputs:

Log Kow (octanol-water): 2.05

Boiling Point (deg C) : 114.00

Melting Point (deg C) : -36.50

Vapor Pressure (mm Hg) : 23

Water Solubility (mg/L): 4580

Henry LC (atm-m3/mole) : 0.000824

KOWWIN Program (v1.68) Results:

=====

Log Kow(version 1.68 estimate): 2.01

Experimental Database Structure Match:

Name : 1,1,2-TRICHLOROETHANE

CAS Num : 000079-00-5

Exp Log P: 1.89

Exp Ref : HANSCH,C ET AL. (1995)

SMILES : CLCC(CL)CL

CHEM : Ethane, 1,1,2-trichloro-

MOL FOR: C2 H3 CL3

MOL WT : 133.41

TYPE	NUM	LOGKOW	FRAGMENT	DESCRIPTION	COEFF	VALUE
Frag	1	-CH2-	[aliphatic carbon]		0.4911	0.4911
Frag	1	-CH	[aliphatic carbon]		0.3614	0.3614
Frag	3	-CL	[chlorine, aliphatic attach]		0.3102	0.9306
Const			Equation Constant			0.2290

Log Kow = 2.0121

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MPBPVP (v1.43) Program Results:

=====

Experimental Database Structure Match:

Name : 1,1,2-TRICHLOROETHANE

CAS Num : 000079-00-5

Exp MP (deg C): -36.6

Exp BP (deg C): 113.8

Exp VP (mm Hg): 2.30E+01

(Pa): 3.07E+003

Exp VP (deg C): 25

Exp VP ref : ENGINEERING SCIENCES DATA UNIT (1976)

SMILES : CLCC(CL)CL

CHEM : Ethane, 1,1,2-trichloro-

MOL FOR: C2 H3 CL3

MOL WT : 133.41

----- SUMMARY MPBPVP v1.43 -----

Boiling Point: 127.75 deg C (Adapted Stein and Brown Method)

Melting Point: -86.10 deg C (Adapted Joback Method)

Melting Point: -39.07 deg C (Gold and Ogle Method)

Mean Melt Pt : -62.59 deg C (Joback; Gold,Ogle Methods)

Selected MP: -62.59 deg C (Mean Value)

Vapor Pressure Estimations (25 deg C):

(Using BP: 114.00 deg C (user entered))

(MP not used for liquids)

VP: 21.7 mm Hg (Antoine Method)

: 2.89E+003 Pa (Antoine Method)

VP: 19.1 mm Hg (Modified Grain Method)

: 2.55E+003 Pa (Modified Grain Method)

VP: 25.3 mm Hg (Mackay Method)

: 3.37E+003 Pa (Mackay Method)

Selected VP: 20.4 mm Hg (Mean of Antoine & Grain methods)

: 2.72E+003 Pa (Mean of Antoine & Grain methods)

TYPE	NUM	BOIL DESCRIPTION	COEFF	VALUE
Group	1	-CH2-	24.22	24.22
Group	1	>CH-	11.86	11.86
Group	1	-Cl (primary)	62.63	62.63
Group	2	-Cl (secondary)	49.41	98.82
*		Equation Constant		198.18

