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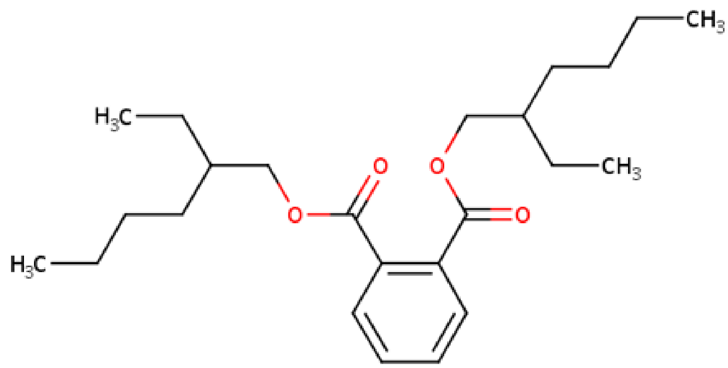
Environmental Protection Agency

Environmental Release and Occupational Exposure Assessment for Diethylhexyl Phthalate (DEHP)

Technical Support Document for the Risk Evaluation

CASRN 117-81-7



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KEY ABBREVIATIONS AND ACRONYMS

AD	Acute retained dose
ADD	Average daily dose
ADC	Average daily concentration
APDR	Acute Potential Dermal Dose Rate
APF	Assigned protection factor
AWD	Annual Working Days
BLS	Bureau of Labor Statistics
CASRN	Chemical Abstracts Service Registry Number
CBI	Confidential business information
CDR	Chemical Data Reporting
CEHD	Chemical Exposure Health Database
CFR	Code of Federal Regulations
COU	Condition of use
CT	Central Tendency
DBP	Dibutyl phthalate
DEHP	Diethylhexyl Phthalate
DMR	Discharge Monitoring Report
EIS	Emissions Inventory System
EPA	Environmental Protection Agency (or “the Agency”)
ESD	Emission Scenario Document
FRS	Facility Registry Services
GS	Generic scenario
HAP	Hazardous Air Pollutant
HHE	Health Hazard Evaluation
HE	High End
IADD	Intermediate average daily dose
ICR	Information Collection Request
IFC	Industrial Function Category
LOD	Limit of detection
MRD	Methodology Review Draft
MW	Molecular weight of DINP
NAICS	North American Industry Classification System
NEI	National Emissions Inventory
NIOSH	National Institute for Occupational Safety and Health
NPDES	National Pollutant Discharge Elimination System
OAQPS	Office of Air Quality Planning and Standards
OD	Operating days
OECD	Organisation for Economic Co-Operation and Development
OEL	Occupational exposure limit
OES	Occupational exposure scenario
ONU	Occupational non-users
OPPT	Office of Pollution Prevention and Toxics
OSHA	Occupational Safety and Health Administration
PBZ	Personal breathing zone
PC	Product category
PEL	Permissible Exposure Limit
PESS	Potentially exposed or susceptible subpopulations
PF	Protection factor

PNOR	Particulates Not Otherwise Regulated
POTW	Publicly owned treatment works
PPE	Personal Protective Equipment
PV	Production volume
PVC	Polyvinyl chloride
RCRA	Resource Conservation and Recovery Act
SCC	Source Classification Code
SDS	Safety data sheet
SIC	Standard Industrial Classification
SLT	State, local, and tribal
SpERC	Specific Emission Release Category
SUSB	Statistics of U.S. Businesses
TRI	Toxics Release Inventory
TSCA	Toxic Substances Control Act
TSD	Technical Support Document
TWA	Time-weighted average
U.S.	United States
VP	Vapor pressure
WWT	Wastewater treatment

SUMMARY

This technical support document (TSD) accompanies the Toxic Substances Control Act (TSCA) *Risk Evaluation for Diethylhexyl Phthalate (DEHP)* (U.S. EPA, 2025f). DEHP is a Toxics Release Inventory (TRI)-reportable substance and is on the TSCA Inventory, making it reportable under the Chemical Data Reporting (CDR) rule. This document describes the use of reasonably available information to estimate environmental releases of DEHP and to evaluate occupational exposure to workers. See the risk evaluation (U.S. EPA, 2025f) for a complete list of all the technical support documents for DEHP.

Focus of the Technical Support Document (TSD) on Environmental Release and Occupational Exposure Assessment

During scoping, EPA considered all known TSCA uses for DEHP. The 2016 CDR report indicated that 10 to 50 million pounds (lb) of DEHP (CASRN 117-81-1) were manufactured or imported in the U.S. in 2015 (U.S. EPA, 2019b). The 2020 CDR report indicates the same range for the manufacture or import volume in 2019. Additionally, review of the preliminary 2024 CDR data indicates that the national aggregate DEHP production volume is expected to be comparable to the previously reported national aggregate production volume range from the 2020 CDR. The largest number of reported uses of DEHP is as a plasticizer in polyvinyl chloride (PVC) plastics. Secondary uses include use as a plasticizer/additive in adhesives, sealants, paints, coatings, rubber, and other applications.

Exposures to workers, consumers, general populations, and ecological species may occur from releases of DEHP to air, land, and water from industrial, commercial, and consumer uses of DEHP and DEHP-containing articles. Workers and occupational non-users (ONUs) may be exposed to DEHP while handling solid and liquid formulations that contain DEHP or during dust and mist generating activities that may be present during most conditions of use (COUs). ONUs are those who may work in the vicinity of chemical-related activities but do not handle the chemicals themselves, such as managers or inspectors. This document provides the details of the assessment of the environmental releases and occupational exposures from each COU of DEHP.

Approach for Assessing Environmental Releases and Occupational Exposures in this Risk Evaluation

The U.S. Environmental Protection Agency (EPA or "the Agency") evaluated environmental releases and occupational exposures for each occupational exposure scenario (OES). Each OES is developed based on a set of occupational activities and conditions such that similar occupational exposures and environmental releases are expected from the use(s) covered under the OES. For each OES, EPA provided occupational exposure and environmental release results, which are expected to be representative of the entire population of workers and sites for a given OES in the United States.

EPA evaluated environmental releases of DEHP to air, water, and land from the OES associated with the COUs assessed in this risk evaluation. The Agency reviewed release data from TRI (data from 2017–2022), Discharge Monitoring Report (DMR; data from 2017–2022), and the 2017 and 2020 National Emissions Inventory (NEI) to identify relevant releases of DEHP to the environment. These sources provide site-specific release information based on measurements, mass balances, or emission factors. In addition, EPA also considered other relevant release data to fill data gaps from other peer-reviewed or literature sources identified through systematic review. For OESs without any release data, the Agency used modeling approaches to assess release estimates.

EPA evaluated acute, intermediate, and chronic exposures to workers and ONUs for each OES. The Agency used inhalation monitoring data from literature sources where available, and exposure models where monitoring data were not available, or these data were deemed insufficient for capturing

exposures within the OES. EPA also used *in vivo* rat absorption data, along with modeling approaches, to estimate dermal exposures to workers and ONUs.

Results for Environmental Releases and Occupational Exposures in this Risk Evaluation
EPA evaluated environmental releases of DEHP to air, water, and/or land for all OESs assessed in this risk evaluation. The OES with the highest expected release was Plastics converting followed by Plastic compounding, then by Rubber manufacturing. Detailed release results for each OES to each media can be found in Section 2.7.

EPA also evaluated inhalation and dermal exposures to worker populations, including ONUs and females of reproductive age, for each OES. Due to the low vapor pressure and low rate of dermal absorption of DEHP, the occupational exposure assessment has shown that inhalation and dermal exposures to DEHP from most industrial and commercial OESs are expected to be rather low—except for Rubber manufacturing and Formulations for diffusion bonding. Detailed exposure results for each OES and exposure route can be found in Section 2.7.

Changes from the draft risk evaluation:
EPA received occupational inhalation exposure data through public comment relevant to the Plastic compounding (Section 3.3.4), Plastic converting (Section 3.4.4), and Recycling (Section 3.15.4) OES. In the draft risk evaluation, data from literature and from the Occupational Safety and Health Administration (OSHA) Chemical Exposure Health Database (CEHD) were used for these occupational exposure estimates. However, the data received through public comment contained more recent data, from multiple sites, and with metadata that indicated variability in the worker activities, operations, and resulting exposures. As a result, the exposure data received through public comment was incorporated into the occupational exposure assessments for Plastic compounding, Plastic converting, and Recycling OESs.

Uncertainties of this Risk Evaluation
Uncertainties exist with the monitoring data and modeling approaches used to assess DEHP environmental releases and occupational exposures. One factor of uncertainty includes the accuracy of the reported releases as well as the limitations in representativeness to all U.S sites because TRI, DMR, and NEI may not capture all relevant sites. For modeled releases, the lack of DEHP facility production volume data adds uncertainty; in such cases, EPA used throughput estimates based on CDR reporting thresholds, which may result in production volume estimates that are not representative of the actual production volume of DEHP in the United States and likely underestimate actual production volume due to the reliance on the reporting threshold. The Agency also used generic EPA models and default input parameter values when site-specific data were not available. In addition, site-specific differences in use practices and engineering controls exist, but are largely unknown. This represents another source of variability that EPA could not quantify in the assessment.

Use of the Results for Environmental Releases and Occupational Exposures – Environmental and Exposure Pathways Considered in this Risk Evaluation
EPA assessed environmental releases to air, water, and land to estimate exposures to the general population and ecological species for DEHP COUs. EPA assessed risks for acute, intermediate, and chronic exposure scenarios in workers (those directly handling DEHP) and ONUs for each OES. EPA assumed that workers and ONUs would be individuals of both sexes (ages 16+ years, including pregnant workers) based upon occupational work permits. An objective of the assessment was to provide separate exposure level estimates for workers and ONUs. Dermal exposures were considered for all workers, but only considered for ONUs with potential exposure to dust or mist deposited on surfaces.

Additionally, the environmental release estimates developed by EPA are used to estimate the presence of DEHP in the environment and biota and evaluate the environmental hazards. The release estimates were used to model exposure to the general population and ecological species where environmental monitoring data were not reasonably available. General population and ecological species exposures can be found in *Environmental Media and General Population and Environmental Exposure for Diethylhexyl Phthalate (DEHP)* (U.S. EPA, 2025a).

1 INTRODUCTION

1.1 Overview

This technical support document (TSD) provides details on the occupational exposure and environmental release assessment and supplements the risk evaluation for diethylhexyl phthalate (DEHP) under the Frank R. Lautenberg Chemical Safety for the 21st Century Act. The Frank R. Lautenberg Chemical Safety for the 21st Century Act amended TSCA on June 22, 2016. The law includes statutory requirements and deadlines for actions related to conducting risk evaluations of chemical substances.

Under Toxic Substances Control Act (TSCA) section 6(b), the U.S. Environmental Protection Agency (EPA or "the Agency") 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, and upon designating a chemical substance as a high-priority substance, initiate a risk evaluation on the substance. TSCA section 6(b)(4) directs EPA to conduct risk evaluations for chemical substances, to "determine whether a chemical substance presents an unreasonable risk of injury to health or the environment, without consideration of costs or other nonrisk 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 potentially exposed or susceptible subpopulations (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. DEHP is one of the chemicals designated as a high priority substance for risk evaluation

DEHP is a colorless, oily liquid that is used primarily as a plasticizer in polyvinyl chloride (PVC) plastics, though it is also used in adhesives, sealants, paints, coatings, rubber, and non-PVC plastics as well as for other applications. Global use of DEHP as a plasticizer has declined over recent years and is expected to decline further as non-phthalate plasticizers replace phthalate plasticizers; however, DEHP is still the international PVC plasticizer of choice. DEHP is a Toxics Release Inventory (TRI)-reportable substance effective January 1, 1987. DEHP is also on the TSCA Inventory and reported under the CDR rule.

1.2 Scope

EPA assessed environmental releases and occupational exposures for conditions of use (COUs) as described in Table 2-2 of the *Final Scope of the Risk Evaluation for Diethylhexyl Phthalate(1,2-Benzenedicarboxylic acid, 1,2-bis(2-ethylhexyl) ester); CASRN 117-81-7* (U.S. EPA, 2020e). To estimate environmental releases and occupational exposures, EPA first developed Occupational Exposure Scenarios (OES) related to the COUs of DEHP. An OES is based on a set of facts, assumptions, and inferences that describe how releases and exposures take place within an occupational COU. The occurrence of releases/exposures may be similar across multiple COUs, or there may be several ways in which releases/exposures take place for a given COU. Table 1-1 in this section provides a crosswalk between the COUs from the *Risk Evaluation for Diethylhexyl Phthalate (DEHP)* (U.S. EPA, 2025f) (also referred to as risk evaluation) and the OES assessed in this report.

In general, EPA mapped OESs to COUs using professional judgment based on reasonably available information. Several of the COU categories and subcategories were grouped and assessed together in a single OES due to similarities in the processes or lack of data to differentiate between them. This grouping minimized repetitive assessments. In other cases, COU subcategories were further delineated into multiple OESs based on expected differences in process equipment and associated release/exposure potential between facilities. EPA assessed environmental releases and occupational exposures as described in Table 1-1.

Table 1-1. Crosswalk of COUs Listed in the Risk Evaluation to Assessed OES

Life Cycle Stage	Category	Subcategory	OES(s)
Manufacture	Domestic manufacturing	Domestic manufacturing	Manufacturing (see Section 3.1)
	Importing	Importing	Repackaging (see Section 3.6)
Processing	Repackaging	Repackaging in wholesale and retail trade and in paint and coating manufacturing	
	Incorporation into formulation, mixture, or reaction product	Plasticizer in: - Adhesive manufacturing - Basic inorganic chemical manufacturing - Synthetic rubber manufacturing - Services - Basic organic chemical manufacturing - Custom compounding of purchased resins - Miscellaneous manufacturing - Paint and coatings manufacturing - Plastics material and resin manufacturing - All other chemical product and preparation manufacturing - Wholesale and retail trade - Ink, toner, and colorant manufacturing	Rubber manufacturing (see Section 3.2); Plastic compounding (see Section 3.3); Incorporation into formulation, mixture, or reaction product (see Section 3.53.5)
	Incorporation into article	Plasticizer in: - Basic organic chemical manufacturing - Plastics product manufacturing - Rubber product manufacturing - Miscellaneous manufacturing - PVC extruding	Rubber manufacturing (see Section 3.2) Plastic converting (see Section 3.4)
	Recycling	Recycling	Recycling (see Section 3.15)
	Other uses	Miscellaneous processing (cyclic crude and intermediate manufacturing; processing aid specific to hydraulic fracturing)	Incorporation into formulation, mixture, or reaction product (see Section 3.5)
Distribution in Commerce	Distribution in commerce	Distribution in commerce	Distribution in commerce
Industrial Use	Construction, paint, electrical, and metal products	Paints and coatings	Application of paints, coatings, adhesives, and sealants (see Section 3.7)
		Adhesives and sealants	Application of paints, coatings, adhesives, and sealants (see Section 3.7) Formulations for diffusion bonding (see Section 3.11)

Life Cycle Stage	Category	Subcategory	OES(s)
	Other uses	Automotive articles	Plastic converting (see Section 3.4)
		Hydraulic fracturing	Use in hydraulic fracturing (see Section 3.14)
		Solid rocket motor insulation	Plastic converting (see Section 3.4)
Commercial Use	Construction, paint, electrical, and metal products	Adhesives and sealants	Application of paints, coatings, adhesives, and sealants (see Section 3.7)
		Paints and coatings	
	Furnishing, cleaning, treatment care products	Fabric, textile, and leather products; furniture and furnishings	Textile finishing (see Section 3.8)
		Fabric enhancer	
	Construction, paint, electrical, and metal products	Batteries and capacitors	Fabrication of final product from articles (see Section 3.9)
	Construction, paint, electrical, and metal products	Construction and building materials covering large surface areas, including paper articles; metal articles; stone, plaster, cement, glass and ceramic articles	
	Construction, paint, electrical, and metal products	Machinery, mechanical appliances, electrical/electronic articles	
	Automotive, fuel, agriculture, and outdoor use products	Lawn and garden care products	
	Packaging, paper, plastic, toys, hobby products	Packaging (excluding food packaging) and other articles with routine direct contact during normal use, including paper articles; rubber articles; plastic articles (hard); plastic articles (soft) Packaging (excluding food packaging), including paper articles	
		Toys, playground, and sporting equipment	
	Furnishing, cleaning, treatment care products	Floor coverings; Construction and building materials covering large surface areas including stone, plaster, cement, glass and ceramic articles fabrics, textiles, and apparel	
	Packaging, paper, plastic, toys, hobby products	Ink, toner, and colorants	Use of dyes and pigments, and fixing agents (see Section 3.10)
	Furnishing, cleaning, treatment care products	All-purpose waxes and polishes	Application of paints, coatings, adhesives, and sealants (see Section 3.7)

Life Cycle Stage	Category	Subcategory	OES(s)
	Other	Automotive articles and products	Use of automotive care products (see Section 3.13) Fabrication of final product from articles (see Section 3.9)
	Other	Laboratory chemicals	Use of laboratory chemicals (see Section 3.12)
Disposal	Disposal	Disposal	Waste handling, treatment, and disposal (see Section 3.16)

The assessment of releases included quantifying annual and daily releases of DEHP to air, water, and land. Releases to air include both fugitive and stack air emissions and emissions resulting from on-site waste treatment equipment, such as incinerators. For purposes of this report, releases to water include both direct discharges to surface water and indirect discharges to publicly owned treatment works (POTW) or non-POTW wastewater treatment (WWT). EPA considered removal efficiencies of POTWs and WWT plants as well as environmental fate and transport properties when evaluating risks from indirect discharges. Releases to land include any disposal of liquid or solid wastes containing DEHP to landfills, land treatment, surface impoundments, or other land applications. The purpose of this TSD is to quantify releases; therefore, this report does not discuss downstream environmental fate and transport factors used to estimate exposures to the general population and ecological species. The *Risk Evaluation for Diethylhexyl phthalate (DEHP)* (U.S. EPA, 2025f) describes how these factors were considered for the purpose of risk characterization.

For workplace exposures, EPA considered exposures to both workers who directly handle DEHP and occupational non-users (ONUs) who do not directly handle DEHP; but may be exposed to DEHP based on their proximity to areas where DEHP is present. EPA evaluated inhalation and dermal exposures to both workers and ONUs.

2 TYPICAL COMPONENTS OF EPA's RELEASE AND OCCUPATIONAL EXPOSURE ASSESSMENT

EPA describes the assessed COUs for DEHP in the *Risk Evaluation for Diethylhexyl Phthalate (DEHP)* (U.S. EPA, 2025f); however, some COUs differ in terms of specific DEHP processes and associated exposure/release scenarios. Therefore, Table 1-1 provides a crosswalk that maps the DEHP COUs to the more specific OESs. The environmental release and occupational exposure assessments of each OES comprised the following components:

- **Process Description:** A description of the OES, including the function of the chemical in the scenario; physical forms and weight fractions of the chemical throughout the process; the total production volume associated with the OES; per site throughputs/use rates of the chemical; operating schedules; and process equipment used during the OES.
- **Facility Estimates:** An estimate of the number of sites that use DEHP for the given OES.
- **Environmental Release Assessment**
  - **Environmental Release Sources:** A description of the potential sources of environmental releases in the process and their expected media of release for the OES.
  - **Environmental Release Assessment Results:** Estimates of DEHP released into each environmental media (*i.e.*, surface water, POTW, non POTW-WWT, fugitive air, stack air, and each type of land disposal) for the given OES.
- **Occupational Exposure Assessment**
  - **Worker Activities:** A description of the worker activities, including an assessment of potential points of worker and ONU exposures.
  - **Number of Workers and Occupational Non-Users:** An estimate of the number of workers and ONUs potentially exposed to the chemical for the given OES. This is contextual information and is not necessary for the assessment of occupational exposure. This document does not include estimates of the number of workers and ONUs, but the final version of this document will contain this information.
  - **Occupational Inhalation Exposure Results:** Central tendency and high-end estimates of inhalation exposures to workers and ONUs.
  - **Occupational Dermal Exposure Results:** Central tendency and high-end estimates of dermal exposures to workers and ONUs.
  - **Occupational Aggregate Exposure Results:** Aggregated central tendency and high-end estimates from the combination of dermal and inhalation exposures

2.1 Approach and Methodology for Process Descriptions

EPA performed a literature search to find descriptions of processes involved in each OES. Where data were available, EPA included the following information in each process description:

- Total production volume associated with the OES;
- Name and location of sites where the OES occurs;
- Facility operating schedules (*e.g.*, year-round, 5 days/week, batch process, continuous process, multiple shifts);
- Key process steps;
- Physical form and weight fraction of the chemical throughout the process steps;

- Information on receiving and shipping containers; and
- Ultimate destination of chemical leaving the facility.

Where DEHP-specific process descriptions were unclear or unavailable, EPA referenced generic process descriptions from literature, including relevant Emission Scenario Documents (ESDs) or Generic Scenarios (GSs). Sections 3.1 through 3.16 provide process descriptions for each OES.

2.2 Approach and Methodology for Estimating Number of Facilities

To estimate the number of facilities within each OES, EPA used a combination of bottom-up analyses of EPA reporting programs and top-down analyses of U.S. economic data and industry-specific data. Generally, EPA used the following steps to develop facility estimates:

1. Identify or "map" each facility reporting for DEHP in the 2020 Chemical Data Reporting (CDR) (U.S. EPA, 2020b, 2016), 2017 to 2022 TRI (U.S. EPA, 2022f), 2017 to 2022 Discharge Monitoring Report (DMR) (U.S. EPA, 2022c) and 2017 and 2020 National Emissions Inventory (NEI) (U.S. EPA, 2022e) to an OES. Mapping consisted of using facility reported industry sectors (typically reported as either North American Industry Classification System [NAICS] or Standard Industrial Classification [SIC] codes), chemical activity, and processing and use information to assign the most likely OES to each facility.

2. Based on the reporting thresholds and requirements of each dataset, evaluate whether the data in the reporting programs are expected to cover most or all the facilities within the OES (for example, comparing the number of mapped facilities of a specific OES to the number of reported downstream users in CDR with the same OES). If so, EPA assessed the total number of facilities in the OES as equal to the number of facilities mapped to the OES from each dataset. If not, EPA proceeded to Step 3.

3. Supplement the available reporting data with U.S. economic and market data using the following steps:

    a. Identify the NAICS codes for the industry sectors associated with the OES.

    b. Estimate total number of facilities using the U.S. Census' Statistics of U.S. Businesses (SUSB) data on total sites by 6-digit NAICS code.

    c. Use market penetration data to estimate the percentage of sites likely to be using DEHP instead of other chemicals.

    d. Combine the data generated in Steps 3.a. through 3.c. to produce an estimate of the number of facilities using DEHP in each 6-digit NAICS code and sum across all applicable NAICS codes to arrive at an estimate of the total number of facilities within the OES. Typically, it was assumed that this estimate encompassed the facilities identified in Step 1; therefore, the total number of facilities for the OES were assessed as the total generated from the analysis.

4. If market penetration data required for Step 3.c. are not reasonably available, EPA relied on generic industry data from GSs, ESDs, and other literature sources on typical throughputs/use rates, operating schedules, and the DEHP production volume used within the OES to estimate the number of facilities. In cases where EPA identified a range of operating data in the literature for an OES, stochastic modeling was used to provide a range of estimates for the number of facilities within the OES. The approaches, equations, and input parameters used in stochastic modeling are described in the relevant OES sections throughout this report.

2.3 Environmental Releases Approach and Methodology

EPA assessed releases to the environment using data obtained through direct measurement (*i.e.*, via monitoring), calculations based on empirical data, and/or assumptions and models. For each OES, where possible, EPA provided annual releases, high-end and central tendency daily releases, and the number of release days per year for each media of release (*i.e.*, air, water, and land).

EPA used the following hierarchy in selecting data and approaches for assessing environmental releases:

1. Monitoring and measured data:
    a. Releases calculated from site- and media-specific concentration and flow rate data.
    b. Releases calculated from mass balances or emission factor methods using site-specific measurements.
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's preference is to rely on facility-specific release data reported in DMR, TRI, and NEI, where available. These sources provide site-specific release information based on measurements, mass balances, or emission factors. In addition, NEI may provide release information at the process unit-level with process-specific stack parameters that can be used for further refinement of the modeling of the air release data, which EPA considers to be a higher tier analysis.

Where modeling approaches were used, EPA described the final release results as either a point estimate (*i.e.*, a single descriptor or statistic, such as central tendency or high-end) or a full distribution. EPA considered the following general approaches for estimating the final release result:

- **Deterministic calculations**: A combination of point estimates of each input parameter (*e.g.*, high-end and low-end values) were used to estimate central tendency and high-end release results for 13 OES. EPA documented the method and rationale for selecting parametric combinations representative of central tendency and high-end releases in the relevant OES subsections in Section 2.7.