RESULT-uncorr| BOILING POINT in deg Kelvin | 395.71

RESULT- corr | BOILING POINT in deg Kelvin | 400.91

| BOILING POINT in deg C | 127.75

TYPE	NUM	MELT DESCRIPTION	COEFF	VALUE
Group	1	-CH2-	11.27	11.27

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14427 Group | 1 | >CH- | 12.64 | 12.64
14428 Group | 1 | -Cl (primary) | 13.55 | 13.55
14429 Group | 2 | -Cl (secondary) | 13.55 | 27.10
14430 * | | Equation Constant | | 122.50
14431 =====+=====+=====+=====
14432 RESULT | MELTING POINT in deg Kelvin | 187.06
14433 | MELTING POINT in deg C | -86.10
14434 -----
```

14438 Water Sol from Kow (WSKOW v1.42) Results:

14441 Water Sol: 2699 mg/L

14443 Experimental Water Solubility Database Match:

14444 Name : 1,1,2-TRICHLOROETHANE

14445 CAS Num : 000079-00-5

14446 Exp WSol : 4590 mg/L (25 deg C)

14447 Exp Ref : HORVATH,AL ET AL. (1999)

14449 Experimental Water Solubility Database Match:

14450 Name : TRICHLOROETHANE

14451 CAS Num : 025323-89-1

14452 Exp WSol : 1100 mg/L (25 deg C)

14453 Exp Ref : TALIAN,SF ET AL. (1986)

14455 SMILES : CLCC(CL)CL

14456 CHEM : Ethane, 1,1,2-trichloro-

14457 MOL FOR: C2 H3 CL3

14458 MOL WT : 133.41

14459 ----- WSKOW v1.42 Results -----

14460 Log Kow (estimated) : 2.01

14461 Log Kow (experimental): 1.89

14462 Cas No: 000079-00-5

14463 Name : 1,1,2-TRICHLOROETHANE

14464 Refer : HANSCH,C ET AL. (1995)

14465 Log Kow used by Water solubility estimates: 2.05 (user entered)

14467 Equation Used to Make Water Sol estimate:

14468 Log S (mol/L) = 0.693-0.96 log Kow-0.0092(Tm-25)-0.00314 MW + Correction

14470 Melting Pt (Tm) = -36.50 deg C (Use Tm = 25 for all liquids)

14472 Correction(s): Value

14473 -----

14474 No Applicable Correction Factors

14476 Log Water Solubility (in moles/L) : -1.694

14477 Water Solubility at 25 deg C (mg/L): 2699

14481 WATERNT Program (v1.01) Results:

14482 =====

14484 Water Sol (v1.01 est): 2800.6 mg/L

14486 Experimental Water Solubility Database Match:

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Name : 1,1,2-TRICHLOROETHANE
CAS Num : 000079-00-5
Exp WSol : 4590 mg/L (25 deg C)
Exp Ref : HORVATH,AL ET AL. (1999)

Experimental Water Solubility Database Match:

Name : TRICHLOROETHANE
CAS Num : 025323-89-1
Exp WSol : 1100 mg/L (25 deg C)
Exp Ref : TALIAN,SF ET AL. (1986)

SMILES : CLCC(CL)CL
CHEM : Ethane, 1,1,2-trichloro-
MOL FOR: C2 H3 CL3
MOL WT : 133.41

TYPE	NUM	WATER SOLUBILITY	FRAGMENT DESCRIPTION	COEFF	VALUE
Frag	1	-CH2-	[aliphatic carbon]	-0.5370	-0.5370
Frag	1	-CH	[aliphatic carbon]	-0.5285	-0.5285
Frag	3	-CL	[chlorine, aliphatic attach]	-0.2872	-0.8616
Const		Equation Constant			0.2492

Log Water Sol (moles/L) at 25 dec C = -1.6779
Water Solubility (mg/L) at 25 dec C = 2800.6

ECOSAR Program (v1.11) Results:

ECOSAR Version 1.11 Results Page

SMILES : CLCC(CL)CL
CHEM : Ethane, 1,1,2-trichloro-
CAS Num:
ChemID1:
MOL FOR: C2 H3 CL3
MOL WT : 133.41
Log Kow: 2.012 (EPISuite Kowwin v1.68 Estimate)
Log Kow: (User Entered)
Log Kow: 1.89 (PhysProp DB exp value - for comparison only)
Melt Pt: -36.50 (deg C, User Entered for Wat Sol estimate)
Melt Pt: -36.60 (deg C, PhysProp DB exp value for Wat Sol est)
Wat Sol: 3845 (mg/L, EPISuite WSKowwin v1.43 Estimate)
Wat Sol: 4580 (mg/L, User Entered)
Wat Sol: 1100 (mg/L, PhysProp DB exp value)

Values used to Generate ECOSAR Profile

Log Kow: 2.012 (EPISuite Kowwin v1.68 Estimate)
Wat Sol: 4580 (mg/L, User Entered)

ECOSAR v1.11 Class-specific Estimations

Neutral Organics

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Predicted ECOSAR Class	Organism	Duration	End Pt	mg/L (ppm)
Neutral Organics	: Fish	96-hr	LC50	106.882
Neutral Organics	: Daphnid	48-hr	LC50	60.756
Neutral Organics	: Green Algae	96-hr	EC50	45.467
Neutral Organics	: Fish		ChV	10.461
Neutral Organics	: Daphnid		ChV	5.943
Neutral Organics	: Green Algae		ChV	11.937
Neutral Organics	: Fish (SW)	96-hr	LC50	134.567
Neutral Organics	: Mysid	96-hr	LC50	99.192
Neutral Organics	: Fish (SW)		ChV	14.715
Neutral Organics	: Mysid (SW)		ChV	8.543
Neutral Organics	: Earthworm	14-day	LC50	231.269

Note: * = asterisk designates: Chemical may not be soluble enough to measure this predicted effect. If the effect level exceeds the water solubility by 10X, typically no effects at saturation (NES) are reported.

Class Specific LogKow Cut-Offs

If the log Kow of the chemical is greater than the endpoint specific cut-offs presented below, then no effects at saturation are expected for those endpoints.

Neutral Organics:

Maximum LogKow: 5.0 (Fish 96-hr LC50; Daphnid LC50, Mysid LC50)
Maximum LogKow: 6.0 (Earthworm LC50)
Maximum LogKow: 6.4 (Green Algae EC50)
Maximum LogKow: 8.0 (ChV)

HENRYWIN (v3.20) Program Results:

Bond Est : 4.27E-003 atm-m3/mole (4.33E+002 Pa-m3/mole)
Group Est: 1.02E-004 atm-m3/mole (1.03E+001 Pa-m3/mole)

SMILES : CLCC(CL)CL
CHEM : Ethane, 1,1,2-trichloro-
MOL FOR: C2 H3 CL3
MOL WT : 133.41

HENRYWIN v3.20 Results

Experimental Database Structure Match:

Name : 1,1,2-TRICHLOROETHANE
CAS Num : 000079-00-5
Exp HLC : 8.24E-04 atm-m3/mole (83.5 Pa-m3/mole)
Temper : 25 deg C
Exp Ref : LEIGHTON,DTJR & CALO,JM (1981)

CLASS	BOND CONTRIBUTION DESCRIPTION	COMMENT	VALUE

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HYDROGEN		3	Hydrogen to Carbon (aliphatic) Bonds				-0.3590
FRAGMENT		1	C-C				0.1163
FRAGMENT		3	C-CL				1.0004

RESULT		BOND ESTIMATION METHOD for LWAPC VALUE					TOTAL		0.758

HENRYs LAW CONSTANT at 25 deg C = 4.27E-003 atm-m3/mole
= 1.75E-001 unitless
= 4.33E+002 Pa-m3/mole

	GROUP CONTRIBUTION DESCRIPTION	COMMENT	VALUE

1	CH2 (C) (CL)		1.05
1	CH (C) (CL) (CL)		1.33

RESULT		GROUP ESTIMATION METHOD for LOG GAMMA VALUE					TOTAL		2.38

HENRYs LAW CONSTANT at 25 deg C = 1.02E-004 atm-m3/mole
= 4.17E-003 unitless
= 1.03E+001 Pa-m3/mole

For Henry LC Comparison Purposes:

Exper Database: 8.24E-04 atm-m3/mole (8.35E+001 Pa-m3/mole)
User-Entered Henry LC: 8.240E-004 atm-m3/mole (8.349E+001 Pa-m3/mole)
Henrys LC [via VP/WSol estimate using User-Entered or Estimated values]:
HLC: 8.815E-004 atm-m3/mole (8.932E+001 Pa-m3/mole)