- **Probabilistic (stochastic) calculations**: EPA ran Monte Carlo simulations for three OES using the statistical distribution for each input parameter to calculate a full distribution of the final release results. EPA selected the 50th and 95th percentiles of the resulting distribution to represent central tendency and high-end releases, respectively.

- **Combination of deterministic and probabilistic calculations**: If EPA has statistical distributions for some parameters and point estimates for the remaining parameters. For example, EPA used Monte Carlo modeling to estimate annual throughputs and emission factors but only had point estimates of release frequency and production volume. This method was not used for this assessment based on modeling parameters available in the ESDs/GSs.

2.3.1 Identifying Release Sources

In situations where programmatic data (*i.e.*, DMR, TRI, NEI) was not reasonably available, EPA performed a literature search to identify process operations that could potentially result in releases of

DEHP to air, water, or land from each OES. For each OES, EPA identified the release sources and the associated media of release. Where DEHP-specific release sources were unclear or unavailable, EPA referenced relevant ESDs or GSs. Sections 3.1 through 3.16 describe the release sources for each OES.

2.3.2 Estimating Number of Release Days

Unless EPA identified conflicting information, EPA assumed that the number of release days per year for a given release source equals the number of operating days at the facility. To estimate the number of operating days, EPA used the following hierarchy:

1. **Facility-specific data:** EPA used facility-specific operating days per year data, if available. Otherwise, EPA used data for other facilities within the same OES, if possible, and estimated the operating days per year using one of the following approaches:
    a. If other facilities have known or estimated average daily use rates, EPA calculated the days per year as: Days/year = Estimated annual use rate for the facility (kg/year) / average daily use rate from facilities with available data (kg/day).
    b. If facilities with days per year data do not have known or estimated average daily use rates, EPA used the average number of days per year from the facilities with available data.
2. **Industry-specific data:** EPA used industry-specific data from GSs, ESDs, trade publications, or other relevant literature.
3. **Manufacture of large-production volume (PV) commodity chemicals:** For the manufacture of the large-PV commodity chemicals, EPA used a value of 350 days per year. This assumes the plant runs seven days per week and 50 weeks per year (with two weeks down for turnaround) and always produces the chemical.
4. **Manufacture of lower-PV specialty chemicals:** For the manufacture of lower-PV specialty chemicals, it is unlikely that the plant continuously manufactures the chemical throughout the year. Therefore, EPA used a value of 250 days per year. This assumes the plant manufactures the chemical five days per week and 50 weeks per year (with two weeks down for turnaround).
5. **Processing as reactant (intermediate use) in the manufacture of commodity chemicals:** Similar to #3, EPA assumed the manufacture of commodity chemicals occurs 350 days per year such that the use of a chemical as a reactant to manufacture a commodity chemical would also occur 350 days per 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, EPA used a value of 250 days per year.
7. **Other chemical plant OESs (*e.g.*, processing into formulation and repackaging):** For these OESs, EPA assumed that campaigns involving the chemical of interest may not operate year-round, even if the facility operates 24 hours/day, 7 days/week. Therefore, EPA used a value of 300 days/year, based on the assumption that the facility operates 6 days/week and 50 weeks/year (with 2 weeks for turnaround). However, in instances where the OES uses a low volume of the chemical of interest, EPA used 250 days per year as a lower estimate based on the assumption that the facility operates 5 days/week and 50 weeks/year (with 2 weeks for turnaround).
8. **POTWs:** Although EPA expects POTWs to operate continuously 365 days per year, the discharge frequency of the chemical of interest from a POTW will depend on the discharge patterns of the chemical from upstream facilities discharging to the POTW. However, there

can be multiple upstream facilities (possibly with different OES) discharging to the same POTW. Information regarding the frequency of simultaneous facility discharges (*e.g.*, on the same day or separate days) is typically unavailable. Since EPA could not determine the exact number of days per year that the POTW discharges the chemical of interest, EPA used a value of 365 days per year.

9. **All other OESs:** Regardless of the facility operating schedule, other OES are unlikely to use the chemical of interest every day. Therefore, EPA used a value of 250 days per year for these OES.

2.3.3 Estimating Releases from Data Reported to EPA

Generally, EPA used the facility-specific release data reported in TRI, DMR, and NEI as annual releases in each dataset for each site and estimated the daily release by averaging the annual release over the expected release days per year. EPA's approach to estimating release days per year is described in Section 2.3.2.

Section 313 of the Emergency Planning and Community Right-to-Know Act (EPCRA) established the TRI. TRI tracks the waste management of designated toxic chemicals from facilities within certain industry sectors. Facilities are required to report to TRI if the facility has 10 or more full-time employees; is included in an applicable NAICS code; and manufactures, processes, or uses the chemical in quantities greater than a certain threshold (25,000 pounds [lb] for manufacturers and processors of DEHP and 10,000 lb for users of DEHP). EPA makes the reported information publicly available through TRI. Each facility subject to the rule must report either using a Form R or a Form A. Facilities reporting using a Form R must report annually the volume of chemical released to the environment (*i.e.*, surface water, air, or land) and/or managed through recycling, energy recovery, and treatment (*e.g.*, incineration) from the facility. Facilities may submit a Form A if the volume of chemical manufactured, processed, or otherwise used does not exceed 1,000,000 pounds per year (lb/year) and the total annual reportable releases do not exceed 500 lb/year. Facilities reporting using a Form A are not required to submit annual release and waste management volumes or use/sub-use information for the chemical. Due to the reporting thresholds, some sites that manufacture, process, or use DEHP may not report to TRI and are, therefore, not included in EPA's assessment. This limitation will increase the uncertainty of the evaluated data as not all environmental releases of DEHP will be accounted for.

EPA included both TRI Form R and Form A submissions in the analysis of environmental releases. For Form Rs, EPA assessed releases using the reported annual release volumes from each media. For Form As, EPA estimated releases to each media using other approaches, where possible. Where no approaches were reasonably available to estimate releases from facilities reporting using Form As, EPA assessed releases using the 500 lb/year threshold for each release media; however, since this threshold is for total site releases, the 500 lb/year is attributed to one release media (one or the other)—not all (to avoid over counting the releases and exceeding the total release threshold for Form A). For this risk evaluation, EPA used TRI data from reporting years 2017 to 2022 to provide a basis for estimating releases (U.S. EPA, 2022f). Multiple reporting years are used for estimation to increase the reliability and accuracy of the release trends. Further details on EPA's approach to using TRI data for estimating releases are described in Sections 2.3.3.1 through 2.3.3.3. There is a decreasing general trend from 2017 to 2022 for total releases of DEHP reported to TRI, though variability in release volumes decreased in the latter years. EPA did not consider data from the 2023 or 2024 TRI because the data were not finalized at the time of this evaluation. However, there is a reasonable expectation, based on preliminary 2024 TRI data, that the downward trend will continue.

Under the Clean Water Act (CWA), EPA regulates the discharge of pollutants into receiving waters through National Pollutant Discharge Elimination System (NPDES). A NPDES permit authorizes discharging facilities to discharge pollutants to specified effluent limits. There are two types of effluent limits: (1) technology-based and (2) water quality-based. While the technology-based effluent limits are uniform across the country, the quality-based effluent limits vary and are more stringent in certain areas. NPDES permits may also contain requirements for sewage sludge management.

NPDES permits apply pollutant discharge limits to each outfall at a facility. For risk evaluation purposes, EPA was interested only on the outfalls to surface water bodies. NPDES permits also include internal outfalls, but they aren't included in this analysis. This is because these outfalls are internal monitoring points within the facility wastewater collection or treatment system, so they do not represent discharges from the facility. NPDES permits require facilities to monitor their discharges and report the results to EPA and the state regulatory agency. Facilities report discharge results in DMR only if required and, therefore, may not capture discharges for one-time events. This leads to additional uncertainty in the data as not all surface water discharges of DEHP will be recorded. EPA makes these reported data publicly available via EPA's Enforcement and Compliance History Online (ECHO) system and EPA's Water Pollutant Loading Tool (Loading Tool). The Loading Tool is a web-based tool that obtains DMR data through ECHO, presents data summaries and calculates pollutant loading (mass of pollutant discharged). For this risk evaluation, the EPA queried DMRs for all DEHP point source water discharges available from 2017 to 2022 to match the reporting periods used for TRI for comparison (U.S. EPA, 2022c). Further details on EPA's approach to using DMR data for estimating releases are described in Section 2.3.3.1 and Appendix H.

The NEI was established to track emissions of Criteria Air Pollutants (CAPs) and CAP precursors and assist with National Ambient Air Quality Standard (NAAQS) compliance under the Clean Air Act (CAA). Air emissions data for the NEI are collected at the state, local, and tribal (SLT) level. 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 Hazardous Air Pollutants (HAPs). EPA uses the data collected from SLT air agencies, in conjunction with supplemental HAP data, to build the NEI. EPA makes an updated NEI publicly available every three years. For this risk evaluation, EPA used NEI data for reporting years 2017 and 2020 data to provide a basis for estimating releases (U.S. EPA, 2022e). The reporting years 2017 and 2020 are used to provide releases during the same reporting period as the TRI data (2017−2022) for comparison.

NEI emissions data are 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 all four 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. While 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. Similar to TRI, some sites that manufacture, process, or use DEHP may not report to NEI due to reporting thresholds and are therefore not included in EPA's assessment. 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, POTW, and solvent emissions may be reported in the point or nonpoint source categories depending upon source size.

Onroad mobile sources include emissions from onroad vehicles that combust liquid fuels during operation, including passenger cars, motorcycles, trucks, and buses. The nonroad mobile 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 are reported in the same format as nonpoint data; however, it is not available for every chemical. For DEHP, onroad and nonroad mobile data are not available and was not used in the air release assessment. Further details on EPA's approach to using NEI data for estimating releases are described in Section 2.3.3.2.

Strengths and limitations for environmental releases used in this evaluation are described in Table 4-1.

2.3.3.1 Estimating Wastewater Discharges from TRI and DMR

Where available, EPA used TRI and DMR data to estimate median and maximum annual wastewater discharges and the associated daily wastewater discharges.

Annual Wastewater Discharges

For TRI, annual discharges are reported directly by facilities. 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, semi-annual, and annual reporting. In instances where a facility reports 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 ND 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.

Average Daily Wastewater Discharges

To estimate average daily discharges, EPA used the following steps:

1. Obtain total annual loads calculated from the Loading Tool and reported annual direct surface water discharges and indirect discharges to POTW and non-POTW WWT in TRI.
2. For TRI reporters using a Form A, estimate annual releases using an alternative approach (see Sections 2.3.4 and 2.3.5) or at the threshold of 500 pounds per year.
3. Determine if any of the facilities receiving indirect discharges reported in TRI have reported DMRs for the corresponding TRI reporting year, if so, exclude these indirect discharges from further analysis. The associated surface water release (after any treatment at the receiving facility) will be incorporated as part of the receiving facility's DMR.
4. Divide the annual discharges by the number of estimated operating days (estimated as described in Section 2.3.2).

EPA's analysis and summary of wastewater releases for 2017 to 2022 can be found in the *Environmental Releases to Wastewater for Diethylhexyl Phthalate (DEHP).*

2.3.3.2 Estimating Air Emissions from TRI and NEI

Where available, EPA used TRI and NEI data to estimate annual and average daily fugitive and stack air emissions. For air emissions, EPA estimated both release patterns (*i.e.*, days per year of release) and release durations (*i.e.*, hours per day the release occurs).

Annual Emissions

Facility-level annual emissions are available for TRI reporters and major sources in NEI. EPA used the reported annual emissions directly as reported in TRI and NEI for major sources. NEI also includes annual emissions for area sources that are aggregated at the county-level. Area source data in NEI is not divided between sites or between stack and fugitive sources. Therefore, EPA only presented annual emissions for each county-OES combination.

Average Daily Emissions
To estimate average daily emissions for TRI reporters and major sources in NEI, EPA used the following steps:

1. Obtain total annual fugitive and stack emissions for each TRI reporter and major source in NEI.
2. For TRI reporters using a Form A, estimate annual releases using an alternative approach (see Sections 2.3.4 and 2.3.5) or at the threshold of 500 pounds per year.
3. Divide the annual stack and fugitive emissions over the number of estimated operating days (note: NEI data includes operating schedules for many facilities that can be used to estimate facility-specific days per year).
4. Estimate a release duration using facility-specific data available in NEI, models, and/or literature sources. If no data are reasonably available, list as "unknown."

To estimate average daily emissions from area sources, EPA followed a very similar approach as described for TRI reporters and major sources in NEI; however, area source data in NEI is not divided between sites or between stack and fugitive sources. Area data also does not include release duration data as the emissions are aggregated at the county-level rather than facility level. Therefore, EPA only presented annual emissions for each county-OES combination.

EPA's analysis and summary of wastewater releases for 2017 and 2020 can be found in *Environmental Releases to Air for Diethylhexyl Phthalate (DEHP).*

2.3.3.3 Estimating Land Disposals from TRI

Where available, EPA used TRI data to estimate annual and average daily land disposal volumes. TRI includes reporting of disposal volumes for a variety of land disposal methods, including but not limited to underground injection, Resource Conservation and Recovery Act (RCRA) Subtitle C landfills, land treatment, RCRA Subtitle C surface impoundments, other surface impoundments, and other land disposal. EPA provided estimates for both a total aggregated land disposal volume and disposal volumes for each disposal method reported in TRI.

Annual Land Disposal
Facility-level annual disposal volumes are available directly for TRI reporters. EPA used the reported annual land disposal volumes directly as reported in TRI for each land disposal method. EPA combined totals from all land disposal methods from each facility to estimate a total annual aggregate disposal volume to land.

Average Daily Land Disposal
To estimate average daily disposal volumes, EPA used the following steps:

1. Obtain total annual disposal volumes for each land disposal method for each TRI reporter.
2. For TRI reporters using a Form A, estimate annual releases using an alternative approach (see Sections 2.3.4 and 2.3.5) or at the threshold of 500 pounds per year.
3. Divide the annual disposal volumes for each land disposal method over the number of estimated operating days.
4. Combine totals from all land disposal methods from each facility to estimate a total aggregate disposal volume to land.

EPA's analysis and summary of wastewater releases for 2017 to 2022 can be found in *Environmental Releases to Land for Diethylhexyl Phthalate (DEHP).*

2.3.4 Estimating Releases from Models

Where releases were expected for an OES but TRI, DMR, and/or NEI data were not available or where EPA determined available data did not capture the entirety of environmental releases for an OES, EPA utilized models to estimate environmental releases. Outputs from models may be the result of deterministic calculations, stochastic calculations, or a combination of both deterministic and stochastic calculations. For each OES with modeled releases, EPA followed these steps to estimate releases:

1. Identify release sources and associated release media.
2. Identify or develop model equations for estimating releases from each source.
3. Identify model input parameter values from relevant literature sources.
4. If a range of input values is available for an input parameter, determine the associated distribution of input values.
5. Calculate annual and daily release volumes for each release source using input values and model equations.
6. Aggregate release volumes by release media and report total releases to each media from each facility.

For release models that utilized stochastic calculations, EPA performed a Monte Carlo simulation using the Palisade @Risk 8.0 software with 100,000 iterations and the Latin Hypercube sampling method. Appendix D provides detailed descriptions of the model approaches that EPA used for each OES as well as model equations, input parameter values, and associated distributions.

2.3.5 Estimating Releases Using Literature Data

Where available, EPA uses data from literature sources to estimate releases. Literature data may include directly measured release data or other information related to release modeling. Therefore, EPA's approach to literature data differs depending on the type of available literature data. For example, if facility-specific release data are available, then EPA may use such data to estimate releases from that specific facility. If facility-specific data are available for a subset of the facilities within an OES, then EPA may build a distribution from such data and estimate releases from facilities within the OES using central tendency and high-end values from this distribution. If facility-specific data are unavailable, but industry- or chemical-specific emission factors are available, then EPA may use such emission factors to calculate releases for an OES or incorporate the emission factors into release models to develop a distribution of potential releases for the OES. Sections 3.1 through 3.16 provide a detailed description of how EPA incorporated literature data into the release estimates for each OES.

2.4 Occupational Exposure Approach and Methodology

For workplace exposures, EPA considered exposures to both workers who directly handle DEHP and ONUs who do not directly handle DEHP but may be exposed to DEHP based on their proximity to areas where DEHP is present. EPA evaluated inhalation and dermal exposures to both workers and ONUs.

EPA provided occupational exposure results representative of central tendency and high-end exposure conditions. EPA expects the central tendency exposure value to represent occupational exposures in the center of the distribution for a given COU. For risk evaluation, EPA used the 50th percentile (median), mean (arithmetic or geometric), mode, or midpoint value of the exposure distribution to represent the central tendency. EPA preferred to provide the 50th percentile of the distribution when sufficient data were available. However, if the full distribution is unknown, EPA may assume that the mean, mode, or midpoint of the distribution represents the central tendency, depending on the statistics available for the distribution.

EPA expects the high-end exposure values to represent occupational exposures that occur at probabilities above the 90th percentile, but below the highest exposure for any individual (U.S. EPA, 1992a). For risk evaluation, EPA provided high-end results at the 95th percentile. If the 95th percentile is not reasonably available, EPA used a different percentile greater than or equal to the 90th percentile but less than or equal to the 99.9th percentile, depending on the statistics available for the distribution. If the full distribution is not known and the preferred statistics are not reasonably available, EPA used a maximum or bounding estimate in lieu of the high-end exposure value.

For occupational exposures, EPA used measured or estimated air concentrations to calculate the exposure concentration metrics required for risk assessment, such as the average daily concentration (ADC). These calculations require additional parameter inputs, such as years of exposure, exposure duration and frequency, and lifetime years. EPA estimated exposure concentrations from monitoring data, modeling, or occupational exposure limits (OELs).

For the final exposure result metrics, each of the input parameters (*e.g.*, air concentrations, 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 the following general approaches for estimating the final exposure result metrics:

- **Deterministic calculations:** EPA may use a combination of point estimates of each parameter to estimate a central tendency and high-end for each final exposure metric result. This approach was used for four OESs.
- **Probabilistic (stochastic) calculations:** EPA may use Monte Carlo simulations using the full distribution of each parameter to calculate a full distribution of the final exposure metric. With this approach, EPA selects the 50th and 95th percentiles of the resulting distribution as the central tendency and high-end, respectively. This method was not used for this assessment based on the available literature data.
- **Combination of deterministic and probabilistic calculations:** EPA may have full distributions for some parameters but point estimates of the remaining parameters. For example, EPA may use Monte Carlo modeling to estimate exposure concentrations but may only have point estimates of exposure duration, exposure frequency, and lifetime years. This method was not used for this assessment based on the available literature data.

Appendix A discusses the equations and input parameter values that EPA used to estimate each exposure metric.

For each OES, EPA provided high-end and central tendency, full shift, time-weighted average (TWA) (typically as an 8-hour TWA) inhalation exposure concentrations as well as high-end and central tendency acute potential dermal dose rates (APDR). EPA applied the following hierarchy in selecting data and approaches for assessing occupational exposures:

1. Monitoring data:
    a. Personal and directly applicable to the OES
    b. Area and directly applicable to the OES
    c. Personal and potentially applicable or similar to the OES
    d. Area and potentially applicable or similar to the OES
2. Modeling approaches:
    a. Surrogate monitoring data
    b. Fundamental modeling approaches

   c. Statistical regression modeling approaches

3. Occupational exposure limits:

   a. Company-specific OELs (for site-specific exposure assessments, *e.g.*, there is only one manufacturer who provides their internal OEL to EPA, but the manufacturer does not provide monitoring data)

   b. Occupational Safety and Health Administration (OSHA) Permissible Exposure Limits (PEL)

   c. Voluntary limits (*i.e.*, American Conference of Governmental Industrial Hygienists [ACGIH] Threshold Limit Values [TLV], National Institute for Occupational Safety and Health [NIOSH] Recommended Exposure Limits [REL], Occupational Alliance for Risk Science (OARS) workplace environmental exposure level (WEEL) [formerly by AIHA])

EPA used the estimated high-end and central tendency, full shift TWA inhalation exposure concentrations and APDR to calculate the exposure metrics required for risk evaluation. Exposure metrics for inhalation and dermal exposures include acute dose (AD), intermediate average daily dose (IADD), and average daily dose (ADD). Appendix A describes the approach that EPA used to estimating each exposure metric.

2.4.1 Identifying Worker Activities

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 reasonably available, EPA referenced relevant ESDs or GSs. Sections 3.1.4.1 through 3.16.4.1 provide worker activities for each OES.

2.4.2 Estimating Inhalation Exposures

2.4.2.1 Inhalation 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 via public comments. For example, occupational inhalation monitoring data was received though public comment and incorporated into the relevant OESs. Studies were evaluated using the strategies laid out in the *Application of Systematic Review in TSCA Risk Evaluations* (U.S. EPA, 2021a).

EPA calculated exposures from the monitoring datasets provided in the sources discussed above, using different methodologies depending on the size of the dataset. For datasets with six or more data points, EPA estimated central tendency and high-end exposures using the 50th and 95th percentile values, respectively. For datasets with three to five data points, EPA estimated the central tendency and high-end exposures using the 50th percentile and maximum values, respectively. For datasets with two data points, EPA presented the midpoint and the maximum value. Finally, EPA presented datasets with only one data point as-is. For datasets that included exposure data reported as below the LOD, EPA estimated exposure concentrations following guidance in EPA's Guidelines for Statistical Analysis of Occupational Exposure Data (U.S. EPA, 1994). That report 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.

If the 8-hour TWA personal breathing zones (PBZ) monitoring samples were not reasonably available, area samples were used for exposure estimates. EPA combined the exposure data from all studies applicable to a given OES into a single dataset.

For each COU, EPA endeavors to distinguish exposures for workers and ONUs. Normally, a primary difference between workers and ONUs is that workers may handle DEHP and have direct contact with the chemical, while ONUs are working in the general vicinity of workers but do not handle DEHP and do not have direct contact with DEHP being handled by the workers. EPA recognizes that worker job titles and activities may vary significantly from site to site; therefore, EPA typically identified samples as worker samples unless it was explicitly clear from the job title (*e.g.*, inspectors) and the description of activities in the report that the employee was not directly involved in the scenario. Samples from employees determined not to be directly involved in the scenario were designated as ONU samples.

OSHA Chemical Exposure Health Data

A key source of monitoring data is samples collected by OSHA during facility inspections. Air sampling data records from inspections are entered into the OSHA Chemical Exposure Health Data (CEHD) that can be accessed online. The database includes PBZ monitoring data, area monitoring data, bulk samples, wipe samples, and serum samples. The collected samples are used for comparing to OSHA's PEL and Short-Term Exposure Limit (STEL). OSHA's CEHD website indicates that they do not (1) perform routine inspections at every business that uses toxic/hazardous chemicals, (2) completely characterize all exposures for all employees every day, or (3) always obtain a sample for an entire shift. Rather, OSHA performs targeted inspections of certain industries based on national and regional emphasis programs and develops "snapshots" of chemical exposures and assess their significance (*e.g.*, comparing measured concentrations to the regulatory limits).

EPA took the following approach to analyzing OSHA CEHD:

1. **Downloaded all monitoring data for DEHP.** See Section 2.6 for evidence integration notes.
2. **Organized data by site** (*i.e.*, grouped data collected at the same site together).
3. **Removed any data not comprised of area or PBZ inhalation monitoring values (*e.g.*, serum samples, bulk samples, wipe samples, and blanks)**. These data are not used in EPA's inhalation exposure assessment.
4. **Assigned each data point to an OES.** Review NAICS codes, SIC codes, and as needed, company information available online, to map each sample to an OES. In some instances, EPA was unable to determine the OES from the information in the CEHD; in such cases, EPA did not use the data in the assessment. EPA also removed data determined to be likely for non-TSCA uses or otherwise out of scope.
5. **Combined samples from the same worker.** In some instances, OSHA inspectors will collect multiple samples from the same worker on the same day (these are indicated by sample ID numbers). In these cases, EPA combined results from all samples for a particular sample ID to construct an exposure concentration based on the totality of exposures from each worker.
6. **Calculated 8-hour TWA results from combined samples**. Where the total sample time was less than 8 hours (480 minutes), but greater than 330 minutes, EPA calculated an 8-hour TWA by assuming exposures were zero for the remainder of the shift. For any calculated 8-hour TWA exposures that were equal to zero or non-detects, EPA replaced this value with the LOD divided by either two or the square root of two (see step 7). EPA did consider all samples for 8-hour TWA that were marked 'eight-hour calculation used' in the OSHA CEHD database with no adjustment.

OSHA CEHD does not provide job titles or worker activities associated with the samples; therefore, EPA assumed all data were collected on workers and not ONUs.