VP: 23 mm Hg (source: User-Entered)
WS: 4.58E+003 mg/L (source: User-Entered)

Log Octanol-Air (KOAWIN v1.10) Results:

Log Koa: 3.523

SMILES : CLCC(CL)CL
CHEM : Ethane, 1,1,2-trichloro-
MOL FOR: C2 H3 CL3
MOL WT : 133.41

----- KOAWIN v1.10 Results -----

Experimental Database Structure Match:

Name : 1,1,2-Trichloroethane
CAS Num : 000079-00-5
Exp LogKoa: 3.40
Exp Ref : Abraham,MH et al. (2001)

Log Koa (octanol/air) estimate: 3.523

Koa (octanol/air) estimate: 3331

Using:

Log Kow: 2.05 (user entered)
HenryLC: 0.000824 atm-m3/mole (user entered)
Log Kaw: -1.473 (air/water part.coef.)

LogKow : 1.89 (exp database)

LogKow : 2.01 (KowWin estimate)

Henry LC: 0.000824 atm-m3/mole (exp database)

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Henry LC: 0.00427 atm-m3/mole (HenryWin bond estimate)

Log Koa (octanol/air) estimate: 2.768 (from KowWin/HenryWin)

BIOWIN (v4.10) Program Results:

SMILES : CLCC(CL)CL

CHEM : Ethane, 1,1,2-trichloro-

MOL FOR: C2 H3 CL3

MOL WT : 133.41

----- BIOWIN v4.10 Results -----

Biowin1 (Linear Model Prediction) : Does Not Biodegrade Fast

Biowin2 (Non-Linear Model Prediction): Does Not Biodegrade Fast

Biowin3 (Ultimate Biodegradation Timeframe): Weeks-Months

Biowin4 (Primary Biodegradation Timeframe): Days-Weeks

Biowin5 (MITI Linear Model Prediction) : Does Not Biodegrade Fast

Biowin6 (MITI Non-Linear Model Prediction): Does Not Biodegrade Fast

Biowin7 (Anaerobic Model Prediction): Biodegrades Fast

Ready Biodegradability Prediction: NO

TYPE	NUM	Biowin1 FRAGMENT DESCRIPTION	COEFF	VALUE
Frag	3	Aliphatic chloride [-CL]	-0.1114	-0.3342
MolWt	*	Molecular Weight Parameter		-0.0635
Const	*	Equation Constant		0.7475
RESULT		Biowin1 (Linear Biodeg Probability)		0.3499

TYPE	NUM	Biowin2 FRAGMENT DESCRIPTION	COEFF	VALUE
Frag	3	Aliphatic chloride [-CL]	-1.8528	-5.5584
MolWt	*	Molecular Weight Parameter		-1.8944
RESULT		Biowin2 (Non-Linear Biodeg Probability)		0.0116

A Probability Greater Than or Equal to 0.5 indicates --> Biodegrades Fast

A Probability Less Than 0.5 indicates --> Does NOT Biodegrade Fast

TYPE	NUM	Biowin3 FRAGMENT DESCRIPTION	COEFF	VALUE
Frag	3	Aliphatic chloride [-CL]	-0.1732	-0.5195
MolWt	*	Molecular Weight Parameter		-0.2948
Const	*	Equation Constant		3.1992
RESULT		Biowin3 (Survey Model - Ultimate Biodeg)		2.3848

TYPE	NUM	Biowin4 FRAGMENT DESCRIPTION	COEFF	VALUE
Frag	3	Aliphatic chloride [-CL]	-0.1006	-0.3018
MolWt	*	Molecular Weight Parameter		-0.1925

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14787
14788
14789
14790
14791 BioHCwin (v1.01) Program Results:14792 =====
14793 SMILES : CLCC(CL)CL

14794 CHEM : Ethane, 1,1,2-trichloro-

14795 MOL FOR: C2 H3 CL3

14796 MOL WT : 133.41

14797 ----- BioHCwin v1.01 Results -----

14798
14799 NO Estimate Possible ... Structure NOT a Hydrocarbon
14800 (Contains atoms other than C, H or S (-S-))
14801
14802
14803

14804 AEROWIN Program (v1.00) Results:

14805 =====

14806 Sorption to aerosols (25 Dec C) [AEROWIN v1.00]:

14807 Vapor pressure (liquid/subcooled): 3.07E+003 Pa (23 mm Hg)