Specific details related to the use of monitoring data for each COU can be found in Sections 3.1.4.2 through 3.16.4.2.

EPA's analysis and summary of inhalation exposures can be found in *Occupational Inhalation Exposure Data for Diethylhexyl Phthalate (DEHP).*

2.4.2.2 Inhalation Exposure Modeling

If EPA expected inhalation exposures for an OES, but monitoring data were either unavailable or did not sufficiently capture exposures, EPA utilized models 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 used the following steps to estimate exposures for each OES:

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 exposure models that utilize stochastic calculations, EPA performed a Monte Carlo simulation using the Palisade @Risk software with 100,000 iterations and the Latin Hypercube sampling method. Appendix C provides detailed descriptions of the model approaches used for each OES, model equations, and input parameter values and associated distributions.

2.4.2.3 Occupational Exposure Limits

If monitoring data or models were not reasonably available to estimate inhalation exposures from an OES, EPA relied on relevant OELs, where available. Relevant limits may include company-specific limits, OSHA PELs, or voluntary limits, such as NIOSH Recommended Exposure Limits (RELs). When utilizing exposure limits, EPA assumed facilities operate such that the workers are exposed at the limit every day of the work year. If EPA used OELs, an explanation of the use of this limit is included in Section 2.7.

2.4.3 Estimating Dermal Exposures

This section summarizes the available dermal absorption data related to DEHP (Section 2.4.3.1), the interpretation of the dermal absorption data (Section 2.4.3.1), and uncertainties associated with dermal absorption estimation (Section 2.4.3.2). Dermal data were sufficient to characterize occupational dermal exposures both to liquids or formulations as well as solids or articles containing DEHP (Section 2.4.3.1). Dermal exposures to vapors are not expected to be significant due to the extremely low volatility of DEHP, and therefore, are not included in the dermal exposure assessment of DEHP. The flux-based dermal exposure approach used for estimating occupational dermal exposures to DEHP is further explained in Appendix C. EPA's analysis and summary of dermal exposures can be found in *Occupational Dermal Exposure Modeling Results for Diethylhexyl Phthalate (DEHP).*

2.4.3.1 Dermal Absorption Data

EPA identified eight acceptable studies directly related to the dermal absorption of liquid DEHP: Hopf et al. (2014); Elsisi et al. (1989); Melnick et al. (1987); Barber et al. (1992); Ng et al. (1992), Scott et al. (1987), Eastman Kodak Company (1989), and a subsequent dermal absorption study by Hopf et al. (2024). EPA used data from Hopf et al. (2014) which determined liquid permeation parameters of neat and dilute DEHP on human skin. Summaries of these dermal absorptions studies and the rationale for selecting the study by Hopf et al. (2014) are detailed in Section 2.1.2 of the *Non-cancer Human Health Hazard Assessment for Diethylhexyl Phthalate (DEHP)* (U.S. EPA, 2025d). Briefly, EPA selected the study by Hopf et al.(2014) for determining dermal absorption of neat and aqueous DEHP because the study used metabolically-active human skin that was used within 2 hours of removal from patients undergoing abdominoplasty surgery, so that the skin retained esterase activity and metabolized DEHP to MEHP. Therefore, this study was considered to most closely approximate the dermal absorption of neat or aqueous DEHP in humans. For Hopf et al. (2014), neat and dilute DEHP was applied to 1.77 cm^2 of flow through diffusion cells at doses of 980 mg (553.67 mg/cm^2) and 50 mg (28.25 mg/cm^2) respectively. The flow through diffusion cells used for neat DEHP testing were monitored for 72 hours, while dilute DEHP study was conducted for 24 hours. For DEHP in an aqueous solution (1.66 µg DEHP/mL), Kp was calculated to be 1.51×10^{-4} cm/h, with a lag time (Tlag) of 8 hours and a steady state flux at 2.5×10^{-5} $mg/cm^2/h$. Neat DEHP had a longer Tlag of 30 hours and a lower Kp of 1.3×10^{-6} cm/hour and lower flux at 1.3×10^{-6} $mg/cm^2/h$. This dermal absorption rate (or flux) represents the slope of the linear portion of the permeation curve, and the study authors estimated lag time as the intercept of the steady-state portion of the permeability rate (J) curve with the time axis.

EPA considered two distinct scenarios for dermal exposures to liquid DEHP, one for neat concentrations of DEHP (EPA considered anything greater than or equal 90 percent DEHP to be a neat liquid) using the steady-state absorptive flux for neat DEHP from Hopf et al. (2014) and the other for dilute formulations of DEHP (EPA considered anything less than 90 percent DEHP to be a dilute formulation) using the steady-state absorptive flux for aqueous solution of DEHP from Hopf et al. (2014). Because the absorptive flux of dilute DEHP is greater than the neat absorptive flux, EPA expects using the dilute absorptive flux for anything less than 90 percent DEHP to be a protective approach for assessing dermal exposures. See Appendix C.2.1.1 for additional information on liquid steady-state flux values obtained from Hopf et al. (2014)

EPA only identified one study directly related to the dermal absorption of DEHP from solids: Chemical Manufacturers Association (1991), which was an absorption study using male F344 rats and DEHP contained within PVC film. For the Chemical Manufacturers Association (1991), 400 mg of DEHP in the form of PVC film was applied to 15 cm^2 clipped area of dorsal skin. The rats were monitored for 24 hours to determine the quantity of DEHP absorbed during the study. Chemical Manufacturers Association (1991) showed that the mean absorptive flux of DEHP within a PVC film applied to rat skin *in vivo* was estimated as 4.8×10^{-5} mg/cm^2/hour over a 24-hour period and 1.19×10^{-4} mg/cm^2/hour over a 168-hour period. Because there was not acceptable dermal absorption data for all solid products containing DEHP, EPA considered the dermal absorption from Chemical Manufacturers Association (1991) to be representative across chemical concentrations and articles.

In a typical occupational exposure setting, the duration of exposure is not expected to exceed the shift time (typically, 8-12 hours). Therefore, EPA used the 24-hour average absorptive flux of 4.8×10^{-5} mg/cm^2/hour from Chemical Manufacturers Association (1991) to provide a conservative estimate for occupational exposures. Because this duration exceeds the occupational exposure duration and because Chemical Manufacturers Association (1991) show that the absorptive flux increased with longer test durations, EPA expects the use of the average absorptive flux data from Chemical Manufacturers Association (1991) to be protective of exposures in occupational settings. See Appendix C.2.1.2 for additional information on solid average flux values obtained from Chemical Manufacturers Association (1991).

2.4.3.1.1 Dermal Absorption Data Interpretation

With respect to interpretation of the DEHP dermal absorption data reported in Hopf et al. (2014) and Chemical Manufacturers Association (1991), it is important to consider the relationship between the applied dermal load and the rate of dermal absorption. Specifically, the work of Kissel (2011) suggests the dimensionless term N_{derm} to assist with interpretation of dermal absorption data. The term N_{derm} represents the ratio of the experimental load (*i.e.*, application dose) to the average absorptive flux for a given experimental duration as shown in the following equation.

Equation A-1. Relationship Between Applied Dermal Load and Rate of Dermal Absorption

$$\boldsymbol{N_{derm}} = \frac{\boldsymbol{experimental\ load\ (\frac{mass}{area})}}{\boldsymbol{steady - state\ flux\ \left(\frac{mass}{area * time}\right) \times\ experimental\ duration\ (time)}}$$

Kissel (2011) indicates that high values of N_{derm} (>> 1) suggest that supply of the material is in surplus and that the dermal absorption is considered “flux-limited,” whereas lower values of N_{derm} indicate that absorption is limited by the experimental load and would be considered “delivery-limited.” Furthermore, Kissel (2011) indicates that values of percent absorption for flux-limited scenarios are highly dependent on the dermal load and should not be assumed transferable to conditions outside of the experimental conditions. Rather, the average absorptive flux should be utilized for estimating dermal absorption of flux-limited scenarios.

The application of N_{derm} to the neat DEHP dermal absorption data reported in Hopf et al. (2014) is shown below.

$$N_{derm} = \frac{553.67\ mg/cm^2}{1.3 \times 10^{-6} \frac{mg}{cm^2 \cdot h} \times\ 72 \frac{h}{day}} = 5.92 \times 10^6$$

Secondly, the application of N_{derm} to the dilute DEHP dermal absorption data reported in Hopf et al. (2014) is shown below.

$$N_{derm} = \frac{28.25\ mg/cm^2}{2.5 \times 10^{-5} \frac{mg}{cm^2 \cdot h} \times 24 \frac{h}{day}} = 4.7 \times 10^4$$

Finally, the application of N_{derm} to the solid DEHP dermal absorption data reported in Chemical Manufacturers Association (1991) is shown below.

$$N_{derm} = \frac{26.67\ mg/cm^2}{4.8 \times 10^{-5} \frac{mg}{cm^2 \cdot h} \times 24 \frac{h}{day}} = 2.31 \times 10^4$$

Because N_{derm} >> 1 for the experimental conditions of Hopf et al. (2014) and Chemical Manufacturers Association (1991), it is shown that the absorption of DEHP is considered flux-limited even at finite doses (*i.e.*, less than 10 µL/cm^2 (OECD, 2004c) for liquids and 1 to 5 mg/cm^2 for solids) and that percent absorption should not be considered transferrable across exposure conditions. The range of estimated average fluxes of DEHP presented in this section, based on the results Hopf et al. (2014) and Chemical Manufacturers Association (1991), is representative of exposures to liquid materials or formulations and solids or articles, respectively. Dermal exposures to liquids and solids containing DEHP are characterized in Appendix C.

2.4.3.2 Uncertainties in Dermal Absorption Estimation

As noted above in Section 2.4.3.1, EPA used data from Hopf et al. (2014) which determined liquid permeation parameters of neat and dilute DEHP on human skin. EPA used the neat steady-state dermal flux for exposures to liquid formulations with 90 percent DEHP or higher, and EPA used the dilute steady-state dermal flux for exposure to formulations with less than 90 percent DEHP. For purposes of assessing dermal exposures to liquids for this risk evaluation, EPA expects using the dilute absorptive flux for anything less than 90 percent DEHP to be a protective approach for assessing dermal exposures. However, dermal contact with products or formulations that have lower concentrations of DEHP may exhibit lower rates of flux since there is less material available for absorption. Conversely, co-formulants or materials within the products or formulations may alter dermal absorption (enhancing or reducing it), even at lower concentrations. Therefore, it is uncertain whether the products or formulations containing DEHP would result in decreased or increased dermal absorption. Based on the available dermal absorption data for DEHP, EPA has made assumptions that result in exposure estimates that are likely, by nature of the conservative assumptions, to be the most human health protective.

Hopf et al. (2014) estimated lag times as the intercept of the steady-state portion of the permeability rate (J) curves with the time axis and found that neat DEHP did not permeate into the skin until after 30 hours of exposure. For aqueous DEHP, Hopf et al. (2014) found that DEHP in a dilute aqueous formulation (0.166 mg/mL = 0.017%) didn't permeate the skin until after eight hours of exposure. In both cases, only a DEHP metabolite was detected in the receptor fluid indicating that DEHP is extensively metabolized *in vitro* in human viable skin (Hopf et al., 2014). In a typical occupational exposure setting, the duration of exposure is not expected to exceed the shift time (typically, 8–12 hours). While intermediate measurements of metabolites in the receptor fluid were taken, no numerical data were presented except for the overall 24-hour study. Use of this steady state dermal absorption rate from the 24-hour study may result in an overestimate of dermal absorption for an 8-hour work shift, given the lag time of 8 hours identified in the Hopf et al. study (2014). However, the potentially absorbable dose, *i.e.*, the amount of DEHP *in* the skin, was not quantified. Given that any DEHP absorbed in the skin may be available for further absorption may be an underestimate. Taking each of these factors into consideration, EPA expects the use of the steady-state absorptive flux data from Hopf *et al.* for dermal exposure to liquids to be protective of the duration of dermal exposures in occupational settings (Hopf et al., 2014).

For dermal exposure to solids, EPA only identified one study directly related to the dermal absorption of DEHP from solids: Chemical Manufacturers Association (1991), which was an absorption study conducted *in vivo* using male F344 rats and DEHP contained within PVC film. There have been studies conducted to determine the difference in dermal absorption between rat skin and human skin. Specifically, Scott (1987) examined the difference in dermal absorption between rat skin and human skin for four different phthalates (*i.e.*, dimethyl phthalate [DMP], diethyl phthalate [DEP], dibutyl phthalate [DBP], and DEHP) using *in vitro* dermal absorption testing. Results from the *in vitro* dermal absorption experiments showed that rat skin was more permeable than human skin for all four phthalates examined. Specifically for DEHP, rat skin was up to 4 times more permeable than human skin.

However, it is important to note that the study by Scott *et al.* (1987) used cadaver skin that was previously frozen and then heated in a 60°C water bath to separate the epidermis which was then refrozen until dermal absorption testing was conducted. Therefore, this ratio indicating different absorption between rat and human skin is based solely on diffusion, whereas the data from the study conducted by the Chemical Manufacturers Association (1991) are an *in vivo* study. For this reason, EPA did not use this ratio to quantitatively adjust the dermal absorption value from the Chemical Manufacturers Association study. Therefore, EPA considers the *in vivo* dermal absorption data using male F344 rats (Chemical Manufacturers Association, 1991) to provide an upper bound of dermal absorption of DEHP in solids, considering the findings of Scott (1987).

In a typical occupational exposure setting, the duration of exposure is not expected to exceed the shift time (typically, 8–12 hours). Therefore, EPA used the 24-hour steady-state absorptive flux of 4.8×10^{-5} mg/cm^2/hour from Chemical Manufacturers Association for dermal exposure to solids to estimate occupational exposures as the timeframe more closely approximates occupational exposure durations. Because this duration exceeds the occupational exposure duration and because Chemical Manufacturers Association that the absorptive flux increased with longer test durations, EPA expects the use of the average absorptive flux data from Chemical Manufacturers Association to be protective of the duration of dermal exposures in occupational settings (Chemical Manufacturers Association, 1991). While both studies are protective of the duration of dermal exposures in occupational settings, EPA still conducts exposure calculations as workplace scenarios present opportunities for dermal absorption and therefore a dermal exposure route.

2.4.4 Estimating Acute, Intermediate, and Chronic (Non-Cancer) Exposures

For each OES, EPA used the estimated exposures to calculate acute, intermediate, and chronic (non-cancer) inhalation exposures and dermal doses. These calculations require additional parameter inputs, such as years of exposure, exposure duration and exposure frequency.

For the final exposure result metrics, each of the input parameters (*e.g.*, air concentrations, dermal doses, working years, exposure frequency) may be a point estimate (*i.e.*, a single descriptor or statistic, such as central tendency or high-end) or a full distribution. As described in Section 2.4, EPA considered three general approaches for estimating the final exposure result metrics: deterministic calculations, probabilistic (stochastic) calculations, and a combination of deterministic and probabilistic calculations. The equations and input parameter values used to estimate each exposure metric are discussed in Appendix A.

2.5 Consideration of Engineering Controls and Personal Protective Equipment

OSHA and NIOSH recommend that employers utilize the hierarchy of controls to address hazardous exposures in the workplace. The hierarchy of controls strategy outlines, in descending order of priority, the use of elimination, substitution, engineering controls, administrative controls, and lastly personal protective equipment (PPE). The hierarchy of controls prioritizes the most effective measures first, which is to 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 workers from 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 exposures to an acceptable level.

The remainder of this section discusses respiratory protection, including protection factors for various respirators. EPA's estimates of occupational exposure presented in this document do not assume the use of engineering controls or PPE; however, the effect of respiratory protection factors on EPA's occupational exposure estimates can be explored in *Occupational Risk Calculator for Diethylhexyl Phthalate (DEHP)* (U.S. EPA, 2025e).

2.5.1 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, provide respirators that are applicable and suitable for the purpose intended. Respirator selection provisions are provided in section 1910.134(d) and require that appropriate respirators are selected based on the respiratory hazard(s) to which the worker will be exposed and workplace and user factors that affect respirator performance and reliability. Assigned protection factors (APFs) are provided in Table 1 under section 1910.134(d)(3)(i)(A) (see below in Table 2-1) 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 continuing, effective respiratory protection program according to the requirements of OSHA's Respiratory Protection Standard.

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 that meet these criteria include air-purifying respirators with organic vapor cartridges. Respirators must meet or exceed the required level of protection listed in Table 2-1. Based on the APF, inhalation exposures may be reduced by a factor of 5 to 10,000 if respirators are properly worn and fitted.

Table 2-1. 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)					

2.6 Evidence Integration for Environmental Releases and Occupational Exposures

Evidence integration for the environmental release and occupational exposure assessment includes analysis, synthesis, and integration of information and data to produce estimates of environmental releases and occupational exposures. During evidence integration, EPA considered the likely location, duration, intensity, frequency, and quantity of releases and exposures while also considering factors that increase or decrease the strength of evidence when analyzing and integrating the data. Key factors that EPA considered when integrating evidence include:

1. **Data Quality:** EPA only integrated data or information rated as *high, medium, or low* obtained during the data evaluation phase. EPA did not use data and information rated as *uninformative* in exposure evidence integration. In general, EPA gave preference to higher rankings over lower rankings; however, EPA may use lower ranked data over higher ranked data after carefully examining and comparing specific aspects of the data. For example, EPA may use a lower ranked dataset that precisely matches the OES of interest over a higher ranked study that does not match the OES of interest as closely.
2. **Data Hierarchy:** EPA used both measured and modeled data to obtain accurate and representative estimates (*e.g.,* central tendency, high-end) of the environmental releases and occupational exposures resulting directly from a specific source, medium, or product. If available, measured release and 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. For example, EPA may use high quality modeled data that is directly applicable to a given OES over low quality measurement data that is not specific to the OES. The final integration of the environmental release and occupational exposure evidence combined decisions regarding the strength of the available information, including information on plausibility and coherence across each evidence stream.

EPA evaluated environmental releases based on reported release data and evaluated occupational exposures based on monitoring data and worker activity information from standard engineering sources and systematic review. EPA estimated COU-specific assessment approaches where supporting data existed and documented uncertainties where supporting data were only applicable for broader assessment approaches.

A summary of the data quality evaluation results for the DEHP occupational exposure sources are presented in the attachment *Data Extraction for Environmental Release and Occupational Exposure for Diethylhexyl Phthalate (DEHP)*.

2.7 Estimating Number of Workers and Occupational Non-Users

This section provides a summary of the estimates for the total exposed workers and ONUs for each OES. To prepare these estimates, EPA first identified relevant North American Industrial Classification (NAICS) codes and Standard Occupational Classification (SOC) codes from the Bureau of Labor Statistics (BLS) (2023). The estimation process for the total number of workers and ONUs is described in Section 2.7.1 below. EPA also estimated the total number facilities associated with the relevant NAICS codes based on data from the U.S. Census Bureau (2015). To estimate the average number of potentially exposed workers and ONUs per site, the total number of workers and ONUs were divided by the total number of facilities. The following sections provide additional details on the approach and methodology for estimating the number of facilities using DEHP and the number of potentially exposed workers and ONUs.

2.7.1 Number of Workers and Occupational Non-Users Estimation Methodology

Where available, EPA used CDR data to provide a basis for estimating the number of workers and ONUs. EPA supplemented the available CDR data with U.S. economic data using the following method:

1. Identify the NAICS codes for the industry sectors associated with these uses (Table 2-2 below).
2. Estimate total employment by industry/occupation combination using the Bureau of Labor Statistics' Occupational Employment Statistics data (BLS Data).
3. Refine the Occupational Employment Statistics estimates where they are not sufficiently granular by using the U.S. Census' SUSB data on total employment by 6-digit NAICS.
4. Use market penetration data to estimate the percentage of employees likely to be using DEHP instead of other chemicals.
5. Where market penetration data are not available, use the estimated workers/ONUs per site in the 6-digit NAICS code and multiply by the number of sites estimated from CDR, TRI, DMR and/or NEI. In DMR data, sites report SIC codes rather than NAICS codes; therefore, EPA mapped each reported SIC code to a NAICS code for use in this analysis.

Combine the data generated in Steps 1 through 5 to produce an estimate of the number of employees using DEHP in each industry/occupation combination and sum these to arrive at a total estimate of the number of employees with potential exposure within the OES.

below contains the relevant NAICS codes and the calculated average number of workers and ONUs identified per site for each OES.

Table 2-2. NAICS Code Crosswalk and Number of Workers and ONUs for Each OES

Occupational Exposure Scenario (OES)	Relevant NAICS Codes	Exposed Workers per Site[a b]	Exposed ONUs per Site[a b]
Manufacturing	325180 – Other Basic Inorganic Chemical Manufacturing 325199 – All Other Basic Organic Chemical Manufacturing 325211 – Plastics Material and Resin Manufacturing 325998 – All Other Miscellaneous Chemical Product and Preparation Manufacturing	26	12
Repackaging	325211 – Plastics Material and Resin Manufacturing 325991 – Custom Compounding of Purchased Resins	8	3

Occupational Exposure Scenario (OES)	Relevant NAICS Codes	Exposed Workers per Site[a b]	Exposed ONUs per Site[a b]
	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) 424910 – Farm Supplies Merchant Wholesalers		
Incorporation into formulation, mixture, or reaction product	325180 – Other Basic Inorganic Chemical Manufacturing 325212 – Synthetic Rubber Manufacturing 325510 – Paint and Coating Manufacturing 325520 – Adhesive Manufacturing 325998 – All Other Miscellaneous Chemical Product and Preparation Manufacturing	19	8
Use in hydraulic fracturing	213112 – Support Activities for Oil and Gas Operations	9	2
Application of paints, coatings, adhesives, and sealants	322220 – Paper Bag and Coated and Treated Paper Manufacturing 334100 – Computer and Peripheral Equipment Manufacturing 334200 – Communications Equipment Manufacturing 334300 – Audio and Video Equipment Manufacturing 334400 – Semiconductor and Other Electronic Component Manufacturing 334500 – Navigational, Measuring, Electromedical, and Control Instruments Manufacturing 334600 – Manufacturing and Reproducing Magnetic and Optical Media 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 336500 – Railroad Rolling Stock Manufacturing 336600 – Ship and Boat Building 336900 – Other Transportation Equipment Manufacturing 337110 – Wood Kitchen Cabinet and Countertop Manufacturing 337122 – Nonupholstered Wood Household Furniture Manufacturing 337124 – Metal Household Furniture Manufacturing 337127 – Institutional Furniture Manufacturing	40	13

Occupational Exposure Scenario (OES)	Relevant NAICS Codes	Exposed Workers per Site[a b]	Exposed ONUs per Site[a b]
	337211 – Wood Office Furniture Manufacturing 337212 – Custom Architectural Woodwork and Millwork Manufacturing 337214 – Office Furniture (except Wood) Manufacturing 337215 – Showcase, Partition, Shelving, and Locker Manufacturing 811120 – Automotive Body, Paint, Interior, and Glass Repair		
Use of laboratory chemicals – liquid	541380 – Testing Laboratories 541712 – Research and Development in the Physical, Engineering, and Life Sciences (except Biotechnology)	1	10
Use of laboratory chemicals – solid	541380 – Testing Laboratories 541712 – Research and Development in the Physical, Engineering, and Life Sciences (except Biotechnology)	1	10
Plastics compounding	325211 – Plastics Material and Resin Manufacturing 325991 – Custom Compounding of Purchased Resins 326100 – Plastics Product Manufacturing 336412 – Aircraft Engine and Engine Parts Manufacturing	28	16
Plastics converting	325199 – All Other Basic Organic Chemical Manufacturing 326199 – All Other Plastics Product Manufacturing 336412 – Aircraft Engine and Engine Parts Manufacturing	34	21
Recycling	562212 – Solid Waste Landfill 562213 – Solid Waste Combustors and Incinerators 562219 – Other Nonhazardous Waste Treatment and Disposal	6	4
Rubber manufacturing	325212 – Synthetic Rubber Manufacturing 326200 – Rubber Product Manufacturing	33	9
Formulations for diffusion bonding	333992 – Welding and Soldering Equipment Manufacturing 336412 – Aircraft Engine and Engine Parts Manufacturing	29	22
Use of dyes and pigments, and fixing agents	323100 – Printing and Related Support Activities	2	1
Textile finishing	313310 – Textile and Fabric Finishing Mills	7	3
Fabrication of final product from articles	335910 – Battery Manufacturing 335999 – All Other Miscellaneous Electrical Equipment and Component Manufacturing 337125 – Household Furniture (except Wood and Metal) Manufacturing 423810 – Construction and Mining (except Oil Well) Machinery and Equipment Merchant Wholesalers 561730 – Landscaping Services	14	5

Occupational Exposure Scenario (OES)	Relevant NAICS Codes	Exposed Workers per Site[a b]	Exposed ONUs per Site[a b]
Use of automotive care products	811111 – General Automotive Repair 811121 – Automotive Body, Paint, and Interior Repair and Maintenance 811191 – Automotive Oil Change and Lubrication Shops 811192 – Car Washes 811198 – All Other Automotive Repair and Maintenance	3	0
Disposal	562212 – Solid Waste Landfill 562213 – Solid Waste Combustors and Incinerators 562219 – Other Nonhazardous Waste Treatment and Disposal	6	4
[a] For cases where multiple NAICS codes were identified for an OES, an average was calculated for the number of workers and ONUs; this average was then applied to the OES. [b] Certain values are updated from the latest guidance documents (GS/ESDs) due to more recent U.S. Census data being made available.			