14808 Log Koa (Exp database): 3.400

14809 Kp (particle/gas partition coef. (m3/ug)):

14810 Mackay model : 9.78E-010

14811 Octanol/air (Koa) model: 6.17E-010

14812 Fraction sorbed to airborne particulates (phi):

14813 Junge-Pankow model : 3.53E-008

14814 Mackay model : 7.83E-008

14815 Octanol/air (Koa) model: 4.93E-008
14816
14817

14818 AOP Program (v1.92) Results:

14819 =====

14820 SMILES : CLCC(CL)CL

14821 CHEM : Ethane, 1,1,2-trichloro-

14822 MOL FOR: C2 H3 CL3

14823 MOL WT : 133.41

14824 ----- SUMMARY (AOP v1.92): HYDROXYL RADICALS (25 deg C) -----

14825 Hydrogen Abstraction = 0.2286 E-12 cm3/molecule-sec

14826 Reaction with N, S and -OH = 0.0000 E-12 cm3/molecule-sec

14827 Addition to Triple Bonds = 0.0000 E-12 cm3/molecule-sec

14828 Addition to Olefinic Bonds = 0.0000 E-12 cm3/molecule-sec

14829 Addition to Aromatic Rings = 0.0000 E-12 cm3/molecule-sec

14830 Addition to Fused Rings = 0.0000 E-12 cm3/molecule-sec
14831

14832 OVERALL OH Rate Constant = 0.2286 E-12 cm3/molecule-sec

14833 HALF-LIFE = 46.785 Days (12-hr day; 1.5E6 OH/cm3)

14834 ----- SUMMARY (AOP v1.91): OZONE REACTION (25 deg C) -----

14835
14836 ***** NO OZONE REACTION ESTIMATION *****14837 (ONLY Olefins and Acetylenes are Estimated)
14838

14839 Experimental Database Structure Match:

14840 Chem Name : 1,1,2-Trichloroethane

14841 CAS Number: 000079-00-5

14842 Exper OH rate constant : 0.196 E-12 cm3/molecule-sec

14843 Exper OH Reference: KWOK,ESC & ATKINSON,R (1994)

14844 Exper Ozone rate constant: --- cm3/molecule-sec

14845 Exper NO3 rate constant : --- cm3/molecule-sec

14846 Fraction sorbed to airborne particulates (phi):

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5.68E-008 (Junge-Pankow, Mackay avg)
4.93E-008 (Koa method)
Note: the sorbed fraction may be resistant to atmospheric oxidation

KOCWIN Program (v2.00) Results:

SMILES : CLCC(CL)CL
CHEM : Ethane, 1,1,2-trichloro-
MOL FOR: C2 H3 CL3
MOL WT : 133.41

Experimental Database Structure Match:

Name : 1,1,2-Trichloroethane
CAS Num : 000079-00-5
Exp LogKoc: 1.89
Exp Ref : SRC (1991); Meylan et al (1992)

KOCWIN v2.00 Results

Koc Estimate from MCI:

First Order Molecular Connectivity Index : 2.270
Non-Corrected Log Koc (0.5213 MCI + 0.60) : 1.7832
Fragment Correction(s) --> NONE : ---
Corrected Log Koc : 1.7832

Estimated Koc: 60.7 L/kg <=====

Koc Estimate from Log Kow:

Log Kow (User entered) : 2.05
Non-Corrected Log Koc (0.8679 logKow - 0.0004) : 1.7788
Fragment Correction(s) --> NONE : ---
Corrected Log Koc : 1.7788

Estimated Koc: 60.09 L/kg <=====

HYDROWIN Program (v2.00) Results:

SMILES : CLCC(CL)CL
CHEM : Ethane, 1,1,2-trichloro-
MOL FOR: C2 H3 CL3
MOL WT : 133.41

HYDROWIN v2.00 Results

R2

| X: -CL (Leaving halogen in R1)
ALKYL HALIDE: R1-C-H R1: -CH2-CL

| R2: -CL

R3 R3: -CL

Kb hydrolysis at atom # 3: 1.876E-002 L/mol-sec

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Total Kb for pH > 8 at 25 deg C : 1.876E-002 L/mol-sec

Kb Half-Life at pH 8: 1.171 years

Kb Half-Life at pH 7: 11.705 years