2.7.2 Summary of Number of Workers and ONUs

Table 2-3 summarizes the number of facilities and estimated total number of exposed workers for all OESs. For scenarios in which the results are expressed as a range, the lower end of the range is based on the 50th percentile estimate of the number of sites and the upper end of the range is based on the 95th percentile estimate of the number of sites. For some OESs, the estimated number of facilities is based on the number of reporting sites to the 2020 CDR (U.S. EPA, 2020b), NEI (U.S. EPA, 2023a), DMR (U.S. EPA, 2022c), and TRI databases (U.S. EPA, 2022f).

Table 2-3. Summary of Total Number of Workers and ONUs Potentially Exposed to DEHP for Each OES

Occupational Exposure Scenario (OES)	Total Exposed Workers	Total Exposed ONUs	Number of Facilities	Notes
Manufacturing	99	45	3	Number of workers and ONU estimates based on the 2021 BLS and 2015 U.S. Census Bureau data (U.S. BLS, 2023; U.S. Census Bureau, 2015). Number of facilities estimate based on identified sites from NEI, DMR, TRI, and CDR.
Repackaging	517	235	47	Number of workers and ONU estimates based on the 2021 BLS and 2015 U.S. Census Bureau data (U.S. BLS, 2023; U.S. Census Bureau, 2015). Number of facilities estimate based on identified sites from NEI, DMR, TRI, and CDR.
Incorporation into formulation, mixture, or reaction product	3,048	1,270	127	Number of workers and ONU estimates based on the 2021 BLS and 2015 U.S. Census Bureau data (U.S. BLS, 2023; U.S. Census Bureau, 2015). Number of

Occupational Exposure Scenario (OES)	Total Exposed Workers	Total Exposed ONUs	Number of Facilities	Notes
				facilities estimate based on identified sites from NEI, DMR, and TRI.
Use in hydraulic fracturing	396	88	44	Number of workers and ONU estimates based on the 2021 BLS and 2015 U.S. Census Bureau data (U.S. BLS, 2023; U.S. Census Bureau, 2015). Number of facilities estimate based on FracFocus (FracFocus, 2022).
Application of paints, coatings, adhesives, and sealants	5,600	1,820	140	Number of workers and ONU estimates based on the 2021 BLS and 2015 U.S. Census Bureau data (U.S. BLS, 2023; U.S. Census Bureau, 2015). Number of facilities estimate based on identified sites from NEI, DMR, and TRI.
Use of laboratory chemicals - Liquid	1,996 (central tendency); 36,873 (high-end)	19,960 (central tendency); 368,730 (high-end)	1,996 (central tendency); 36,873 (high-end)	Number of workers and ONU estimates based on the 2021 BLS and 2015 U.S. Census Bureau data (U.S. BLS, 2023; U.S. Census Bureau, 2015). Number of facilities estimate based on results from Monte Carlo modeling.
Use of Laboratory chemicals – solid	36,873	368,730	36,873	Number of workers and ONU estimates based on the 2021 BLS and 2015 U.S. Census Bureau data (U.S. BLS, 2023; U.S. Census Bureau, 2015). Number of facilities estimate based on results from Monte Carlo modeling.
Plastics compounding	2,170	1,178	62	Number of workers and ONU estimates based on the 2021 BLS and 2015 U.S. Census Bureau data (U.S. BLS, 2023; U.S. Census Bureau, 2015). Number of facilities estimate based on identified sites from NEI, DMR, and TRI.
Plastics converting	2,414	1,491	71	Number of workers and ONU estimates based on the 2021 BLS and 2015 U.S. Census Bureau data (U.S. BLS, 2023; U.S. Census Bureau, 2015). Number of facilities estimate based on identified sites from NEI, DMR, and TRI.
Recycling	6	4	1	Number of workers and ONU estimates based on the 2021 BLS and 2015 U.S. Census Bureau data (U.S. BLS, 2023; U.S. Census Bureau, 2015). Number of facilities estimate based on identified sites from TRI.
Rubber manufacturing	2,805	765	85	Number of workers and ONU estimates based on the 2021 BLS and 2015 U.S. Census Bureau data (U.S. BLS, 2023; U.S. Census Bureau, 2015). Number of facilities estimate based on identified sites from NEI, DMR, and TRI.

Occupational Exposure Scenario (OES)	Total Exposed Workers	Total Exposed ONUs	Number of Facilities	Notes
Formulations for diffusion bonding	406	308	14	Number of workers and ONU estimates based on the 2021 BLS and 2015 U.S. Census Bureau data (U.S. BLS, 2023; U.S. Census Bureau, 2015). Number of facilities estimate based on identified sites from NEI and DMR.
Use of dyes and pigments, and fixing agents	10	5	5	Number of workers and ONU estimates based on the 2021 BLS and 2015 U.S. Census Bureau data (U.S. BLS, 2023; U.S. Census Bureau, 2015). Number of facilities estimate based on identified sites from DMR.
Textile finishing	77	33	11	Number of workers and ONU estimates based on the 2021 BLS and 2015 U.S. Census Bureau data (U.S. BLS, 2023; U.S. Census Bureau, 2015). Number of facilities estimate based on identified sites from NEI, DMR, and TRI.
Fabrication of final product from articles	224	80	16	Number of workers and ONU estimates based on the 2021 BLS and 2015 U.S. Census Bureau data (U.S. BLS, 2023; U.S. Census Bureau, 2015). Number of facilities estimate based on identified sites from NEI, DMR, and TRI.
Use of automotive care products	75,510 (central tendency); 441,456 (high-end)	0	25,170 (central tendency); 147,152 (high-end)	Number of workers and ONU estimates based on the 2021 BLS and 2015 U.S. Census Bureau data (U.S. BLS, 2023; U.S. Census Bureau, 2015). Number of facilities estimate based on results from Monte Carlo modeling.
Disposal	2,862	1,908	477	Number of workers and ONU estimates based on the 2021 BLS and 2015 U.S. Census Bureau data (U.S. BLS, 2023; U.S. Census Bureau, 2015). Number of facilities estimate based on identified sites from NEI, DMR, and TRI.

3 ENVIRONMENTAL RELEASE AND OCCUPATIONAL EXPOSURE ASSESSMENTS BY OES

3.1 Manufacturing

3.1.1 Process Description

DEHP is produced in a batch or continuous process by reacting 2-ethylhexanol with phthalic anhydride (Gaudin et al., 2011; ECHA, 2009; Hines et al., 2009; ECJRC, 2008; ATSDR, 2002; Kozumbo et al., 1982). This reaction is either conducted in the presence of an acid or metal catalyst or at a high temperature. This reaction occurs in two successive steps. The first reaction step results in the formation of monoester by alcoholysis of phthalic acid. The second step involves the conversion of the monoester to the di-ester. Depending on the catalyst used in the second step, the temperature varies from between 140 and 165°C to between 200 and 250°C (ECHA, 2009). The second step is a reversible reaction and proceeds more slowly than the first. To shift the equilibrium towards the di-ester, the reaction water is removed by distillation. Elevated temperatures and a catalyst accelerate the reaction rate. Excess alcohol is recovered and recycled and DEHP is purified by vacuum distillation and/or activated charcoal. The reaction sequence is performed in a closed system (ECJRC, 2008).

The physical form of the DEHP end product is liquid or pellets (U.S. CPSC, 2015). Sources indicate the purity of commercial DEHP is 99.0 to 99.6 percent (IARC, 1982). The typical number of production days during a year is greater than 330 days (ECJRC, 2008). For manufacturing operations, EPA typically assumes 350 days/yr based on the assumptions that the plant runs 7 days/week and 50 weeks/yr and always produces the chemical of interest.

In the 2020 CDR, a single site reported domestically manufacturing DEHP in liquid form. The site, Momentive Performance Materials in Waterford, NY, reported the manufactured concentration as 1 to 30 percent by weight (U.S. EPA, 2020a). Figure 3-1 provides an illustration of the typical manufacturing process.

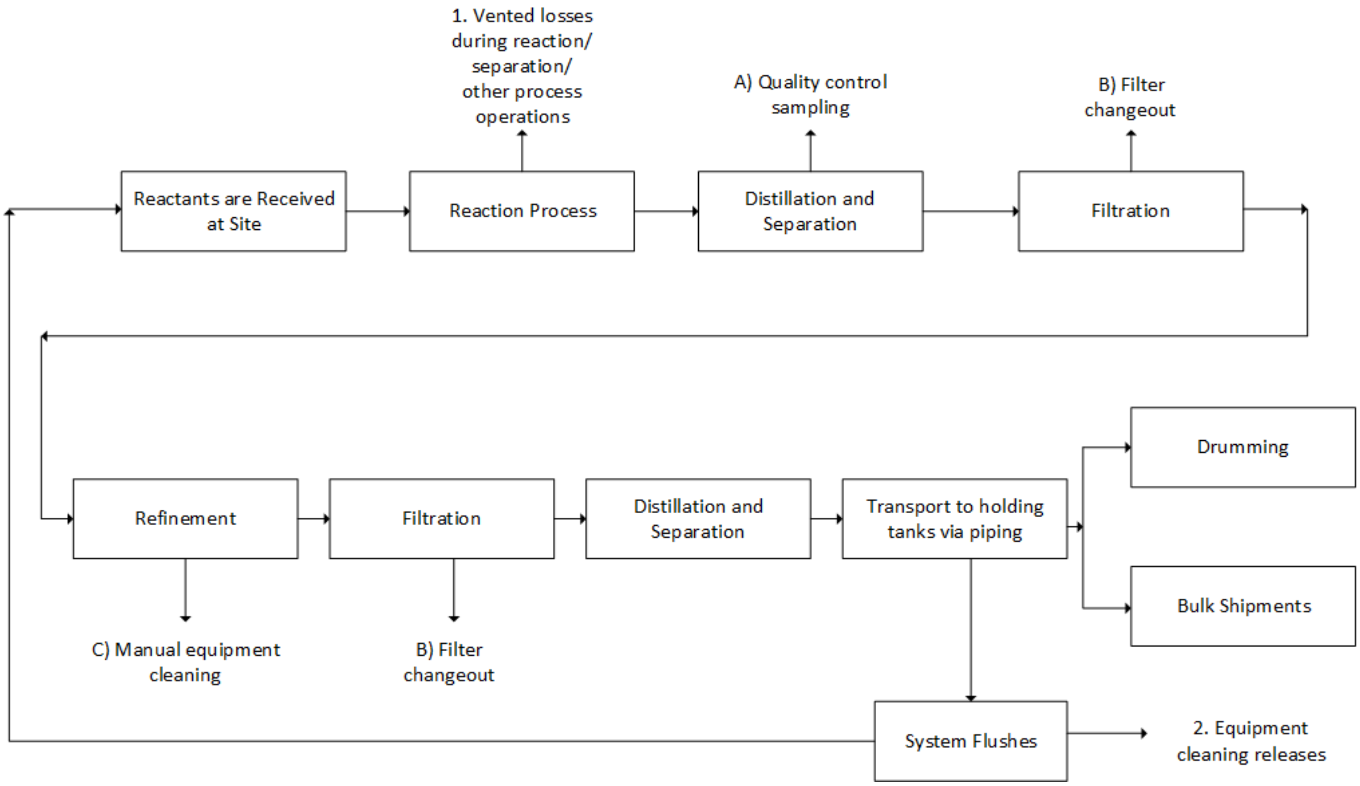


Figure 3-1. Manufacturing Flow Diagram

3.1.2 Facility Estimates

In the 2020 CDR, two companies, Eastman Chemical Co Tennessee Operations in Kingsport, TN and Momentive Performance Materials in Waterford, NY, reported manufacturing DEHP; however, Momentive Performance Materials did not report releases to the environment between 2017 and 2022. (U.S. EPA, 2020a). EPA identified these sites and assessed one additional site, Westlake Chemicals & Vinyls LLC Plaquemine/Axiall LLC – Plaquemine, that reported to TRI (U.S. EPA, 2022f), and NEI (U.S. EPA, 2022e) release data for the manufacturing of DEHP. There is a decreasing general trend from 2017 to 2022 for total releases of DEHP reported to TRI, though variability in release volumes decreased in the latter years. EPA did not consider data from the 2023 or 2024 TRI because the data were not finalized at the time of this evaluation. However, there is a reasonable expectation, based on preliminary 2024 TRI data, that the downward trend will continue. Only one of these sites, Westlake Chemicals & Vinyl's LLC Plaquemine/Axiall LLC – Plaquemine, reported operating information, reporting 364 operating days through NEI air release data. TRI/DMR do not report operating days. However, through public comment (Eastman Chemical Company, EPA-HQ-OPPT-2018-0433-0137, 2025) an estimate of 180 days/yr was provided which was used as the lower end of the operating days range. As a result, EPA used a range of 180 to 350 days/yr of operation, as discussed in Section 2.3.1.

According to a 2015 technical report from the U.S. Consumer Product Safety Commission, five sites made up all the primary producers of domestically manufactured DEHP in 2002 which rose to 23 DEHP manufacturers in the U.S. by 2012 (U.S. CPSC, 2015). One manufacturing facility reported a production rate of 180 million lbs/yr in 1982 (Liss and Hartel, 1983). In 2002, annual U.S. production of DEHP was reported to range from roughly 265 million to 4 billion pounds (U.S. CPSC, 2015). The exact amount is available for one year, 2011, in which 152,694,720 lbs. of DEHP was produced or imported. The U.S. EPA Chemical Data Access Tool (CDAT) reports that the 2012 national production volume was 152,694,720 lb/yr and shows at least 15 companies listed as importing or manufacturing DEHP.

Subsequent years show the number remains between 100 and 500 million through 2015 and decreased to 50 to 100 million pounds in 2019 based on the 2020 CDR data (U.S. EPA, 2020b).

EPA evaluated the production volumes for sites that reported this information as confidential business information (CBI) by subtracting known production volumes for other manufacturing and import sites from the total DEHP production volume reported to the 2020 CDR. EPA considered production volumes for both import and manufacturing sites because the annual DEHP production volume in the CDR includes both domestic manufacture and repackaging. The 2020 CDR reported a range of national production volume for DEHP; therefore, EPA provided the import and repackaging production volume as a range. EPA split the remaining production volume range evenly across all sites that reported this information as CBI. The calculated production volume range for the unknown sites resulted in 186,653 to 1,002,979 kg/site-yr. Releases from these sites are not included in the release estimates due to a lack of DEHP manufacturing facilities reporting releases. Review of preliminary 2024 CDR data shows that the national aggregate DEHP production volume for the 2024 CDR is expected to be comparable to the previously reported national aggregate production volume range from the 2020 CDR.

3.1.3 Release Assessment

3.1.3.1 Environmental Release Points

Based on TRI (U.S. EPA, 2022f), NEI (U.S. EPA, 2022e), and DMR (U.S. EPA, 2022c) data, manufacturing releases may go to fugitive air, stack air, surface water, POTWs, and landfills. Additional releases may occur from transfers of wastes to off-site treatment facilities (assessed in the waste handling OES). Fugitive air releases may occur during sampling, equipment cleaning, and container loading. Stack air releases may occur from vented losses during process operations. Releases to surface water, POTWs, or landfills may occur from equipment cleaning wastes, process wastes, and sampling wastes. Surface water releases may occur from container cleaning. Additional fugitive air releases may occur during leakage of pipes, flanges, and other equipment and devices used for transport.

3.1.3.2 Environmental Release Assessment Results

Table 3-1 presents fugitive and stack air releases per year and per day for DEHP Manufacturing based on the 2017 to 2022 TRI (U.S. EPA, 2022f) database years along with the number of release days per year, with medians and maxima presented from across the six-year reporting range. Table 3-2 presents fugitive and stack air releases per year and per day based on the 2020 NEI (U.S. EPA, 2022e) database along with the number of release days per year. Table 3-3 presents land releases per year based on the 2017 to 2022 TRI database along with the number of release days per year. Table 3-4 presents water releases per year and per day based on the 2017 to 2022 DMR (U.S. EPA, 2022c) and TRI databases along with the number of release days per year, with medians and maxima presented from across the six-year reporting range. The *Environmental Releases to Wastewater for Diethylhexyl Phthalate (DEHP)*, *Environmental Releases to Air for Diethylhexyl Phthalate (DEHP)*, *Environmental Releases to Land for Diethylhexyl Phthalate (DEHP)* contains additional information about the calculation results; refer to Appendix J for a reference to this supplemental document.

Table 3-1. Summary of Air Releases from TRI for Manufacture of DEHP

Site Identity	Maximum Annual Fugitive Air Release (kg/yr)	Max. Annual Stack Air Release (kg/yr)	Median Annual Fugitive Air Release (kg/yr)	Median Annual Stack Air Release (kg/yr)	Max. Daily Fugitive Air Release (kg/day)	Max. Daily Stack Air Release (kg/day)	Median Daily Fugitive Air Release (kg/day)	Median Daily Stack Air Release (kg/day)	Annual Release Days (days/yr)
Eastman Chemical Co Tennessee Operations, Kingsport, TN	162	156	152	135	0.45	0.43	0.42	0.37	364
Westlake Chemicals & Vinyls LLC, Plaquemine, LA/ Axiall LLC – Plaquemine Facility	0	5.0	0	0	0	1.4E−02	0	0	364

Table 3-2. Summary of Air Releases from NEI (2020) for Manufacture of DEHP

Site Identity	Total Fugitive Air Release (kg/yr)	Daily Fugitive Air Release (kg/day)	Total Stack Air Release (kg/yr)	Daily Stack Air Release (kg/day)	Annual Release Days (days/yr)
Eastman Chemical Co Tennessee Operations, Kingsport, TN	26	3.6E−02	50	6.9E−02	364
Westlake Chemicals & Vinyls LLC, Plaquemine, LA/ Axiall LLC – Plaquemine Facility	NR[a]	NR	6.5	9.0E−03	364
[a] NR = Not reported					

Table 3-3. Summary of Land Releases from TRI for Manufacture of DEHP

Site Identity	Median Total Release (kg/yr)	Maximum Total Release (kg/yr)	Annual Release Days (days/yr)
Eastman Chemical Co Tennessee Operations, Kingsport, TN	38	204	350

Table 3-4. Summary of Water Releases from DMR and TRI for Manufacture of DEHP

Site Identity	Source-Discharge Type	Median Annual Discharge (kg/yr)	Daily Discharge (Corresponding to Median Annual Discharge) (kg/day)	Maximum Annual Discharge (kg/yr)	Daily Discharge (Corresponding to Maximum Daily Discharge) (kg/day)	Annual Release Days (days/yr)
Eastman Chemical Co Tennessee Operations, Kingsport, TN	DMR – Direct Discharges	281	0.80	296	0.85	350
Eastman Chemical Co Tennessee Operations, Kingsport, TN	TRI – Direct Discharges	92	0.26	468	1.3	350
Eastman Chemical Co Tennessee Operations, Kingsport, TN	TRI –Transfers to POTW	0.91	2.6E−03	3.2	9.1E−03	350
Eastman Chemical Co Tennessee Operations, Kingsport, TN	TRI –Transfers to non-POTW	0	0	0	0	350

3.1.4 Occupational Exposure Assessment

3.1.4.1 Workers Activities

During manufacturing, worker exposures to DEHP may occur during product sampling. Additionally, worker exposures may occur via inhalation of vapors or dermal contact with liquids during equipment cleaning, and packaging and loading of DEHP into transport containers for shipment.

During DEHP manufacturing, half-face dual cartridge respirators may be used by operators (Liss and Hartel, 1983). Worker exposures may also be reduced by the use of local exhaust ventilation during manufacturing or a closed-mesh filter for air filtration in the production area of DEHP (Modigh et al., 2002; Liss et al., 1985).

ONUs include employees (*e.g.*, supervisors, managers) that work at the manufacturing facility, but do not directly handle DEHP. Generally, EPA expects ONUs to have lower inhalation and dermal exposures than workers who handle the chemicals directly. For the worker activities within the Manufacturing OES, it is expected that workers are exposed through inhalation of vapors and dermal contact with concentrated liquids. However, ONUs are not expected to encounter dermal contact with liquids containing DEHP; therefore, only inhalation exposures were estimated for ONUs under the Manufacturing OES.

3.1.4.2 Occupational Inhalation Exposure Results

The high-end and central tendency worker inhalation exposure results for this OES are based on the 95th and 50th percentile exposure values from full shift samples collected from two DEHP manufacturing plants (Liss and Hartel, 1983; Nuodex Inc., 1983). These data had data quality ratings ranging from medium to high. EPA determined that all data were of acceptable quality without notable deficiencies and integrated all the data into the final exposure assessment. Results of this analysis are presented in Table 3-5. Several references were not included in the analysis as they did not provide discrete sample data (Kim, 2016; ECJRC, 2008; ECB, 2003; Modigh et al., 2002; Liss et al., 1985). The absence of discrete data (*e.g.*, instances where only high-level summary data are presented) does not allow for data integration or useful comparison of datasets due to the uncertainties in knowledge of the underlying measurements. In this case, other data were available which were used for exposure estimates. The estimated central tendency from EPA's analysis generally aligns with these additional studies and is within an order of magnitude of the median presented in each study. Additional discussion on the uncertainty and limitations of these data are included in the weight of scientific evidence 4.2. No data with full shift samples for ONUs was identified for this OES through systematic review. For this reason, worker central tendency exposures were used for both the ONU high-end and central tendency exposures. The *Occupational Inhalation Exposure Data for Diethylhexyl Phthalate (DEHP)* contains additional information about the calculation results; refer to Appendix J for a reference to this supplemental document.

Table 3-5. Summary of Estimated Worker Inhalation Exposures for Manufacture of DEHP

Worker Population	Exposure Concentration Type	Central Tendency	High-End
Average Adult Worker	8-hour TWA Exposure Concentration (mg/m^3)	1.2E−02	2.2E−02
	Acute (AD, mg/kg-day)	1.5E−03	2.8E−03
	Intermediate (IADD, mg/kg-day)	1.1E−03	2.0E−03
	Chronic, Non-Cancer (ADD, mg/kg-day)	1.0E−03	1.9E−03
Female of Reproductive Age	8-hour TWA Exposure Concentration (mg/m^3)	1.2E−02	2.2E−02
	Acute (AD, mg/kg-day)	1.7E−03	3.0E−03
	Intermediate (IADD, mg/kg-day)	1.2E−03	2.2E−03
	Chronic, Non-Cancer (ADD, mg/kg-day)	1.1E−03	2.1E−03
ONU	8-hour TWA Exposure Concentration (mg/m^3)	1.2E−02	
	Acute (AD, mg/kg-day)	1.5E−03	
	Intermediate (IADD, mg/kg-day)	1.1E−03	
	Chronic, Non-Cancer (ADD, mg/kg-day)	1.0E−03	

3.1.4.3 Occupational Dermal Exposure Results

EPA estimated dermal exposures for this OES using the methodology outlined in Appendix C. The various "Exposure Concentration Types" from Table 3-6 are explained in Appendix A. Because dermal exposures to workers may occur in the neat liquid form during manufacturing of DEHP, EPA assessed the absorptive flux of DEHP using dermal absorption data for liquid DEHP (see Appendix C.2.1.1 for details). Table 3-6 summarizes the APDR, Acute Dose (AD), IADD, and ADD for both average adult workers and female workers of reproductive age. Because dust and mist are not expected to be deposited on surfaces from this OES, EPA did not assess dermal exposures to ONUs from contact with surfaces. Dermal exposure parameters are described in Appendix C. The *Occupational Dermal Exposure Modeling Results for Diethylhexyl Phthalate (DEHP)* also contains information about model equations and parameters and contains calculation results; refer to Appendix J for a reference to this supplemental document.