The rate constant estimated for the ALKYL HALIDE DOES NOT include the neutral hydrolysis rate constant!!

For some alkyl halides, the neutral rate constant is the dominant hydrolysis rate at environmental pHs!

If the neutral rate constant is important, the HYDRO estimated rate will under-estimate the actual rate!

BCFBAF Program (v3.01) Results:

SMILES : CLCC(CL)CL

CHEM : Ethane, 1,1,2-trichloro-

MOL FOR: C2 H3 CL3

MOL WT : 133.41

----- BCFBAF v3.01 -----

Summary Results:

Log BCF (regression-based estimate): 1.02 (BCF = 10.5 L/kg wet-wt)

Biotransformation Half-Life (days) : 0.464 (normalized to 10 g fish)

Log BAF (Arnot-Gobas upper trophic): 0.94 (BAF = 8.65 L/kg wet-wt)

Experimental BCF-kM Database Structure Match:

Name : Ethane, 1,1,2-trichloro-

CAS Num : 000079-00-5

Log BCF : 0.699 (BCF = 5 L/kg wet-wt)

BCF Data : BCF NonIonic Training Set

Log Bio HL: -1.014 (Bio Half-life = 0.0968 days)

Bio Data : kM Validation Set

Log Kow (experimental): 1.89

Log Kow used by BCF estimates: 2.05 (user entered)

Equation Used to Make BCF estimate:

Log BCF = 0.6598 log Kow - 0.333 + Correction

Correction(s): Value

No Applicable Correction Factors

Estimated Log BCF = 1.020 (BCF = 10.46 L/kg wet-wt)

Whole Body Primary Biotransformation Rate Estimate for Fish:

TYPE	NUM	LOG BIOTRANSFORMATION FRAGMENT DESCRIPTION	COEFF	VALUE
Frag	3	Aliphatic chloride [-CL]	0.3608	1.0823
Frag	1	-CH2- [linear]	0.0242	0.0242
Frag	1	-CH- [linear]	-0.1912	-0.1912
L Kow	*	Log Kow = 2.05 (user-entered)	0.3073	0.6301
MolWt	*	Molecular Weight Parameter		-0.3421
Const	*	Equation Constant		-1.5371

RESULT | LOG Bio Half-Life (days) | -0.3339

RESULT | Bio Half-Life (days) | 0.4636

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NOTE | Bio Half-Life Normalized to 10 g fish at 15 deg C |
 =====+=====+=====+=====+=====+=====+=====+=====+=====+=====

Biotransformation Rate Constant:
 kM (Rate Constant): 1.495 /day (10 gram fish)
 kM (Rate Constant): 0.8408 /day (100 gram fish)
 kM (Rate Constant): 0.4728 /day (1 kg fish)
 kM (Rate Constant): 0.2659 /day (10 kg fish)

Note: For Arnot-Gobas BCF & BAF Methods, Experimental Km Half-Life Used:
 Exp Km Half-Life = -1.014 days (Rate Constant = 7.159/ day)
 Arnot-Gobas BCF & BAF Methods (including biotransformation rate estimates):
 Estimated Log BCF (upper trophic) = 0.937 (BCF = 8.646 L/kg wet-wt)
 Estimated Log BAF (upper trophic) = 0.937 (BAF = 8.646 L/kg wet-wt)
 Estimated Log BCF (mid trophic) = 0.848 (BCF = 7.053 L/kg wet-wt)
 Estimated Log BAF (mid trophic) = 0.848 (BAF = 7.053 L/kg wet-wt)
 Estimated Log BCF (lower trophic) = 0.814 (BCF = 6.521 L/kg wet-wt)
 Estimated Log BAF (lower trophic) = 0.814 (BAF = 6.522 L/kg wet-wt)

Arnot-Gobas BCF & BAF Methods (assuming a biotransformation rate of zero):
 Estimated Log BCF (upper trophic) = 1.110 (BCF = 12.89 L/kg wet-wt)
 Estimated Log BAF (upper trophic) = 1.121 (BAF = 13.21 L/kg wet-wt)

Volatilization From Water
 =====

Chemical Name: Ethane, 1,1,2-trichloro-

Molecular Weight : 133.41 g/mole