Table 3-6. Summary of Estimated Worker Dermal Exposures for Manufacture of DEHP

Worker Population	Exposure Concentration Type	Central Tendency	High-End
Average Adult Worker	Dose Rate (APDR, mg/day)	5.6E−03	1.1E−02
	Acute (AD, mg/kg-day)	7.0E−05	1.4E−04
	Intermediate (IADD, mg/kg-day)	5.1E−05	1.0E−04
	Chronic, Non-Cancer (ADD, mg/kg-day)	4.8E−05	9.5E−05
Female of Reproductive Age	Dose Rate (APDR, mg/day)	5.6E−03	1.0E−02
	Acute (AD, mg/kg-day)	6.4E−05	1.3E−04
	Intermediate (IADD, mg/kg-day)	4.7E−05	9.4E−05
	Chronic, Non-Cancer (ADD, mg/kg-day)	4.4E−05	8.8E−05

3.1.4.4 Occupational Aggregate Exposure Results

Inhalation and dermal exposure estimates were aggregated based on the approach described in Appendix A.3 to arrive at the aggregate worker and ONU exposure estimates in the table below. The *Occupational*

Risk Calculator for Diethylhexyl Phthalate (DEHP) (U.S. EPA, 2025e) contains the calculations of aggregate exposure; refer to Appendix J for a reference to this supplemental document.

Table 3-7. Summary of Estimated Worker Aggregate Exposures for Manufacture of DEHP

Worker Population	Exposure Concentration Type	Central Tendency	High-End
Average Adult Worker	Acute (AD, mg/kg-day)	1.6E−03	2.9E−03
	Intermediate (IADD, mg/kg-day)	1.2E−03	2.1E−03
	Chronic, Non-Cancer (ADD, mg/kg-day)	1.1E−03	2.0E−03
Female of Reproductive Age	Acute (AD, mg/kg-day)	1.7E−03	3.2E−03
	Intermediate (IADD, mg/kg-day)	1.3E−03	2.3E−03
	Chronic, Non-Cancer (ADD, mg/kg-day)	1.2E−03	2.2E−03
ONU	Acute (AD, mg/kg-day)	1.5E−03	
	Intermediate (IADD, mg/kg-day)	1.1E−03	
	Chronic, Non-Cancer (ADD, mg/kg-day)	1.0E−03	

3.2 Rubber Manufacturing

3.2.1 Process Description

The 2020 *Final Scope of the Risk Evaluation for Diethylhexyl Phthalate* (U.S. EPA, 2020d) and CDR reports under plastic material and resin manufacturing indicate DEHP use in as a plasticizer in plastic materials and resin manufacturing, such as rubber manufacturing and synthetic rubber manufacturing.

EPA expects that a typical rubber manufacturing site operates similar to non-PVC plastic compounding and converting sites; however, unlike with plastics, EPA assumes that for a typical rubber manufacturing facility, both compounding and converting occur at the same site. Rubber may be formulated via a consolidated compounding and converting operation, as described in the *SpERC Fact Sheet on Rubber Production and Processing*. Figure 3-2 provides an illustration of the rubber formulation process (ESIG, 2020; OECD, 2004a).

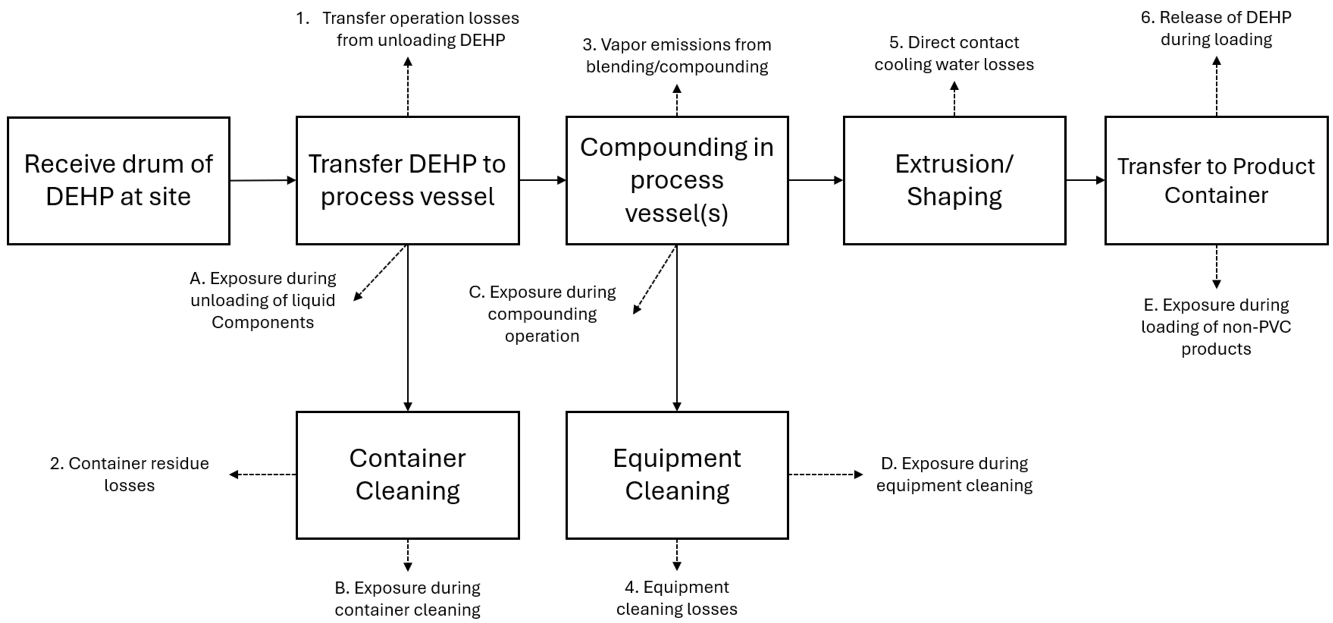


Figure 3-2. Consolidated Compounding and Converting for Rubber Manufacturing Flow Diagram (ESIG, 2020; OECD, 2004a)

3.2.2 Facility Estimates

In the NEI (U.S. EPA, 2022e), DMR (U.S. EPA, 2022c), and TRI (U.S. EPA, 2022f) data that EPA analyzed, EPA identified 84 unique sites which it assessed for rubber manufacturing involving DEHP, while no sites were reported under CDR. For air, 29 sites reported to TRI and 57 reported to NEI. For water, eight sites reported to TRI. For land, all 17 sites reported to TRI. The total number of sites reporting air, water, and land releases can be larger than the number of unique sites due to the overlap of facilities between reporting databases. Due to the lack of data on the annual PV of DEHP in rubber manufacturing, EPA did not present annual or daily site throughputs. EPA identified information on operating days in the NEI air release data. Operating days ranged from 120 to 365 days per year, with an average of 334 days. TRI/DMR (U.S. EPA, 2022c) datasets do not report operating days; therefore, EPA assumed 250 days/yr of operation as discussed in Section 2.3.2.

3.2.3 Release Assessment

3.2.3.1 Environmental Release Points

Based on TRI (U.S. EPA, 2022f) and NEI (U.S. EPA, 2022e) data, Rubber manufacturing releases may go to stack air, fugitive air, surface water, POTWs, and landfills. Additional releases may occur from transfers of wastes to off-site treatment facilities (assessed in the waste handling OES). Fugitive air, POTW, incineration, or landfill releases may occur from loading and unloading plastic additives and from particulates released during converting operations. Fugitive or stack air releases may occur from blending/compounding operations or from vapors released during converting operations. Surface water or POTW releases may occur from direct contact cooling. POTW, incineration, or landfill releases may occur from container residues and equipment cleaning wastes. Incineration or landfill releases may occur from solid waste trimming. Additional fugitive air releases may occur during leakage from pipes, flanges, and other equipment used for transport.

Sites may utilize air capture technology, in which case releases to incineration or landfill may occur from dust captured during product loading. The remaining uncontrolled dust would be released to stack air. Releases to fugitive air, POTW, incineration, or landfill may occur from dust during product loading in cases where air capture technology is not utilized.

3.2.3.2 Environmental Release Assessment Results

Table 3-8 presents fugitive and stack air releases per year and per day for rubber manufacturing based on the 2017 to 2022 TRI (U.S. EPA, 2022f) database years along with the number of release days per year, with medians and maxima presented from across the six-year reporting range. Table 3-9 presents fugitive and stack air releases per year and per day based on 2020 NEI (U.S. EPA, 2022e) database along with the number of release days per year. Table 3-10 presents land releases per year based on the 2017 to 2022 TRI database along with the number of release days per year. Table 3-11 presents water releases per year and per day based on the 2017 to 2022 DMR (U.S. EPA, 2022c) and TRI databases along with the number of release days per year, with medians and maxima presented from across the six-year reporting range.

The *Environmental Releases to Wastewater for Diethylhexyl Phthalate (DEHP), Environmental Releases to Air for Diethylhexyl Phthalate (DEHP), Environmental Releases to Land for Diethylhexyl Phthalate (DEHP)* contain additional information about the calculation results; refer to Appendix J for a full list of these supplemental documents.

Table 3-8. Summary of Air Releases from TRI for Rubber Manufacturing

Site Identity	Maximum Annual Fugitive Air Release (kg/yr)	Max. Annual Stack Air Release (kg/yr)	Median Annual Fugitive Air Release (kg/yr)	Median Annual Stack Air Release (kg/yr)	Max. Daily Fugitive Air Release (kg/day)	Max. Daily Stack Air Release (kg/day)	Median Daily Fugitive Air Release (kg/day)	Median Daily Stack Air Release (kg/day)	Annual Release Days (days/yr)
Pawling Engineered Products, Pawling, NY	227	227	227	227	0.62	0.62	0.62	0.62	364
Rex-Hide Industries Inc, Grafton, WV	2.3	113	2.3	113	6.2E−03	0.31	6.2E−03	0.31	364
Ace Elastomer, Rock Hill, SC	0	0	0	0	0	0	0	0	364
American Roller Co LLC, Union Grove, WI	2.3	2.3	1.1	1.1	6.2E−03	6.2E−03	3.1E−03	3.1E−03	365
Hexpol Compounding Burton Rubber Processing, Jonesborough, TN	0	0	0	0	0	0	0	0	364
Hexpol Dyersburg, Dyersburg, TN	0	0	0	0	0	0	0	0	364
GRT Ripley Operations LLC, Ripley, MS	0	17	0	14	0	0	0	0	364
Elite Advanced Polymers Inc, Ripley, MS	0.94	0.50	0.42	0.20	2.6E−03	1.4E−03	1.1E−03	5.4E−04	364
Quanex Ig Systems Dba Quanex Custom Mixing, Cambridge, OH	0	0	0	0	0	0	0	0	364
Hexpol Compounding Burton Rubber Processing, Burton, OH	0	0	0	0	0	0	0	0	364
Chardon Custom Polymers, Chardon, OH	0	0	0	0	0	0	0	0	364
Gold Key Processing Inc, Middlefield, OH	0	0	0	0	0	0	0	0	364
Hexpol - Barberton, Barberton, OH	0	0	0	0	0	0	0	0	364
Parker Hannifin Corp O-Ring Div, Lebanon, TN	0	0	0	0	0	0	0	0	364
Polymerics Inc, Cuyahoga Falls, OH	0	0	0	0	0	0	0	0	364
Mantaline Corp, Mantua, OH	0	0.45	0	0.26	0	1.2E−03	0	7.2E−04	364

Site Identity	Maximum Annual Fugitive Air Release (kg/yr)	Max. Annual Stack Air Release (kg/yr)	Median Annual Fugitive Air Release (kg/yr)	Median Annual Stack Air Release (kg/yr)	Max. Daily Fugitive Air Release (kg/day)	Max. Daily Stack Air Release (kg/day)	Median Daily Fugitive Air Release (kg/day)	Median Daily Stack Air Release (kg/day)	Annual Release Days (days/yr)
Cooper Standard Industrial & Specialty Group, New Philadelphia, OH	0	0	0	0	0	0	0	0	364
Sumiriko Ohio Inc, Bluffton, OH	0	0	0	0	0	0	0	0	364
Midwest Elastomers Inc, Wapakoneta, OH	113	113	113	113	0.31	0.31	0.31	0.31	364
Rotadyne Roll Group La Porte, La Porte, IN	67	0.77	63	0.73	0.18	0	0.17	0	364
Michigan Rubber Products Inc, Cadillac, MI	2.3	2.3	2.3	2.3	1E−02	1E−02	1E−02	1E−02	364
Hexpol - Whitewater, Whitewater, WI	1.8	0	0.91	0	0	0	0	0	364
Ace Midwest, Chicago, IL	0.40	13	0.32	10	0.00	4E−02	0.00	3E−02	364
GRT Rubber Technologies LLC, Paragould, AR	7.34	17	7.1	16	2E−02	5E−02	2E−02	5E−02	364
Rex-Hide Industries Inc, Tyler, TX	0	4.1	0	4.1	0	1E−02	0	1E−02	364
Hexpol Kennedale, Kennedale, TX	0	0	0	0	0	0	0	0	364
Nov Rig Systems Rubber Plant & Controls Building, Houston, TX	0	0	0	0	0	0	0	0	364
R&S Processing Co Inc, Paramount, CA	0	0	0	0	0	0	0	0	364
Kirkhill Inc., Brea, CA	0	0	0	0	0	0	0	0	364

Table 3-9. Summary of Air Releases from NEI (2020) for Rubber Manufacturing

Site Identity	Total Fugitive Air Release (kg/yr)	Daily Fugitive Air Release (kg/day)	Total Stack Air Release (kg/yr)	Daily Stack Air Release (kg/day)	Annual Release Days (days/yr)
Fulflex Inc, Brattleboro, VT	0	0	Stack releases not reported	Stack releases not reported	364

Site Identity	Total Fugitive Air Release (kg/yr)	Daily Fugitive Air Release (kg/day)	Total Stack Air Release (kg/yr)	Daily Stack Air Release (kg/day)	Annual Release Days (days/yr)
Honeywell Safety Products USA, Inc., Smithfield, RI	4	5.5E−03	Stack releases not reported	Stack releases not reported	364
Fluid Routing Systems, Inc., Ocala, FL	0	0	Stack releases not reported	Stack releases not reported	154
The Biltrite Corporation, Ripley, MS	31	4.5E−02	Stack releases not reported	Stack releases not reported	347
The Goodyear Tire & Rubber Company, Fayetteville, NC	0.11	1.5E−04	268	0.37	364
Cooper Tire and Rubber Company Clarksda, Clarksdale, MS	7.7	1.2E−02	1	1.5E−03	329
Airboss Rubber Compounding (NC) Inc., Scotland Neck, NC	Fugitive releases not reported	Fugitive releases not reported	Stack releases not reported	Stack releases not reported	364
Patch Rubber Company, Weldon, NC	0	0	Stack releases not reported	Stack releases not reported	250
Cooper Tire Company, The, Tupelo, MS	179	0.28	19	2.9E−02	321
Snider Tire, Inc., Statesville, NC	Fugitive releases not reported	Fugitive releases not reported	Stack releases not reported	Stack releases not reported	260
Bridgestone-Bandag, LLC, Oxford, NC	Fugitive releases not reported	Fugitive releases not reported	81	0.11	364
Oliver Rubber Company, LLC, Asheboro, NC	1.4E−02	1.9E−05	10	1.4E−02	350
Bridgestone Aircraft Tire (USA), Inc., Mayodan, NC	0	0	Stack releases not reported	Stack releases not reported	250
Giti Tire Manufacturing USA, Richburg, SC	12	1.9E−02	Stack releases not reported	Stack releases not reported	329
Bridgestone Americas Tire Operations, LLC, Wilson, NC	Fugitive releases not reported	Fugitive releases not reported	53	7.3E−02	364
Michelin Aircraft Tire Company, Norwood, NC	Fugitive releases not reported	Fugitive releases not reported	12	1.6E−02	364
Michelin NA US8 Starr Facility, Anderson, SC	Fugitive releases not reported	Fugitive releases not reported	21	3.4E−02	302

Site Identity	Total Fugitive Air Release (kg/yr)	Daily Fugitive Air Release (kg/day)	Total Stack Air Release (kg/yr)	Daily Stack Air Release (kg/day)	Annual Release Days (days/yr)
Parrish Tire Company, Yadkinville, NC	0	0	Stack releases not reported	Stack releases not reported	255
Michelin NA US2 Sandy Springs, Sandy Springs, SC	Fugitive releases not reported	Fugitive releases not reported	146	0.21	354
Michelin NA US1 Greenville, Greenville, SC	0.68	1.0E−03	29	4.3E−02	337
Michelin North America Inc US10, Anderson, SC	Fugitive releases not reported	Fugitive releases not reported	12	1.8E−02	335
Michelin NA US3 Spartanburg, Spartanburg, SC	Fugitive releases not reported	Fugitive releases not reported	66	9.5E−02	345
Michelin Na US5 & Us7 Lexington, Lexington, SC	Fugitive releases not reported	Fugitive releases not reported	108	0.16	343
Continental Tire the Americas LLC, Sumter, SC	Fugitive releases not reported	Fugitive releases not reported	37	5.0E−02	365
Snider Fleet Solutions, Antioch, TN	Fugitive releases not reported	Fugitive releases not reported	Stack releases not reported	Stack releases not reported	120
Bridgestone Americas Tire Operations, LLC, La Vergne, TN	39	5.4E−02	Stack releases not reported	Stack releases not reported	364
Bridgestone Americas Tire Operations, LLC - Warren Plant, Morrison, TN	Fugitive releases not reported	Fugitive releases not reported	122	0.17	364
Parker Hannifin O-Ring Div, Lebanon, TN	1.2E−05	1.6E−08	1.2E−04	1.6E−07	364
Rotation Dynamics Corp, Chicago, IL	0	0	Stack releases not reported	Stack releases not reported	364
Akwel Cadillac USA, Inc., Cadillac, MI	Fugitive releases not reported	Fugitive releases not reported	Stack releases not reported	Stack releases not reported	364
Industrial Rubber Applicators Inc, Hibbing, MN	Fugitive releases not reported	Fugitive releases not reported	2.5E−02	3.5E−05	364
The Cooper Tire Company, Texarkana, AR	147	0.22	38	5.8E−02	328
Eaton Aeroquip Inc, Mountain Home, AR	Fugitive releases not reported	Fugitive releases not reported	Stack releases not reported	Stack releases not reported	364
Garlock Rubber Techs, Paragould, AR	5.8	8.0E−03	14	1.9E−02	364

Site Identity	Total Fugitive Air Release (kg/yr)	Daily Fugitive Air Release (kg/day)	Total Stack Air Release (kg/yr)	Daily Stack Air Release (kg/day)	Annual Release Days (days/yr)
Goodyear Lawton, Lawton, OK	315	0.46	109	0.16	345
Bridgestone Americas Tire Operations, LLC, Des Moines, IA	9.1	1.8E−02	18	3.6E−02	250
Henniges Automotive Sealing Systems Na Danny Scott Drive, New Haven, MO	0.68	9.3E−04	0.93	1.3E−03	364
Goodyear Tire & Rubber, Topeka, KS	38	5.4E−02	4.9	7.0E−03	350
Timken SMO LLC Springfield, Springfield, MO	7.7	1.1E−02	6.9	9.5E−03	364
Mitchell Rubber Products Inc, Mira Loma, CA	0	0	Stack releases not reported	Stack releases not reported	364
Cary Compounds, LLC, Dayton, NJ	4.5	6.2E−03	Stack releases not reported	Stack releases not reported	364
B/E Aerospace - SMR Technologies, Fenwick, WV	Fugitive releases not reported	Fugitive releases not reported	2.2	3.2E−03	350
Snider Tire, Inc. dba Snider Fleet Sol, Birmingham, AL	Fugitive releases not reported	Fugitive releases not reported	Stack releases not reported	Stack releases not reported	364
Boston Weatherhead, Newbern, TN	0	0	6.4	8.8E−03	364
Dana Sealing Products, LLC, Paris, TN	0.33	4.5E−04	Stack releases not reported	Stack releases not reported	364
Titan Tire Corporation of Union City, Union City, TN	0	0	Stack releases not reported	Stack releases not reported	364
Hiawatha Rubber Co, Minneapolis, MN	Fugitive releases not reported	Fugitive releases not reported	202	0.28	364
Midwest Elastomers Inc, Wapakoneta, OH	113	0.16	113	0.16	364
Hexpol Compounding Ca Inc.,, City of Industry, CA	3.4	6.9E−03	Stack releases not reported	Stack releases not reported	250
Les Schwab Production Center, Prineville, OR	Fugitive releases not reported	Fugitive releases not reported	13	1.7E−02	364
Goodyear Tire & Rubber Company, Social Circle, GA	Fugitive releases not reported	Fugitive releases not reported	89	0.14	321

Site Identity	Total Fugitive Air Release (kg/yr)	Daily Fugitive Air Release (kg/day)	Total Stack Air Release (kg/yr)	Daily Stack Air Release (kg/day)	Annual Release Days (days/yr)
Saint-Gobain SGPPL, Portage, WI	2.1	2.9E−03	Stack releases not reported	Stack releases not reported	364
American Synthetic Rubber Company, Louisville, KY	Fugitive releases not reported	Fugitive releases not reported	1.6	3.2E−03	255
Gates Corp., Iola, KS	7.3	1.0E−02	Stack releases not reported	Stack releases not reported	364
Yokohama Tire Manufacturing Mississippi, West Point, MS	5.6	7.7E−03	Stack releases not reported	Stack releases not reported	365
Superior Tire Service, Inc., Salem, OR	Fugitive releases not reported	Fugitive releases not reported	2.6	3.6E−03	364
Ultimate RB, Inc., McMinnville, OR	Fugitive releases not reported	Fugitive releases not reported	7	9.7E−03	364

Table 3-10. Summary of Land Releases from TRI for Rubber Manufacturing

Site Identity	Median Total Release (kg/yr)	Maximum Total Release (kg/yr)	Annual Release Days (days/yr)
Ace Elastomer, Rock Hill, SC	113	113	364
Ace Midwest, Chicago, IL	779	862	364
Chardon Custom Polymers, Chardon, OH	279	308	364
Cooper Standard Industrial & Specialty Group, New Philadelphia, OH	525	644	364
Elite Advanced Polymers Inc, Ripley, MS	449	610	364
GRT Ripley Operations LLC, Ripley, MS	2,038	3,394	364
GRT Rubber Technologies LLC, Paragould, AR	400	762	364
Hexpol - Whitewater, Whitewater, WI	69	69	364
Kirkhill Inc., Brea, CA	830	830	364
Mantaline Corp, Mantua, OH	1,444	2,326	364
Michigan Rubber Products Inc, Cadillac, MI	929	929	364
Midwest Elastomers Inc, Wapakoneta, OH	5,762	9,644	364
Nov Rig Systems Rubber Plant & Controls Building, Houston, TX	5,164	5,164	364
Polymerics Inc, Cuyahoga Falls, OH	1,674	2,585	364

Site Identity	Median Total Release (kg/yr)	Maximum Total Release (kg/yr)	Annual Release Days (days/yr)
Rex-Hide Industries Inc, Grafton, WV	227	227	364
Rex-Hide Industries Inc, Tyler, TX	1,766	2,107	364
Rotadyne Roll Group La Porte, La Porte, IN	2,311	2,602	364

Table 3-11. Summary of Water Releases from DMR and TRI for Rubber Manufacturing

Site Identity	Source-Discharge Type	Median Annual Discharge (kg/yr)	Daily Discharge (Corresponding to Median Annual Discharge) (kg/day)	Maximum Annual Discharge (kg/yr)	Daily Discharge (Corresponding to Maximum Daily Discharge) (kg/day)	Annual Release Days (days/yr)
Pawling Engineered Products, Pawling, NY	DMR-Direct Discharges	N/A – facility does not report DMRs	N/A – facility does not report DMRs	N/A – facility does not report DMRs	N/A – facility does not report DMRs	250
Pawling Engineered Products, Pawling, NY	TRI-Direct Discharges	227	0.91	227	0.91	250
Pawling Engineered Products, Pawling, NY	TRI-Transfers to POTW	227	0.91	227	0.91	250
Pawling Engineered Products, Pawling, NY	TRI-Transfers to non-POTW	227	0.91	227	0.91	250
Rex-Hide Industries Inc, Grafton, WV	DMR-Direct Discharges	N/A – facility does not report DMRs	N/A – facility does not report DMRs	N/A – facility does not report DMRs	N/A – facility does not report DMRs	250
Rex-Hide Industries Inc, Grafton, WV	TRI-Direct Discharges	227	0.91	227	0.91	250
Rex-Hide Industries Inc, Grafton, WV	TRI-Transfers to POTW	227	0.91	227	0.91	250
Rex-Hide Industries Inc, Grafton, WV	TRI-Transfers to non-POTW	227	0.91	227	0.91	250
Sumiriko Ohio Inc, Bluffton, OH	DMR-Direct Discharges	N/A – facility does not report DMRs	N/A – facility does not report DMRs	N/A – facility does not report DMRs	N/A – facility does not report DMRs	250
Sumiriko Ohio Inc, Bluffton, OH	TRI-Direct Discharges	0	0	0	0	250
Sumiriko Ohio Inc, Bluffton, OH	TRI-Transfers to POTW	0	0	0	0	250