 Water Solubility : 4580 ppm
 Vapor Pressure : 23 mm Hg
 Henry's Law Constant: 0.000824 atm-m3/mole (entered by user)

RIVER	LAKE
-----	-----
Water Depth (meters):	1
Wind Velocity (m/sec):	0.5
Current Velocity (m/sec):	0.05
HALF-LIFE (hours) :	1.999 118.7
HALF-LIFE (days) :	0.08331 4.944

STP Fugacity Model: Predicted Fate in a Wastewater Treatment Facility
 =====

(using 10000 hr Bio P,A,S)
 PROPERTIES OF: Ethane, 1,1,2-trichloro-

Molecular weight (g/mol)	133.41
Aqueous solubility (mg/l)	4580
Vapour pressure (Pa)	3066.41
(atm)	0.0302632
(mm Hg)	23
Henry 's law constant (Atm-m3/mol)	0.000824
Air-water partition coefficient	0.0336992
Octanol-water partition coefficient (Kow)	112.202

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15027 Log Kow 2.05
15028 Biomass to water partition coefficient 23.2404
15029 Temperature [deg C] 25
15030 Biodeg rate constants (h^-1), half life in biomass (h) and in 2000 mg/L MLSS (h):
15031 -Primary tank 0.00 444.16 10000.00
15032 -Aeration tank 0.00 444.16 10000.00
15033 -Settling tank 0.00 444.16 10000.00
15034
15035 STP Overall Chemical Mass Balance:
15036 -----
15037 g/h mol/h percent
15038
15039 Influent 1.00E+001 7.5E-002 100.00
15040
15041 Primary sludge 5.11E-002 3.8E-004 0.51
15042 Waste sludge 1.25E-001 9.4E-004 1.25
15043 Primary volatilization 1.01E-001 7.6E-004 1.01
15044 Settling volatilization 2.07E-001 1.6E-003 2.07
15045 Aeration off gas 2.26E+000 1.7E-002 22.60
15046
15047 Primary biodegradation 1.81E-003 1.4E-005 0.02
15048 Settling biodegradation 4.06E-004 3.0E-006 0.00
15049 Aeration biodegradation 5.43E-003 4.1E-005 0.05
15050
15051 Final water effluent 7.25E+000 5.4E-002 72.49
15052
15053 Total removal 2.75E+000 2.1E-002 27.51
15054 Total biodegradation 7.64E-003 5.7E-005 0.08
15055
15056
15057 Level III Fugacity Model (Full-Output):
15058 =====
15059 Chem Name : Ethane, 1,1,2-trichloro-
15060 Molecular Wt: 133.41
15061 Henry's LC : 0.000824 atm-m3/mole (user-entered)
15062 Vapor Press : 23 mm Hg (user-entered)
15063 Log Kow : 2.05 (user-entered)
15064 Soil Koc : 2.06 (user-entered)
15065
15066 Mass Amount Half-Life Emissions
15067 (percent) (hr) (kg/hr)
15068 Air 34.8 1.31e+003 1000
15069 Water 51.4 8.76e+003 1000
15070 Soil 13.7 8.76e+003 1000
15071 Sediment 0.104 8.76e+003 0
15072
15073 Fugacity Reaction Advection Reaction Advection
15074 (atm) (kg/hr) (kg/hr) (percent) (percent)
15075 Air 4.52E-010 131 2.47e+003 4.35 82.3
15076 Water 1.13E-008 28.8 365 0.961 12.2
15077 Soil 9.35E-008 7.68 0 0.256 0
15078 Sediment 1.08E-008 0.0583 0.0147 0.00194 0.000491
15079
15080 Persistence Time: 236 hr
15081 Reaction Time: 4.24e+003 hr
15082 Advection Time: 250 hr
15083 Percent Reacted: 5.57
15084 Percent Advected: 94.4
15085
15086 Half-Lives (hr), (based upon user-entry):

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15087 Air: 1310
15088 Water: 8760
15089 Soil: 8760
15090 Sediment: 8760
15091
15092 Advection Times (hr):
15093 Air: 100
15094 Water: 1000
15095 Sediment: 5e+004
15096
15097
15098
15099