Site Identity	Source-Discharge Type	Median Annual Discharge (kg/yr)	Daily Discharge (Corresponding to Median Annual Discharge) (kg/day)	Maximum Annual Discharge (kg/yr)	Daily Discharge (Corresponding to Maximum Daily Discharge) (kg/day)	Annual Release Days (days/yr)
Sumiriko Ohio Inc, Bluffton, OH	TRI-Transfers to non-POTW	18	7.2E−02	19	7.4E−02	250
GRT Rubber Technologies LLC, Paragould, AR	DMR-Direct Discharges	N/A – facility does not report DMRs	N/A – facility does not report DMRs	N/A – facility does not report DMRs	N/A – facility does not report DMRs	250
GRT Rubber Technologies LLC, Paragould, AR	TRI-Direct Discharges	2.9	1.2E−02	3.3	1.3E−02	250
GRT Rubber Technologies LLC, Paragould, AR	TRI-Transfers to POTW	0	0	0	0	250
GRT Rubber Technologies LLC, Paragould, AR	TRI-Transfers to non-POTW	0	0	0	0	250
Rex-Hide Industries Inc, Tyler, TX	DMR-Direct Discharges	N/A – facility does not report DMRs	N/A – facility does not report DMRs	N/A – facility does not report DMRs	N/A – facility does not report DMRs	250
Rex-Hide Industries Inc, Tyler, TX	TRI-Direct Discharges	227	0.91	227	0.91	250
Rex-Hide Industries Inc, Tyler, TX	TRI-Transfers to POTW	227	0.91	227	0.91	250
Rex-Hide Industries Inc, Tyler, TX	TRI-Transfers to non-POTW	227	0.91	227	0.91	250
Chardon Custom Polymers, Chardon, OH	DMR-Direct Discharges	N/A – facility does not report DMRs	N/A – facility does not report DMRs	N/A – facility does not report DMRs	N/A – facility does not report DMRs	250
Chardon Custom Polymers, Chardon, OH	TRI-Direct Discharges	227	0.91	227	0.91	250
Chardon Custom Polymers, Chardon, OH	TRI-Transfers to POTW	227	0.91	227	0.91	250
Chardon Custom Polymers, Chardon, OH	TRI-Transfers to non-POTW	227	0.91	227	0.91	250

Site Identity	Source-Discharge Type	Median Annual Discharge (kg/yr)	Daily Discharge (Corresponding to Median Annual Discharge) (kg/day)	Maximum Annual Discharge (kg/yr)	Daily Discharge (Corresponding to Maximum Daily Discharge) (kg/day)	Annual Release Days (days/yr)
Ace Elastomer, Rock Hill, SC	DMR-Direct Discharges	N/A – facility does not report DMRs	N/A – facility does not report DMRs	N/A – facility does not report DMRs	N/A – facility does not report DMRs	250
Ace Elastomer, Rock Hill, SC	TRI-Direct Discharges	227	0.91	227	0.91	250
Ace Elastomer, Rock Hill, SC	TRI-Transfers to POTW	227	0.91	227	0.91	250
Ace Elastomer, Rock Hill, SC	TRI-Transfers to non-POTW	227	0.91	227	0.91	250
Ace Midwest, Chicago, IL	DMR-Direct Discharges	N/A – facility does not report DMRs	N/A – facility does not report DMRs	N/A – facility does not report DMRs	N/A – facility does not report DMRs	250
Ace Midwest, Chicago, IL	TRI-Direct Discharges	227	0.91	227	0.91	250
Ace Midwest, Chicago, IL	TRI-Transfers to POTW	227	0.91	227	0.91	250
Ace Midwest, Chicago, IL	TRI-Transfers to non-POTW	227	0.91	227	0.91	250

3.2.4 Occupational Exposure Assessment

3.2.4.1 Workers Activities

During the manufacture of rubber containing DEHP, workers may be exposed via dust inhalation during the compounding and converting processes and dermal contact with liquids during equipment cleaning. Additionally, workers may be exposed to DEHP via dermal contact with liquids and inhalation of vapors during unloading and loading, and transport container cleaning (U.S. EPA, 2021d, e).

EPA did not identify information on engineering controls or worker PPE used at DEHP-containing rubber manufacturing facilities. Based on the Generic Scenarios for plastic compounding and Plastic converting, suitable PPE in the plastics industry includes gloves, hearing protection in high noise levels, eye protection, and respiratory protection in areas where ventilation is not used. The generic scenarios also state that most plants use forced ventilation techniques to reduce worker exposures to vapors and local exhaust ventilation in areas where particulates or vapor may be formed (U.S. EPA, 2021d, e). EPA expects the types of PPE and controls used at each site to be based on the hazards present; therefore, the common PPE/controls presented in the GS/ESD may or may not apply when DEHP is being used.

For this OES, ONUs may include supervisors, managers, and other employees that work in the manufacturing area but do not directly contact DEHP that is received or processed onsite or handle the finished rubber products. ONUs are potentially exposed through the inhalation route while in the working area.

3.2.4.2 Occupational Inhalation Exposure Results

EPA did not identify any references with discrete, full shift samples for this OES through systematic review; however, the European Commission document provided maximum concentrations based on time-weighted average personal and area samples from a plant performing rubber calendaring (ECB, 2003). These data included the highest air concentration values for each sampling event along with the sampling duration. EPA assessed high-end worker inhalation exposures for this OES by calculating the 8-hour TWA using the sampling event with highest air concentration. Similarly, EPA assessed the central tendency exposures using the sampling event with lowest reported air concentration. The reported range for these data (n = 25 samples) was 0.04 mg/m^3 to 26.7 mg/m^3. However, the actual individual measurements (concentration and duration) were not presented. These data had a data quality rating of high, meaning they are of acceptable quality. These results are presented in Table 3-12. Additional discussion on the uncertainty and limitations of these data are included in the weight of scientific evidence 4.2. No data with full shift samples for ONUs were identified for this OES through systematic review. For this reason, worker central tendency exposure concentrations were used to assess ONU high-end and central tendency exposures. The *Occupational Inhalation Exposure Data for Diethylhexyl Phthalate (DEHP)* contains additional information about the calculation results; refer to Appendix J for a reference to this supplemental document.

Table 3-12. Summary of Estimated Worker Inhalation Exposures for Rubber Manufacturing

Worker Population	Exposure Concentration Type	Central Tendency	High-End
Average Adult Worker	8-hour TWA Exposure Concentration (mg/m^3)	1.7	10
	Acute (AD, mg/kg-day)	0.21	1.02
	Intermediate (IADD, mg/kg-day)	0.15	0.75
	Chronic, Non-Cancer (ADD, mg/kg-day)	0.14	0.70
Female of Reproductive Age	8-hour TWA Exposure Concentration (mg/m^3)	1.7	10
	Acute (AD, mg/kg-day)	0.23	1.1
	Intermediate (IADD, mg/kg-day)	0.17	0.82
	Chronic, Non-Cancer (ADD, mg/kg-day)	0.16	0.77
ONU	8-hour TWA Exposure Concentration (mg/m^3)	1.7	
	Acute (AD, mg/kg-day)	0.21	
	Intermediate (IADD, mg/kg-day)	0.15	
	Chronic, Non-Cancer (ADD, mg/kg-day)	0.14	

3.2.4.3 Occupational Dermal Results

EPA estimated dermal exposures for this OES using the methodology outlined in Appendix C. The various "Exposure Concentration Types" from Table 3-13 are explained in Appendix A. Dermal exposures to workers may occur via contact with DEHP in concentrated liquid form prior to compounding, as well as via contact with DEHP in solid, compounded rubber products. Because both physical forms are expected, EPA assessed the absorptive flux of DEHP using dermal absorption data for liquid DEHP (see Appendix C.2.1.1 for details) as well as for solid DEHP (see Appendix C.2.1.2 for details) and used the maximum value for the exposure calculations. Table 3-13 summarizes the APDR, the AD, the IADD, and the ADD for both average adult workers and female workers of reproductive age. Because dust or mist is expected to be deposited on surfaces from this OES, EPA assessed dermal exposures to ONUs from contact with surfaces. Dermal exposure parameters are described in Appendix C. The *Occupational Dermal Exposure Modeling Results for Diethylhexyl Phthalate (DEHP)* also contains information about model equations and parameters and contains calculation results; refer to Appendix J for a reference to this supplemental document.

Table 3-13. Summary of Estimated Worker Dermal Exposures for Rubber Manufacturing

Worker Population	Exposure Concentration Type	Central Tendency	High-End
Average Adult Worker	Dose Rate (APDR, mg/day)	0.21	0.41
	Acute (AD, mg/kg-day)	2.6E−03	5.1E−03
	Intermediate (IADD, mg/kg-day)	1.9E−03	3.8E−03
	Chronic, Non-Cancer (ADD, mg/kg-day)	1.8E−03	3.5E−03
Female of Reproductive Age	Dose Rate (APDR, mg/day)	0.17	0.34
	Acute (AD, mg/kg-day)	2.4E−03	4.7E−03
	Intermediate (IADD, mg/kg-day)	1.7E−03	3.5E−03
	Chronic, Non-Cancer (ADD, mg/kg-day)	1.6E−03	3.2E−03
ONU	Dose Rate (APDR, mg/day)	0.21	
	Acute (AD, mg/kg-day)	2.6E−03	
	Intermediate (IADD, mg/kg-day)	1.9E−03	
	Chronic, Non-Cancer (ADD, mg/kg-day)	1.8E−03	

3.2.4.4 Occupational Aggregate Exposure Results (waiting)

Inhalation and dermal exposure estimates were aggregated based on the approach described in Appendix A to arrive at the aggregate worker and ONU exposure estimates in the table below. The *Occupational Risk Calculator for Diethylhexyl Phthalate (DEHP)* (U.S. EPA, 2025e) contains the calculations of aggregate exposure; refer to Appendix J for a reference to this supplemental document.

Table 3-14. Summary of Estimated Worker Aggregate Exposures for Rubber Manufacturing

Worker Population	Exposure Concentration Type	Central Tendency	High-End
Average Adult Worker	Acute (AD, mg/kg-day)	0.21	1.0
	Intermediate (IADD, mg/kg-day)	0.15	0.75
	Chronic, Non-Cancer (ADD, mg/kg-day)	0.14	0.70
Female of Reproductive Age	Acute (AD, mg/kg-day)	0.23	1.1
	Intermediate (IADD, mg/kg-day)	0.17	0.83
	Chronic, Non-Cancer (ADD, mg/kg-day)	0.16	0.77
ONU	Acute (AD, mg/kg-day)	0.21	
	Intermediate (IADD, mg/kg-day)	0.15	
	Chronic, Non-Cancer (ADD, mg/kg-day)	0.14	

3.3 Plastics Compounding

3.3.1 Process Description

During the process of compounding, plasticizers such as DEHP may be incorporated into the compounded plastic. Plasticizers are used in plastics to enhance the flexibility, processability, and softness of plastics (OECD, 2009b). The majority of DEHP is reported to be used as a plasticizer in the production of PVC, with 94 percent of the consumption of DEHP used in PVC and the remaining 6 precent used for other polymeric products (ECHA, 2011; Björklund, 2010). In 2005, 30 percent of

DEHP was used as a plasticizer in consumer products (U.S. CPSC, 2015). In 2007, 84 percent of DEHP in the UK was compounded, equivalent to 52,000 tonnes/year (ECHA, 2009). Also in 2007, DEHP made up the vast majority of plasticizer consumption, representing approximately 50 percent of the total use (ECHA, 2012).

According to the GS on plastic compounding (U.S. EPA, 2014c), additives are mixed with polymers and other raw materials to produce a compounded masterbatch. A typical compounding site receive DEHP in steel drums where the components are unloaded into mixing vessels. Compounding operations occur in either closed or partially open processes. Compounding can be completed in a closed process, such as tumbling, ball blending, gravity mixing, paddle/double arm mixing, Banbury (type) internal mixing, and intensive vortex action mixing. Partially open processes are also used, including two-roll mills and extruders. Temperatures for compounding are expected to range from 65 to 365 degrees Celsius. Once the solid masterbatch is completed, it is transferred into an extruder where it is converted into pellets, sheets, films, or pipes. The resulting converted masterbatch is packaged for shipment to downstream converting sites (U.S. EPA, 2021d). Figure 3-3 provides an illustration of the plastic compounding process (U.S. EPA, 2021d).

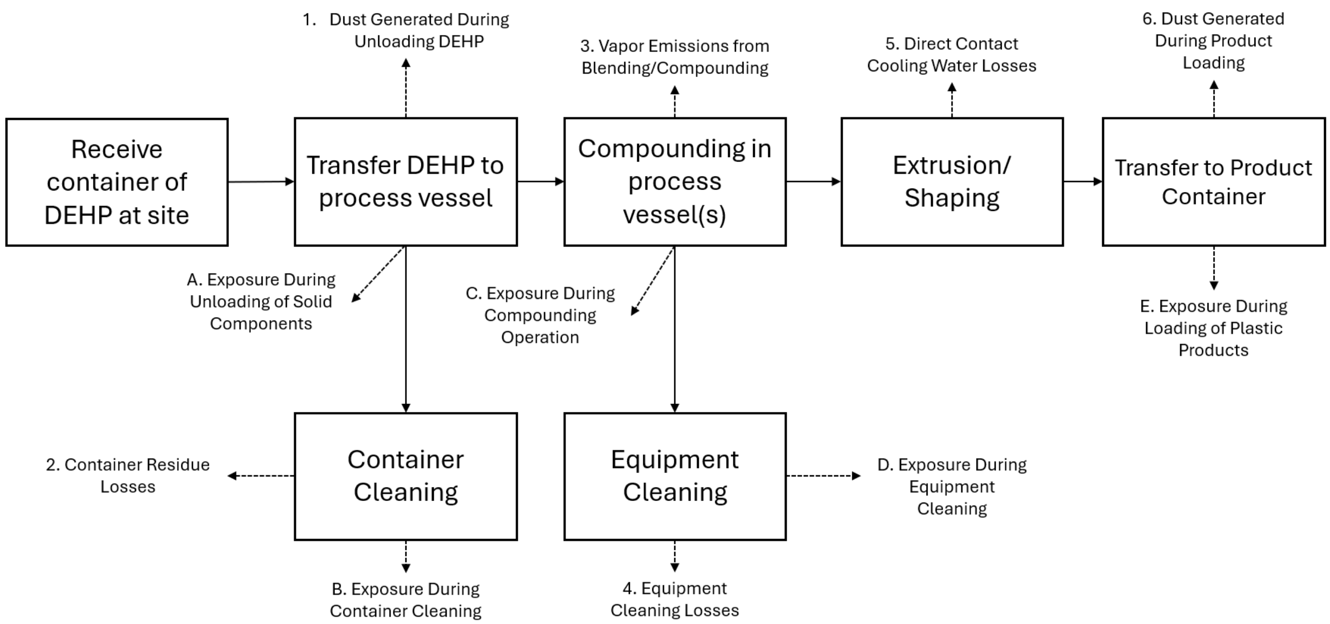


Figure 3-3. PVC Plastics Compounding Flow Diagram (U.S. EPA, 2025c)

Most sources indicate that DEHP concentrations in plasticizers are typically 20 to 40 percent by weight (Chao et al., 2015; Koch and Angerer, 2011; Xu et al., 2010; CDC, 2009; ECJRC, 2008; OEHHA, 1997; Reddy and Rao, 1986; Turnbull and Rodricks, 1985), though a couple of sources listed a range of 20 to 60 percent (Gaudin et al., 2011; Gaudin et al., 2008).

3.3.2 Facility Estimates

In the NEI (U.S. EPA, 2022e), DMR (U.S. EPA, 2022c), and TRI (U.S. EPA, 2022f) data that EPA analyzed, EPA identified 62 unique sites which it assessed for the plastic compounding OES. For air, 20 sites reported to TRI and 14 reported to NEI. For water, 13 sites reported to TRI and 28 sites reported to DMR. For land, all nine sites reported to TRI. The total number of sites reporting air, water, and land releases can be larger than the number of unique sites due to the overlap of facilities between reporting databases. Due to the lack of data on the annual PV of DEHP used in plastic compounding, EPA did not present annual or daily site throughputs. EPA identified operating days ranging from 350 to 365 days, with an average of 363 days through NEI air release data. TRI/DMR datasets do not report operating days; therefore, EPA assumed 246 days/yr of operation per the *Revised Plastic Compounding GS* as discussed in Section 2.3.2 (U.S. EPA, 2021d).

3.3.3 Release Assessment

3.3.3.1 Environmental Release Points

Based on TRI (U.S. EPA, 2022f), NEI (U.S. EPA, 2022e), and DMR (U.S. EPA, 2022c) data, Plastic compounding releases may go to fugitive air, stack air, surface water, POTWs, and landfills. Additional releases may occur from transfers of wastes to off-site treatment facilities (assessed in the waste handling OES). Fugitive air, POTW, incineration, or landfill releases may occur from loading of plastic masterbatch and unloading of plastic additives. Fugitive or Stack air releases may occur from blending/compounding operations. Surface water or POTW releases may occur from direct contact cooling. POTW, incineration, or landfill releases may occur from container residues and equipment cleaning. Additional fugitive air releases may occur during leakage of pipes, flanges, and other equipment used for transport; however, as EPA did not quantify specific emission data from these sources, they were not evaluated.

Sites may utilize air capture technology, in which case releases to incineration or landfill may occur from dust captured during product loading. The remaining uncontrolled dust would be released to stack air. Releases to fugitive air, POTW, incineration, or landfill may occur from dust released during product loading in cases where air capture technology is not utilized.

3.3.3.2 Environmental Release Assessment Results

Table 3-15 presents fugitive and stack air releases per year and per day for plastic compounding based on the 2017 to 2022 TRI (U.S. EPA, 2022f) database years along with the number of release days per year, with medians and maxima presented from across the six-year reporting range. Table 3-16 presents fugitive and stack air releases per year and per day based on 2020 NEI (U.S. EPA, 2022e) database along with the number of release days per year. Table 3-17 presents land releases per year based on the 2017 to 2022 TRI database along with the number of release days per year. Table 3-18 presents water releases per year and per day based on the 2017 to 2022 DMR (U.S. EPA, 2022c) and TRI databases along with the number of release days per year, with medians and maxima presented from across the six-year reporting range. The *Environmental Releases to Wastewater for Diethylhexyl Phthalate (DEHP)*, *Environmental Releases to Air for Diethylhexyl Phthalate (DEHP)*, *Environmental Releases to Land for Diethylhexyl Phthalate (DEHP)* contains additional information about the calculation results; refer to Appendix J for a reference to these supplemental documents.

Table 3-15. Summary of Air Releases from TRI for Plastics Compounding

Site Identity	Maximum Annual Fugitive Air Release (kg/yr)	Max. Annual Stack Air Release (kg/yr)	Median Annual Fugitive Air Release (kg/yr)	Median Annual Stack Air Release (kg/yr)	Max. Daily Fugitive Air Release (kg/day)	Max. Daily Stack Air Release (kg/day)	Median Daily Fugitive Air Release (kg/day)	Median Daily Stack Air Release (kg/day)	Annual Release Days (days/yr)
Mexichem Specialty Compounds, Leominster, MA	2.3	2.3	2.3	2.3	6.2E−03	6.2E−03	6.2E−03	6.2E−03	365
Teknor Apex Co, Pawtucket, RI	2.3	777	2.3	232	6.2E−03	2.1	6.2E−03	0.64	365
Colorite Polymers, Ridgefield, NJ	0	0	0	0	0	0	0	0	365
Cary Compounds LLC, Dayton, NJ	11	9.7	6.6	3	2.9E−02	2.7E−02	1.8E−02	8.1E−03	365
Sylvin Technologies Inc., Denver, PA	0.92	4.8E−02	0.57	3.0E−02	2.5E−03	1.3E−04	1.6E−03	8.3E−05	365
Geon Performance Solutions, Croydon, PA	73	0	52	0	0.2	0	0.14	0	365
Lanxess Solutions Us Inc, Gastonia, NC	227	227	227	227	0.62	0.62	0.62	0.62	365
Rutland Plastic Technologies Inc, Pineville, NC	227	227	227	227	0.62	0.62	0.62	0.62	365
Mexichem Specialty Compounds, Pineville, NC	2.3	1.8	0.45	1.2	6.2E−03	5.0E−03	1.2E−03	3.2E−03	365
Samos Polymers Corp, Stanley, NC	227	227	227	227	0.62	0.62	0.62	0.62	365
Teknor Apex - Carolina Co, Fountain Inn, SC	2.3	155	2.3	121	6.2E−03	0.42	6.2E−03	0.33	365
Avient Corp, Kennesaw, GA	227	227	227	227	0.62	0.62	0.62	0.62	365
Teknor Apex Tennessee Co (Aka Haywood Co), Brownsville, TN	2.3	1,584	2.3	588	6.2E−03	4.3	6.2E−03	1.6	365

Site Identity	Maximum Annual Fugitive Air Release (kg/yr)	Max. Annual Stack Air Release (kg/yr)	Median Annual Fugitive Air Release (kg/yr)	Median Annual Stack Air Release (kg/yr)	Max. Daily Fugitive Air Release (kg/day)	Max. Daily Stack Air Release (kg/day)	Median Daily Fugitive Air Release (kg/day)	Median Daily Stack Air Release (kg/day)	Annual Release Days (days/yr)
Westlake Compounds LLC, Prairie, MS	227	227	227	227	0.62	0.62	0.62	0.62	365
Avient Corp North Baltimore, North Baltimore, OH	227	227	227	227	0.62	0.62	0.62	0.62	365
Geon Performance Solutions LLC, Terre Haute, IN	0	0	0	0	0	0	0	0	365
Eagle Packaging Inc., Earth City, MO	0	3.6	0	2.5	0	9.9E−03	0	6.8E−03	365
Manner Polymers Inc, McKinney, TX	0	0	0	0	0	0	0	0	365
Teknor Apex Co, City of Industry, CA	2.3	118	2.3	42	6.2E−03	0.32	6.2E−03	0.12	365
Northwest Pipe Co, Brea, CA	310	607	169	0	0.85	1.7	0.46	0	365

Table 3-16. Summary of Air Releases from NEI (2020) for Plastics Compounding

Site Identity	Total Fugitive Air Release (kg/yr)	Daily Fugitive Air Release (kg/day)	Total Stack Air Release (kg/yr)	Daily Stack Air Release (kg/day)	Annual Release Days (days/yr)
Mexichem Specialty Compounds Inc, Leominster, MA	0	0	Stack releases not reported	Stack releases not reported	365
Sylvin Techs Inc, Denver, PA	0.22	3.1E−04	1.2E−02	1.6E−05	365
Chemours Washington Works, Washington, WV	Fugitive releases not reported	Fugitive releases not reported	2.7	3.6E−03	365
Lubrizol Advanced Materials, Louisville, KY	9.2E−05	1.3E−07	9.1E−03	1.3E−05	352
Teknor Apex Carolina Co, Fountain Inn, SC	0	0	Stack releases not reported	Stack releases not reported	350

Site Identity	Total Fugitive Air Release (kg/yr)	Daily Fugitive Air Release (kg/day)	Total Stack Air Release (kg/yr)	Daily Stack Air Release (kg/day)	Annual Release Days (days/yr)
Teknor Apex Tennessee Company, Brownsville, TN	Fugitive releases not reported	Fugitive releases not reported	777	1.1	365
Shintech Freeport Plant, Freeport, TX	729	1	2,546	3.5	365
Formosa Point Comfort Plant, Point Comfort, TX	Fugitive releases not reported	Fugitive releases not reported	Stack releases not reported	Stack releases not reported	365
Teknor Apex Company, Maclin Division, City of Industry, CA	2.3	3.1E−03	35	4.8E−02	365
Formosa Plastics Corporation, Delaware City, De	0	0	Stack releases not reported	Stack releases not reported	365
Alphagary Corporation, Pineville, NC	0.45	6.2E−04	1.1	1.5E−03	365
Sabic Innovative Plastics US LLC, Selkirk, NY	Fugitive releases not reported	Fugitive releases not reported	0.45	6.2E−04	365
Dak Americas LLC Cooper River Plant, Moncks Corner, SC	0	0	0	0	365
Mexichem Specialty Resins Inc, Henry, IL	Fugitive releases not reported	Fugitive releases not reported	Stack releases not reported	Stack releases not reported	365

Table 3-17. Summary of Land Releases from TRI for Plastics Compounding

Site Identity	Median Total Release (kg/yr)	Maximum Total Release (kg/yr)	Annual Release Days (days/yr)
Cary Compounds LLC, Dayton, NJ	17	18	365
Colorite Polymers, Ridgefield, NJ	1,437	1,486	365
Geon Performance Solutions LLC, Terre Haute, In	6.5	6.5	365
Mexichem Specialty Compounds, Pineville, NC	1.7	3.1	365
Northwest Pipe Co, Brea, CA	3,266	4,082	365
Teknor Apex - Carolina Co, Fountain Inn, SC	1,290	2,527	365
Teknor Apex Co, Pawtucket, RI	232	647	365
Teknor Apex Co, City of Industry, CA	739	919	365

Site Identity	Median Total Release (kg/yr)	Maximum Total Release (kg/yr)	Annual Release Days (days/yr)
Teknor Apex Tennessee Co (Aka Haywood Co), Brownsville, TN	4,864	8,408	365

Table 3-18. Summary of Water Releases from DMR and TRI for Plastics Compounding for DEHP

Site Identity	Source-Discharge Type	Median Annual Discharge (kg/yr)	Daily Discharge (Corresponding to Median Annual Discharge) (kg/day)	Maximum Annual Discharge (kg/yr)	Daily Discharge (Corresponding to Maximum Daily Discharge) (kg/day)	Annual Release Days (days/yr)
Teknor Apex Co, Pawtucket, RI	DMR-Direct Discharges	N/A – facility does not report DMRs	N/A – facility does not report DMRs	N/A – facility does not report DMRs	N/A – facility does not report DMRs	246
Teknor Apex Co, Pawtucket, RI	TRI-Direct Discharges	0	0	0	0	246
Teknor Apex Co, Pawtucket, RI	TRI-Transfers to POTW	1.4E−02	5.5E−05	0.45	1.8E−03	246
Teknor Apex Co, Pawtucket, RI	TRI-Transfers to non-POTW	0	0	0	0	246
Sunlite Plastics Inc., Weyers Cave, VA	DMR-Direct Discharges	N/A – facility does not report DMRs	N/A – facility does not report DMRs	N/A – facility does not report DMRs	N/A – facility does not report DMRs	246
Sunlite Plastics Inc., Weyers Cave, VA	TRI-Direct Discharges	227	0.92	227	0.92	246
Sunlite Plastics Inc., Weyers Cave, VA	TRI-Transfers to POTW	227	0.92	227	0.92	246
Sunlite Plastics Inc., Weyers Cave, VA	TRI-Transfers to non-POTW	227	0.92	227	0.92	246
Lanxess Solutions US Inc, Gastonia, NC	DMR-Direct Discharges	N/A – facility does not report DMRs	N/A – facility does not report DMRs	N/A – facility does not report DMRs	N/A – facility does not report DMRs	246
Lanxess Solutions US Inc, Gastonia, NC	TRI-Direct Discharges	227	0.92	227	0.92	246
Lanxess Solutions US Inc, Gastonia, NC	TRI-Transfers to POTW	227	0.92	227	0.92	246
Lanxess Solutions US Inc, Gastonia, NC	TRI-Transfers to non-POTW	227	0.92	227	0.92	246

Site Identity	Source-Discharge Type	Median Annual Discharge (kg/yr)	Daily Discharge (Corresponding to Median Annual Discharge) (kg/day)	Maximum Annual Discharge (kg/yr)	Daily Discharge (Corresponding to Maximum Daily Discharge) (kg/day)	Annual Release Days (days/yr)
Rutland Plastic Technologies Inc, Pineville, NC	DMR-Direct Discharges	N/A – facility does not report DMRs	N/A – facility does not report DMRs	N/A – facility does not report DMRs	N/A – facility does not report DMRs	246
Rutland Plastic Technologies Inc, Pineville, NC	TRI-Direct Discharges	227	0.92	227	0.92	246
Rutland Plastic Technologies Inc, Pineville, NC	TRI-Transfers to POTW	227	0.92	227	0.92	246
Rutland Plastic Technologies Inc, Pineville, NC	TRI-Transfers to non-POTW	227	0.92	227	0.92	246
Mexichem Specialty Compounds, Pineville, NC	DMR-Direct Discharges	N/A – facility does not report DMRs	N/A – facility does not report DMRs	N/A – facility does not report DMRs	N/A – facility does not report DMRs	246
Mexichem Specialty Compounds, Pineville, NC	TRI-Direct Discharges	0	0	0	0	246
Mexichem Specialty Compounds, Pineville, NC	TRI-Transfers to POTW	4.3	1.8E−02	8.2	3.3E−02	246
Mexichem Specialty Compounds, Pineville, NC	TRI-Transfers to non-POTW	0	0	0	0	246
Teknor Apex - Carolina Co, Fountain Inn, SC	DMR-Direct Discharges	N/A – facility does not report DMRs	N/A – facility does not report DMRs	N/A – facility does not report DMRs	N/A – facility does not report DMRs	246
Teknor Apex - Carolina Co, Fountain Inn, SC	TRI-Direct Discharges	227	0.92	227	0.92	246
Teknor Apex - Carolina Co, Fountain Inn, SC	TRI-Transfers to POTW	227	0.92	227	0.92	246
Teknor Apex - Carolina Co, Fountain Inn, SC	TRI-Transfers to non-POTW	227	0.92	227	0.92	246
Teknor Apex Tennessee Co (Aka Haywood Co), Brownsville, TN	DMR-Direct Discharges	4.3	1.7E−02	18	7.4E−02	246

Site Identity	Source-Discharge Type	Median Annual Discharge (kg/yr)	Daily Discharge (Corresponding to Median Annual Discharge) (kg/day)	Maximum Annual Discharge (kg/yr)	Daily Discharge (Corresponding to Maximum Daily Discharge) (kg/day)	Annual Release Days (days/yr)
Teknor Apex Tennessee Co (Aka Haywood Co), Brownsville, TN	TRI-Direct Discharges	1.8	7.4E−03	2.7	1.1E−02	246
Teknor Apex Tennessee Co (Aka Haywood Co), Brownsville, TN	TRI-Transfers to POTW	8.2	3.3E−02	41	0.17	246
Teknor Apex Tennessee Co (Aka Haywood Co), Brownsville, TN	TRI-Transfers to non-POTW	0	0	0	0	246
Westlake Compounds LLC, Prairie, MS	DMR-Direct Discharges	N/A – facility does not report DMRs	N/A – facility does not report DMRs	N/A – facility does not report DMRs	N/A – facility does not report DMRs	246
Westlake Compounds LLC, Prairie, MS	TRI-Direct Discharges	227	0.92	227	0.92	246
Westlake Compounds LLC, Prairie, MS	TRI-Transfers to POTW	227	0.92	227	0.92	246
Westlake Compounds LLC, Prairie, MS	TRI-Transfers to non-POTW	227	0.92	227	0.92	246
Teknor Apex Co, City of Industry, CA	DMR-Direct Discharges	N/A – facility does not report DMRs	N/A – facility does not report DMRs	N/A – facility does not report DMRs	N/A – facility does not report DMRs	246
Teknor Apex Co, City of Industry, CA	TRI-Direct Discharges	2	8.3E−03	3.6	1.5E−02	246
Teknor Apex Co, City of Industry, CA	TRI-Transfers to POTW	2.7	1.1E−02	5	2.0E−02	246
Teknor Apex Co, City of Industry, CA	TRI-Transfers to non-POTW	0	0	0	0	246
Mexichem Specialty Compounds, Leominster, MA	DMR-Direct Discharges	N/A – facility does not report DMRs	N/A – facility does not report DMRs	N/A – facility does not report DMRs	N/A – facility does not report DMRs	246
Mexichem Specialty Compounds, Leominster, MA	TRI-Direct Discharges	227	0.92	227	0.92	246
Mexichem Specialty Compounds, Leominster, MA	TRI-Transfers to non-POTW	0	0	0	0	246

Site Identity	Source-Discharge Type	Median Annual Discharge (kg/yr)	Daily Discharge (Corresponding to Median Annual Discharge) (kg/day)	Maximum Annual Discharge (kg/yr)	Daily Discharge (Corresponding to Maximum Daily Discharge) (kg/day)	Annual Release Days (days/yr)
Mexichem Specialty Compounds, Leominster, MA	TRI-Transfers to non-POTW	227	0.92	227	0.92	246
Samos Polymers Corp, Stanley, NC	DMR-Direct Discharges	N/A – facility does not report DMRs	N/A – facility does not report DMRs	N/A – facility does not report DMRs	N/A – facility does not report DMRs	246
Samos Polymers Corp, Stanley, NC	TRI-Direct Discharges	227	0.92	227	0.92	246
Samos Polymers Corp, Stanley, NC	TRI-Transfers to POTW	227	0.92	227	0.92	246
Samos Polymers Corp, Stanley, NC	TRI-Transfers to non-POTW	227	0.92	227	0.92	246
Avient Corp, Kennesaw, GA	DMR-Direct Discharges	N/A – facility does not report DMRs	N/A – facility does not report DMRs	N/A – facility does not report DMRs	N/A – facility does not report DMRs	246
Avient Corp, Kennesaw, GA	TRI-Direct Discharges	227	0.92	227	0.92	246
Avient Corp, Kennesaw, GA	TRI-Transfers to POTW	227	0.92	227	0.92	246
Avient Corp, Kennesaw, GA	TRI-Transfers to non-POTW	227	0.92	227	0.92	246
Avient Corp North Baltimore, North Baltimore, OH	DMR-Direct Discharges	N/A – facility does not report DMRs	N/A – facility does not report DMRs	N/A – facility does not report DMRs	N/A – facility does not report DMRs	246
Avient Corp North Baltimore, North Baltimore, OH	TRI-Direct Discharges	227	0.92	227	0.92	246
Avient Corp North Baltimore, North Baltimore, OH	TRI-Transfers to POTW	227	0.92	227	0.92	246
Avient Corp North Baltimore, North Baltimore, OH	TRI-Transfers to non-POTW	227	0.92	227	0.92	246
Air Products & Chemicals Inc, Marshall, KY	DMR-Direct Discharges	1.3	5.5E−03	1.3	5.5E−03	246

Site Identity	Source-Discharge Type	Median Annual Discharge (kg/yr)	Daily Discharge (Corresponding to Median Annual Discharge) (kg/day)	Maximum Annual Discharge (kg/yr)	Daily Discharge (Corresponding to Maximum Daily Discharge) (kg/day)	Annual Release Days (days/yr)
Air Products & Chemicals Inc, Marshall, KY	TRI-Direct Discharges	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	246
Air Products & Chemicals Inc, Marshall, KY	TRI-Transfers to POTW	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	246
Air Products & Chemicals Inc, Marshall, KY	TRI-Transfers to non-POTW	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	246
Amerchol Corp, Saint Helena, LA	DMR-Direct Discharges	0.38	1.5E−03	0.38	1.5E−03	246
Amerchol Corp, Saint Helena, LA	TRI-Direct Discharges	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	246
Amerchol Corp, Saint Helena, LA	TRI-Transfers to POTW	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	246
Amerchol Corp, Saint Helena, LA	TRI-Transfers to non-POTW	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	246
APG Polytech, LLC, Mason, WV	DMR-Direct Discharges	1	4.2E−03	1.8	7.4E−03	246
APG Polytech, LLC, Mason, WV	TRI-Direct Discharges	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	246
APG Polytech, LLC, Mason, WV	TRI-Transfers to POTW	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	246
APG Polytech, LLC, Mason, WV	TRI-Transfers to non-POTW	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	246
Arclin Resins, Winn, LA	DMR-Direct Discharges	0.23	9.3E−04	0.37	1.5E−03	246
Arclin Resins, Winn, LA	TRI-Direct Discharges	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	246
Arclin Resins, Winn, LA	TRI-Transfers to POTW	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	246

Site Identity	Source-Discharge Type	Median Annual Discharge (kg/yr)	Daily Discharge (Corresponding to Median Annual Discharge) (kg/day)	Maximum Annual Discharge (kg/yr)	Daily Discharge (Corresponding to Maximum Daily Discharge) (kg/day)	Annual Release Days (days/yr)
Arclin Resins, Winn, LA	TRI-Transfers to non-POTW	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	246
Bayer Houston Plant, Harris, TX	DMR-Direct Discharges	5.4	2.2E−02	5.4	2.2E−02	246
Bayer Houston Plant, Harris, TX	TRI-Direct Discharges	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	246
Bayer Houston Plant, Harris, TX	TRI-Transfers to POTW	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	246
Bayer Houston Plant, Harris, TX	TRI-Transfers to non-POTW	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	246
Bayer Materialscience, Wetzel, WV	DMR-Direct Discharges	6.5	2.6E−02	10	4.1E−02	246
Bayer Materialscience, Wetzel, WV	TRI-Direct Discharges	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	246
Bayer Materialscience, Wetzel, WV	TRI-Transfers to POTW	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	246
Bayer Materialscience, Wetzel, WV	TRI-Transfers to non-POTW	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	246
Bp Amoco Chemicals, Morgan, AL	DMR-Direct Discharges	23	9.4E−02	23	9.4E−02	246
Bp Amoco Chemicals, Morgan, AL	TRI-Direct Discharges	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	246
Bp Amoco Chemicals, Morgan, AL	TRI-Transfers to POTW	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	246
Bp Amoco Chemicals, Morgan, AL	TRI-Transfers to non-POTW	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	246
Braskem America Inc Laporte Site, Harris, TX	DMR-Direct Discharges	9.3	3.8E−02	18	7.5E−02	246

Site Identity	Source-Discharge Type	Median Annual Discharge (kg/yr)	Daily Discharge (Corresponding to Median Annual Discharge) (kg/day)	Maximum Annual Discharge (kg/yr)	Daily Discharge (Corresponding to Maximum Daily Discharge) (kg/day)	Annual Release Days (days/yr)
Braskem America Inc Laporte Site, Harris, TX	TRI-Direct Discharges	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	246
Braskem America Inc Laporte Site, Harris, TX	TRI-Transfers to POTW	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	246
Braskem America Inc Laporte Site, Harris, TX	TRI-Transfers to non-POTW	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	246
Chemours Company Fc LLC, Wood, WV	DMR-Direct Discharges	106	0.43	106	0.43	246
Chemours Company Fc LLC, Wood, WV	TRI-Direct Discharges	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	246
Chemours Company Fc LLC, Wood, WV	TRI-Transfers to POTW	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	246
Chemours Company Fc LLC, Wood, WV	TRI-Transfers to non-POTW	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	246
Equistar Chemicals Lp, Clinton, IA	DMR-Direct Discharges	3.9	1.6E−02	7.6	3.1E−02	246
Equistar Chemicals Lp, Clinton, IA	TRI-Direct Discharges	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	246
Equistar Chemicals Lp, Clinton, IA	TRI-Transfers to POTW	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	246
Equistar Chemicals Lp, Clinton, IA	TRI-Transfers to non-POTW	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	246
Equistar Chemicals LP - Lake Charles Polymers Site, Calcasieu, LA	DMR-Direct Discharges	0.66	2.7E−03	0.66	2.7E−03	246
Equistar Chemicals LP - Lake Charles Polymers Site, Calcasieu, LA	TRI-Direct Discharges	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	246

Site Identity	Source-Discharge Type	Median Annual Discharge (kg/yr)	Daily Discharge (Corresponding to Median Annual Discharge) (kg/day)	Maximum Annual Discharge (kg/yr)	Daily Discharge (Corresponding to Maximum Daily Discharge) (kg/day)	Annual Release Days (days/yr)
Equistar Chemicals LP - Lake Charles Polymers Site, Calcasieu, LA	TRI-Transfers to POTW	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	246
Equistar Chemicals LP - Lake Charles Polymers Site, Calcasieu, LA	TRI-Transfers to non-POTW	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	246
Equistar Chemicals-Laporte, Harris, TX	DMR-Direct Discharges	27	0.11	62	0.25	246
Equistar Chemicals-Laporte, Harris, TX	TRI-Direct Discharges	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	246
Equistar Chemicals-Laporte, Harris, TX	TRI-Transfers to POTW	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	246
Equistar Chemicals-Laporte, Harris, TX	TRI-Transfers to non-POTW	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	246
Honeywell International Inc - Geismar Complex, Ascension, LA	DMR-Direct Discharges	7	2.8E−02	8.9	3.6E−02	246
Honeywell International Inc - Geismar Complex, Ascension, LA	TRI-Direct Discharges	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	246
Honeywell International Inc - Geismar Complex, Ascension, LA	TRI-Transfers to POTW	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	246
Honeywell International Inc - Geismar Complex, Ascension, LA	TRI-Transfers to non-POTW	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	246
Honeywell International, Baton Rouge, East Baton Rouge, LA	DMR-Direct Discharges	12	4.7E−02	12	4.7E−02	246
Honeywell International, Baton Rouge, East Baton Rouge, LA	TRI-Direct Discharges	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	246
Honeywell International, Baton Rouge, East Baton Rouge, LA	TRI-Transfers to POTW	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	246

Site Identity	Source-Discharge Type	Median Annual Discharge (kg/yr)	Daily Discharge (Corresponding to Median Annual Discharge) (kg/day)	Maximum Annual Discharge (kg/yr)	Daily Discharge (Corresponding to Maximum Daily Discharge) (kg/day)	Annual Release Days (days/yr)
Honeywell International, Baton Rouge, East Baton Rouge, LA	TRI-Transfers to non-POTW	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	246
Mpm Silicones LLC, Tyler, WV	DMR-Direct Discharges	19	7.9E−02	33	0.13	246
Mpm Silicones LLC, Tyler, WV	TRI-Direct Discharges	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	246
Mpm Silicones LLC, Tyler, WV	TRI-Transfers to POTW	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	246
Mpm Silicones LLC, Tyler, WV	TRI-Transfers to non-POTW	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	246
Neal Plant, WAyne, WV	DMR-Direct Discharges	0.11	4.5E−04	0.12	5.0E−04	246
Neal Plant, WAyne, WV	TRI-Direct Discharges	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	246
Neal Plant, WAyne, WV	TRI-Transfers to POTW	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	246
Neal Plant, WAyne, WV	TRI-Transfers to non-POTW	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	246
Nouryon Surface Chemistry LLC, Grundy, IL	DMR-Direct Discharges	0.39	1.6E−03	0.44	1.8E−03	246
Nouryon Surface Chemistry LLC, Grundy, IL	TRI-Direct Discharges	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	246
Nouryon Surface Chemistry LLC, Grundy, IL	TRI-Transfers to POTW	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	246
Nouryon Surface Chemistry LLC, Grundy, IL	TRI-Transfers to non-POTW	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	246
Occidental Chemical Corporation, San Patricio, TX	DMR-Direct Discharges	43	0.17	43	0.17	246

Site Identity	Source-Discharge Type	Median Annual Discharge (kg/yr)	Daily Discharge (Corresponding to Median Annual Discharge) (kg/day)	Maximum Annual Discharge (kg/yr)	Daily Discharge (Corresponding to Maximum Daily Discharge) (kg/day)	Annual Release Days (days/yr)
Occidental Chemical Corporation, San Patricio, TX	TRI-Direct Discharges	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	246
Occidental Chemical Corporation, San Patricio, TX	TRI-Transfers to POTW	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	246
Occidental Chemical Corporation, San Patricio, TX	TRI-Transfers to non-POTW	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	246
Owensboro Specialty Polymers, Daviess, KY	DMR-Direct Discharges	0.33	1.3E−03	0.33	1.3E−03	246
Owensboro Specialty Polymers, Daviess, KY	TRI-Direct Discharges	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	246
Owensboro Specialty Polymers, Daviess, KY	TRI-Transfers to POTW	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	246
Owensboro Specialty Polymers, Daviess, KY	TRI-Transfers to non-POTW	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	246
Oxy Vinyls LP Houston Operations Pasadena Pvc Plant, Harris, TX	DMR-Direct Discharges	104	0.42	140	0.57	246
Oxy Vinyls LP Houston Operations Pasadena Pvc Plant, Harris, TX	TRI-Direct Discharges	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	246
Oxy Vinyls LP Houston Operations Pasadena Pvc Plant, Harris, TX	TRI-Transfers to POTW	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	246
Oxy Vinyls LP Houston Operations Pasadena Pvc Plant, Harris, TX	TRI-Transfers to non-POTW	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	246
Rohm & Haas Bristol Facility, Bucks, PA	DMR-Direct Discharges	0.39	1.6E−03	0.39	1.6E−03	246

Site Identity	Source-Discharge Type	Median Annual Discharge (kg/yr)	Daily Discharge (Corresponding to Median Annual Discharge) (kg/day)	Maximum Annual Discharge (kg/yr)	Daily Discharge (Corresponding to Maximum Daily Discharge) (kg/day)	Annual Release Days (days/yr)
Rohm & Haas Bristol Facility, Bucks, PA	TRI-Direct Discharges	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	246
Rohm & Haas Bristol Facility, Bucks, PA	TRI-Transfers to POTW	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	246
Rohm & Haas Bristol Facility, Bucks, PA	TRI-Transfers to non-POTW	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	246
Sabic Innovative Plastics Mount Vernon LLC, Posey, In	DMR-Direct Discharges	44	0.18	44	0.18	246
Sabic Innovative Plastics Mount Vernon LLC, Posey, In	TRI-Direct Discharges	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	246
Sabic Innovative Plastics Mount Vernon LLC, Posey, In	TRI-Transfers to POTW	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	246
Sabic Innovative Plastics Mount Vernon LLC, Posey, In	TRI-Transfers to non-POTW	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	246
Si Group Inc /Rott Jct Fac, Schenectady, NY	DMR-Direct Discharges	0.75	3.0E−03	0.79	3.2E−03	246
Si Group Inc /Rott Jct Fac, Schenectady, NY	TRI-Direct Discharges	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	246
Si Group Inc /Rott Jct Fac, Schenectady, NY	TRI-Transfers to POTW	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	246
Si Group Inc /Rott Jct Fac, Schenectady, NY	TRI-Transfers to non-POTW	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	246
Solvay Specialty Polymers USA, L.L.C., Washington, OH	DMR-Direct Discharges	14	5.8E−02	14	5.8E−02	246
Solvay Specialty Polymers USA, L.L.C., Washington, OH	TRI-Direct Discharges	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	246

Site Identity	Source-Discharge Type	Median Annual Discharge (kg/yr)	Daily Discharge (Corresponding to Median Annual Discharge) (kg/day)	Maximum Annual Discharge (kg/yr)	Daily Discharge (Corresponding to Maximum Daily Discharge) (kg/day)	Annual Release Days (days/yr)
Solvay Specialty Polymers USA, L.L.C., Washington, OH	TRI-Transfers to POTW	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	246
Solvay Specialty Polymers USA, L.L.C., Washington, OH	TRI-Transfers to non-POTW	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	246
Styrolution America LLC, Will, IL	DMR-Direct Discharges	0.33	1.3E−03	0.33	1.3E−03	246
Styrolution America LLC, Will, IL	TRI-Direct Discharges	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	246
Styrolution America LLC, Will, IL	TRI-Transfers to POTW	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	246
Styrolution America LLC, Will, IL	TRI-Transfers to non-POTW	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	246
Total Petrochemicals & Refining USA Inc, Harris, TX	DMR-Direct Discharges	9.5	3.9E−02	13	5.4E−02	246
Total Petrochemicals & Refining USA Inc, Harris, TX	TRI-Direct Discharges	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	246
Total Petrochemicals & Refining USA Inc, Harris, TX	TRI-Transfers to POTW	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	246
Total Petrochemicals & Refining USA Inc, Harris, TX	TRI-Transfers to non-POTW	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	246
Ucc Seadrift Operations, Calhoun, TX	DMR-Direct Discharges	68	0.28	96	3.9E−01	246
Ucc Seadrift Operations, Calhoun, TX	TRI-Direct Discharges	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	246
Ucc Seadrift Operations, Calhoun, TX	TRI-Transfers to POTW	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	246
Ucc Seadrift Operations, Calhoun, TX	TRI-Transfers to non-POTW	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	246

3.3.4 Occupational Exposure Assessment

3.3.4.1 Worker Activities

Worker exposures during the unloading of solid products or compounding process may occur via inhalation of DEHP-containing dusts. Dermal or inhalation exposures to liquids and vapors may occur during equipment cleaning. Worker exposures may also occur via dermal contact with liquids and inhalation of vapors during DEHP unloading and loading and transport container cleaning (U.S. EPA, 2021d).

During plastic compounding using DEHP, worker exposures may be reduced by the use of local exhaust ventilation in the mixing and milling areas of compounding plants (Salisbury, 1984). A document identified from systematic review that examined six French PVC manufacturing factories stated that all factories were equipped with local exhaust systems at their workstations but workers at the factories worked without special PPE except the use of gloves during direct contact with a liquid plasticizer (Henrotin et al., 2020). Based on the Generic Scenario for Plastic Compounding, suitable PPE in the plastics industry includes gloves, hearing protection in high noise levels, eye protection, and respiratory protection in areas where ventilation is not used. The generic scenario also states that most plants use forced ventilation techniques to reduce worker exposures to vapors and local exhaust ventilation in areas where particulates or vapor may be formed (U.S. EPA, 2021d). EPA expects the types of PPE and controls used at each site to be based on the hazards present; therefore, the common PPE/controls presented in the GS/ESD may or may not apply when DEHP is being used.

ONUs include supervisors, managers, and other employees that work in the formulation area but do not directly contact DEHP received or processed onsite or handle compounded product. ONUs are potentially exposed through the inhalation route while in the working area. EPA also assessed dermal exposures from contact with surfaces where dust has been deposited for ONUs.

3.3.4.2 Occupational Inhalation Exposure Results

EPA received occupational inhalation exposure data through public comment relevant to plastic compounding. In the draft risk evaluation, data from literature and from the OSHA CEHD were used for these occupational exposure estimates. However, the data received through public comment was more recent, from multiple sites, and with metadata that indicated variability in the worker activities, operations, and resulting exposures. As a result, the exposure data received through public comment was incorporated into the occupational exposure assessment.

The inhalation exposure results for this OES are based on inhalation monitoring data from full and partial shift samples collected from three U.S. PVC compounding and processing facilities (Vinyl Institute, 2025) from workers involved in bagging, kneading, and blending operations. These data had a data quality rating of high. EPA determined that all data were of acceptable quality without notable deficiencies and integrated the data into the final exposure assessment. Results of this analysis are presented in Table 3-19. Several references were not included in the analysis as they did not provide discrete sample data (Huang et al., 2011; Modigh et al., 2002) or the age of the data (Salisbury, 1984) was not anticipated to be reflective of current occupational exposures in light of recent inhalation monitoring data submission (Vinyl Institute, 2025). Additional discussion on the uncertainty and limitations of these data are included in the weight of scientific evidence 4.2. No data with full shift samples for ONUs were identified for this OES through systematic review. For this reason, worker central tendency exposure concentrations were used to assess exposures for ONUs. The *Occupational Inhalation Exposure Data for Diethylhexyl Phthalate (DEHP)* contains additional information about the calculation results; refer to Appendix J for a reference to this supplemental document.

Table 3-19. Summary of Estimated Worker Inhalation Exposures for Plastics Compounding

Modeled Scenario	Exposure Concentration Type	Central Tendency	High-End
Average Adult Worker	8-hour TWA Exposure Concentration (mg/m^3)	8.5E−02[a]	
	Acute (AD, mg/kg-day)	1.1E−02	1.1E−02
	Intermediate (IADD, mg/kg-day)	7.8E−03	7.8E−03
	Chronic, Non-Cancer (ADD, mg/kg-day)	7.3E−03	7.3E−03
Female of Reproductive Age	8-hour TWA Exposure Concentration (mg/m^3)	8.5E−02[a]	
	Acute (AD, mg/kg-day)	1.2E−02	1.2E−02
	Intermediate (IADD, mg/kg-day)	8.6E−03	8.6E−03
	Chronic, Non-Cancer (ADD, mg/kg-day)	8.0E−03	8.0E−03
ONU	8-hour TWA Exposure Concentration (mg/m^3)	8.5E−02[a]	
	Acute (AD, mg/kg-day)	1.1E−02	
	Intermediate (IADD, mg/kg-day)	7.8E−03	
	Chronic, Non-Cancer (ADD, mg/kg-day)	7.3E−03	

[a] A single value representing the highest 8-hour TWA provided for plastic compounding was used as both the central tendency and high-end exposure value (Vinyl Institute, 2025) for all populations. The underlying data was not provided in the public comment, therefore the highest value measured was used as a screening value.

3.3.4.3 Occupational Dermal Exposure Results

EPA estimated dermal exposures for this OES using the methodology outlined in Appendix C. The various "Exposure Concentration Types" from Table 3-20 are explained in Appendix A. Dermal exposures to workers may occur via contact with DEHP in concentrated liquid form prior to compounding, as well as via contact with DEHP in solid, compounded rubber products. Because both physical forms are expected, EPA assessed the absorptive flux of DEHP using dermal absorption data for liquid DEHP (see Appendix D.2.1.1 for details) as well as for solid DEHP (see Appendix D.2.1.2 for details) and used the maximum value for the exposure calculations. Table 3-20 summarizes the APDR, the AD, the IADD, and the ADD for both average adult workers and female workers of reproductive age. Because there is dust or mist expected to be deposited on surfaces from this OES, dermal exposures to ONUs from contact with surfaces are assessed. Dermal exposure parameters are described in Appendix C. The *Occupational Dermal Exposure Modeling Results for Diethylhexyl Phthalate (DEHP)* also contains information about model equations and parameters and contains calculation results; refer to Appendix J for a reference to this supplemental document.

Table 3-20. Summary of Estimated Worker Dermal Exposures for Plastics Compounding

Worker Population	Exposure Concentration Type	Central Tendency	High-End
Average Adult Worker	Dose Rate (APDR, mg/day)	0.21	0.41
	Acute (AD, mg/kg-day)	2.6E−03	5.1E−03
	Intermediate (IADD, mg/kg-day)	1.9E−03	3.8E−03
	Chronic, Non-Cancer (ADD, mg/kg-day)	1.8E−03	3.5E−03
Female of Reproductive Age	Dose Rate (APDR, mg/day)	0.17	0.34
	Acute (AD, mg/kg-day)	2.4E−03	4.7E−03
	Intermediate (IADD, mg/kg-day)	1.7E−03	3.5E−03
	Chronic, Non-Cancer (ADD, mg/kg-day)	1.6E−03	3.2E−03
ONU	Dose Rate (APDR, mg/day)	0.21	
	Acute (AD, mg/kg-day)	2.6E−03	
	Intermediate (IADD, mg/kg-day)	1.9E−03	
	Chronic, Non-Cancer (ADD, mg/kg-day)	1.8E−03	

3.3.4.4 Occupational Aggregate Exposure Results

Inhalation and dermal exposure estimates were aggregated based on the approach described in Appendix A to arrive at the aggregate worker and ONU exposure estimates in the table below. The *Occupational Risk Calculator for Diethylhexyl Phthalate (DEHP)* (U.S. EPA, 2025e) contains the calculations of aggregate exposure; refer to Appendix J for a reference to this supplemental document.

Table 3-21. Summary of Estimated Worker Aggregate Exposures for Plastics Compounding

Modeled Scenario	Exposure Concentration Type (mg/kg/day)	Central Tendency	High-End
Average Adult Worker	Acute (AD, mg/kg-day)	1.0E−02	2.0E−02
	Intermediate (IADD, mg/kg-day)	1.0E−02	1.0E−02
	Chronic, Non-Cancer (ADD, mg/kg-day)	1.0E−02	1.0E−02
Female of Reproductive Age	Acute (AD, mg/kg-day)	1.0E−02	2.0E−02
	Intermediate (IADD, mg/kg-day)	1.0E−02	1.0E−02
	Chronic, Non-Cancer (ADD, mg/kg-day)	1.0E−02	1.0E−02
ONU	Acute (AD, mg/kg-day)	1.0E−02	
	Intermediate (IADD, mg/kg-day)	1.0E−02	
	Chronic, Non-Cancer (ADD, mg/kg-day)	1.0E−02	

3.4 Plastics Converting

3.4.1 Process Description

After the compounding process described in the previous section, compounded plastic resins are converted into solid plastic articles. According to the ESD on Plastic Additives, plasticized resin can be converted into final products through many processes, including closed processes such as extrusion, injection molding, compression molding, extrusion blow molding, partially open processes such as film extrusion, and open processes including, calendaring, thermoforming, and fiber reinforced plastic fabrication (OECD, 2009b). Vapor (fume) elimination equipment is commonly used during these processes (OECD, 2009b).

During extrusion, heated plastic resin is forced through a die and then quenched to form products such as pipe, profiles, sheets, and wire coating (OECD, 2009b). Injection molding involves heated plastic resin which is injected into a cold mold where the plastic takes the shape of the mold as it solidifies. Compression molding is the main process used for thermosetting materials. This process is performed by inserting prepared compound into a mold which is closed and maintained under pressure during a heating cycle. In extrusion blow molding, an extruder delivers a tubular extrudate between two halves of a mold joined around the hot extrudate before air is blown through, forcing the polymer to meld against the sides of the mold. The high-speed process is used to manufacture packaging bottles and containers. During film extrusion, a film is cooled by travelling upwards over a vertical bubble of air before being taken up onto reels or extruded through a slit die and immediately quenched. In calendaring, heated plastic resin is fed onto rolls that compress the material into a thin layer to form sheets and films. With thermoforming, a plastic sheet is locked in a frame and heated to the forming temperature then brought into contact with a mold of the desired shape. The sheet may be drawn onto the form using vacuum or applied pressure. If the sheets are extruded on site rather than being brought in, the process may be continuous. Fiber reinforced plastic fabrication involves unsaturated polyester resins and reinforcements cured at ambient temperatures or with small amounts of heat. This process may fabricate large shapes by using hand lay up or spray techniques to deposit resin and reinforcements onto a mold for curing. Filament winding may also be used to deposit resin and reinforcements onto a rotating mandrel before being introduced to an oven for heating (OECD, 2009b).

In some cases, after converting into the desired shape, the plastic product may undergo subsequent trimming to remove excess material (OECD, 2009b). Other finishing operations, such as paint, coating, and bonding may occur (these are covered under other COUs). Plasticizers are not chemically bound to the polymer and are able to migrate to the surface (OECD, 2009b).

Companies that reported the use of DEHP as a plasticizer in plastic products in 2020 CDR report the use of DEHP in primarily liquid form, with some companies also using pellet form. The DEHP concentration varied widely from less than 30 to over 90 percent (U.S. EPA, 2020a). Sources indicate that plasticizers are typically used at concentrations of 20 to 40 percent of the plastic material (Chao et al., 2015; Xu et al., 2010), but may be up to 60 percent (Gaudin et al., 2011; Gaudin et al., 2008). EPA did not identify other sources with information on DEHP concentration in plastic products. Figure 3-4 provides an illustration of the Plastic converting process.

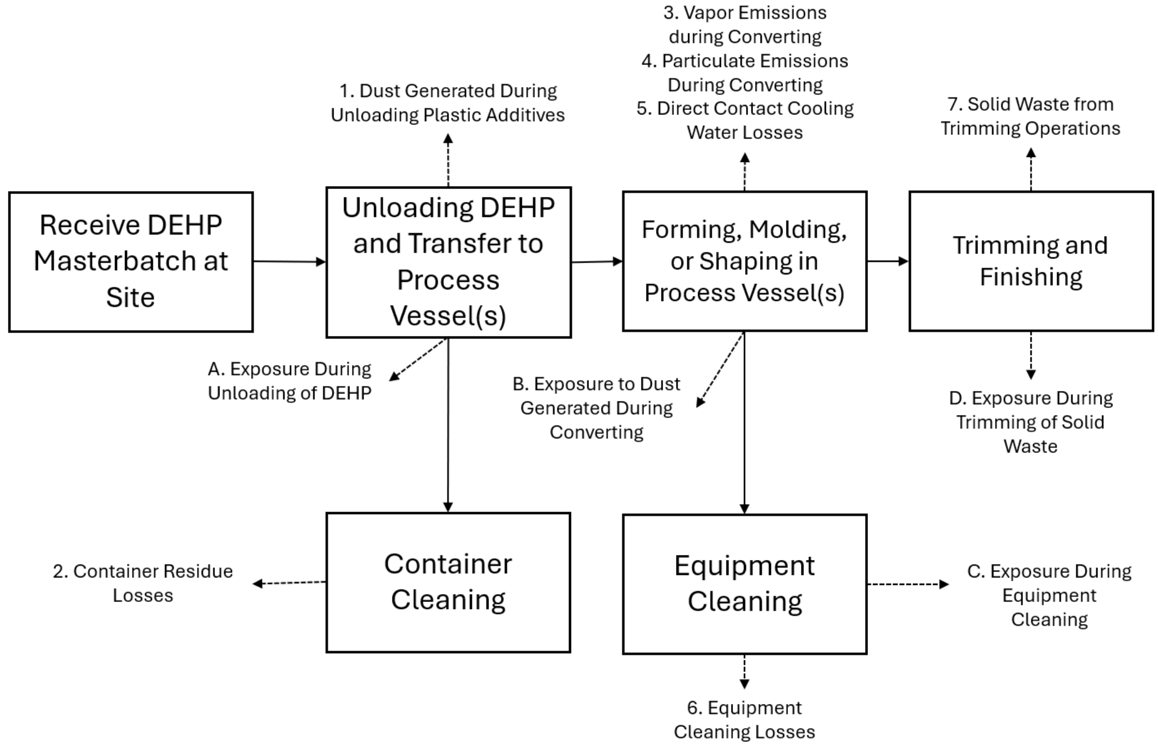


Figure 3-4. PVC Plastics Converting Flow Diagram (U.S. EPA, 2021e)

3.4.2 Facility Estimates

In the NEI (U.S. EPA, 2022e), DMR (U.S. EPA, 2022c), and TRI (U.S. EPA, 2022f) data that EPA analyzed, EPA identified 70 unique sites which it assessed as using DEHP in plastics converting. For air, 50 sites reported to TRI and 23 reported to NEI. For water, all 13 sites reported to TRI. For land, all 31 sites reported to TRI. The total number of sites reporting air, water, and land releases can be larger than the number of unique sites due to the overlap of facilities between reporting databases. No sites reported the use of DEHP for plastics converting in 2020 CDR. EPA identified operating days ranging from 172 to 365 with an average of 296 days through NEI air release data. TRI/DMR (U.S. EPA, 2022c) datasets did not report operating days; therefore, EPA used 253 days/yr of operation according to the Revised Plastic Converting GS as discussed in Section 2.3.2 (U.S. EPA, 2014g).

The ESD on Plastic Additives estimates 341 to 3,990 metric tons of flexible PVC produced per site per year (341,000 to 3,990,000 kg/site-yr) (OECD, 2009b). A typical number of production days during a year is 148 to 264 days (U.S. EPA, 2014f). Assuming a concentration of DEHP in the plastic of 20 to 60 percent (see above) and 264 days/yr, this is a use rate of 258 to 9,068 kg/site-day and 68,200 to 2,394,000 kg/site-yr.

3.4.3 Release Assessment

3.4.3.1 Environmental Release Points

Based on TRI (U.S. EPA, 2022f) and NEI (U.S. EPA, 2022e) data, Plastic converting releases may go to fugitive air, stack air, surface water, POTW, and landfill, and additional releases may occur from transfers of wastes to off-site treatment facilities (assessed in the waste handling OES). Fugitive air, POTW, incineration, or landfill releases may occur from unloading plastic additives and from particulates released during converting operations. Fugitive or Stack air releases may occur from vapors released during converting operations. Surface water or POTW releases may occur from direct contact cooling. POTW, incineration, or landfill releases may occur from container residues and equipment cleaning. Incineration or landfill releases may occur from solid waste trimming. Additional fugitive air releases may occur during leakage from pipes, flanges, and accessories used for transport.

Sites may utilize air capture technology, in which case releases to incineration or landfill may occur from dust during transfer operations of plastic additives and the remaining uncontrolled dust would be released to stack air. Releases to fugitive air, POTW, incineration, or landfill may occur from dust during transfer operations of plastic additives in cases where air capture technology is not utilized.

3.4.3.2 Environmental Release Assessment Results

Table 3-22 presents fugitive and stack air releases per year and per day for Plastic converting based on the 2017 to 2022 TRI (U.S. EPA, 2022f) database years along with the number of release days per year, with medians and maxima presented from across the six-year reporting range. Table 3-23 presents fugitive and stack air releases per year and per day based on 2020 NEI (U.S. EPA, 2022e) database along with the number of release days per year. Table 3-24 presents land releases per year based on the 2017 to 2022 TRI database along with the number of release days per year. Table 3-25 presents water releases per year and per day based on the 2017 to 2022 DMR (U.S. EPA, 2022c) and TRI databases along with the number of release days per year, with medians and maxima presented from across the six-year reporting range. The *Environmental Releases to Wastewater for Diethylhexyl Phthalate (DEHP), Environmental Releases to Air for Diethylhexyl Phthalate (DEHP),* and *Environmental Releases to Land for Diethylhexyl Phthalate (DEHP)* contain additional information about the calculation results; refer to Appendix J for a reference to these supplemental documents.

Table 3-22. Summary of Air Releases from TRI for Plastics Converting

Site Identity	Maximum Annual Fugitive Air Release (kg/yr)	Max. Annual Stack Air Release (kg/yr)	Median Annual Fugitive Air Release (kg/yr)	Median Annual Stack Air Release (kg/yr)	Max. Daily Fugitive Air Release (kg/day)	Max. Daily Stack Air Release (kg/day)	Median Daily Fugitive Air Release (kg/day)	Median Daily Stack Air Release (kg/day)	Annual Release Days (days/yr)
Fenwal International Inc, San German, PR	112	0	95	0	0.38	0	0.32	0	296
Baxter Healthcare of Puerto Rico, Aibonito, PR	0	5	0	4.5	0	1.7E−02	0	1.5E−02	296
Pexco LLC, Athol, MA	1.8	0	1.8	0	6.1E−03	0	6.1E−03	0	296
Entegris Inc, Bedford, MA	0	723	0	335	0	2.4	0	1.1	296
Winchester Interconnect Cm Corp, Dayville, CT	0	0	0	0	0	0	0	0	296
Hishi Plastics USA Inc, Lincoln Park, NJ	227	227	227	227	0.77	0.77	0.77	0.77	296
Chemprene LLC, Beacon, NY	0	970	0	366	0	3.3	0	1.2	296
Conmed Corp, UTica, NY	0	2.7	0	2.3	0	9.0E−03	0	7.8E−03	296
Veka Inc, Fombell, PA	0	0	0	0	0	0	0	0	296
Snap-Tite Hose/ Union City, Union City, PA	0	0	0	0	0	0	0	0	296
O'sullivan Films Inc, Winchester, VA	19	109	15	86	6.5E−02	0.37	5.1E−02	0.29	296
Natvar, Clayton, NC	113	0	113	0	0.38	0	0.38	0	296
Pass & Seymour Legrand, Concord, NC	340	340	0	170	1.1	1.1	0	0.57	296
Sunlite Plastics Inc., Weyers Cave, VA	227	227	227	227	0.77	0.77	0.77	0.77	296
Danfoss Power Solutions, Forest City, NC	113	214	69	99	0.38	0.72	0.23	0.33	296
Flexible Technologies Inc., Abbeville, SC	4.1	0	1.3	0	1.4E−02	0	4.5E−03	0	296
M-D Building Products Inc., Brooklet, GA	54	0	44	0	0.18	0	0.15	0	296
Vytron Corp, Loudon, TN	0	0	0	0	0	0	0	0	296

Site Identity	Maximum Annual Fugitive Air Release (kg/yr)	Max. Annual Stack Air Release (kg/yr)	Median Annual Fugitive Air Release (kg/yr)	Median Annual Stack Air Release (kg/yr)	Max. Daily Fugitive Air Release (kg/day)	Max. Daily Stack Air Release (kg/day)	Median Daily Fugitive Air Release (kg/day)	Median Daily Stack Air Release (kg/day)	Annual Release Days (days/yr)
HBD Thermoid Inc., Oneida, TN	2.3	113	0	0	7.7E−03	0.38	0	0	296
Danfoss Power Solutions II LLC, Newbern, TN	153	1,225	68	11	0.52	4.1	0.23	3.6E−02	296
Baxter Healthcare Corp., Cleveland, MS	5.9	0.45	4.4	0	2.0E−02	1.5E−03	1.5E−02	0	296
Contitech Inc., Marysville, OH	0	0	0	0	0	0	0	0	296
Zimmer Surgical, Dover, OH	0	2.3	0	2.3	0	7.7E−03	0	7.7E−03	296
Westlake Dimex, Marietta, OH	0	0	0	0	0	0	0	0	296
American Renolit Corp, La Porte, IN	0	59	0	59	0	0.2	0	0.2	296
Coleman Cable LLC East Facility, Bremen, IN	227	227	227	227	0.77	0.77	0.77	0.77	296
Flexaust Co, Warsaw, IN	227	227	227	227	0.77	0.77	0.77	0.77	296
Akwel Cadillac USA Inc., Cadillac, MI	0	156	0	113	0	0.53	0	0.38	296
Mgs, Germantown, WI	227	227	227	227	0.77	0.77	0.77	0.77	296
Poly Vinyl Co Inc., Sheboygan Falls, WI	7.3	0	7	0	2.5E−02	0	2.4E−02	0	296
Teel Plastics LLC, Baraboo, WI	0	0	0	0	0	0	0	0	296
Ronken Industries Inc, Spring Valley, IL	5.4	1.7	5.4	1.7	1.8E−02	5.6E−03	1.8E−02	5.6E−03	296
Parker Hannifin Corp, Kennett, MO	0	0	0	0	0	0	0	0	296
Fiskars Brands Inc, Excelsior Springs, MO	340	479	290	410	1.1	1.6	0.98	1.4	296
Sioux Chief, Peculiar, MO	0	18	0	5	0	6.0E−02	0	1.7E−02	296

Site Identity	Maximum Annual Fugitive Air Release (kg/yr)	Max. Annual Stack Air Release (kg/yr)	Median Annual Fugitive Air Release (kg/yr)	Median Annual Stack Air Release (kg/yr)	Max. Daily Fugitive Air Release (kg/day)	Max. Daily Stack Air Release (kg/day)	Median Daily Fugitive Air Release (kg/day)	Median Daily Stack Air Release (kg/day)	Annual Release Days (days/yr)
Baxter Healthcare Corp, Mountain Home, AR	13	132	12	61	4.4E−02	0.44	3.9E−02	0.21	296
Danfoss-Mountain Home, Mountain Home, AR	2.3	4.5	0	4.2	7.7E−03	1.5E−02	0	1.4E−02	296
Vytron, Terrell, TX	0	0	0	0	0	0	0	0	296
Oil States Industries Inc., Arlington, TX	0	0	0	0	0	0	0	0	296
Nov Fiber Glass Systems-Burkburnett, Burkburnett, TX	0	0	0	0	0	0	0	0	296
Greif Packaging LLC, La Porte, TX	664	252	664	252	2.2	0.85	2.2	0.85	296
ICU Medical Inc - Round Rock Site, Round Rock, TX	0	1.8	0	0.24	0	6.1E−03	0	8.0E−04	296
Colorite Plastics Co, Sparks, NV	0	0	0	0	0	0	0	0	296
American Renolit Corp La, Commerce, CA	2.3	187	2.3	121	7.7E−03	0.63	7.7E−03	0.41	296
Sunlite Plastics, Germantown, WI	113	113	0	0	0.38	0.38	0	0	296
Natvar, City of Industry, CA	113	0	113	0	0.38	0	0.38	0	296
Gillig, Livermore, CA	0	0	0	0	0	0	0	0	296
M-D Building Products Inc., Woodburn, Or	30	0	24	0	0.1	0	8.3E−02	0	296
Achilles USA Inc, Everett, WA	182	4,272	0	807	0.62	14	0	2.7	296
Pexco LLC, Tacoma, WA	1	0	0.48	0	3.4E−03	0	1.6E−03	0	296

Table 3-23. Summary of Air Releases from NEI (2020) for Plastics Converting

Site Identity	Total Fugitive Air Release (kg/yr)	Daily Fugitive Air Release (kg/day)	Total Stack Air Release (kg/yr)	Daily Stack Air Release (kg/day)	Annual Release Days (days/yr)
Entegris Inc, Bedford, MA	Fugitive releases not reported	Fugitive releases not reported	723	1.2	296
Pexco LLC, Athol, MA	1.8	3.1E−03	Stack releases not reported	Stack releases not reported	296
Chemprene Inc, Beacon, NY	17	2.9E−02	Stack releases not reported	Stack releases not reported	296
Osullivan Films Inc, Winchester, VA	19	3.3E−02	109	0.18	296
Diversified Structural Composites Inc, Erlanger, KY	1.2E−02	2.0E−05	2.4	4.1E−03	296
Loxcreen Co Inc, Brooklet, GA	54	9.1E−02	Stack releases not reported	Stack releases not reported	296
Eaton Aeroquip, Inc., Forest City, NC	113	0.19	85	0.14	296
Static Control Components, Inc. - Plant 17, Sanford, NC	Fugitive releases not reported	Fugitive releases not reported	Stack releases not reported	Stack releases not reported	172
Eaton Aeroquip Incorporated, Middlesex, NC	Fugitive releases not reported	Fugitive releases not reported	Stack releases not reported	Stack releases not reported	208
Michigan Rubber Products Inc., Cadillac, MI	0	0	Stack releases not reported	Stack releases not reported	296
Baxter Healthcare Corporation, Marion, NC	Fugitive releases not reported	Fugitive releases not reported	77	0.11	350
Sunlite Plastics Inc, Germantown, WI	5,241	8.9	Stack releases not reported	Stack releases not reported	296
Eagle Us 2 LLC - Lake Charles Complex, Westlake, LA	Fugitive releases not reported	Fugitive releases not reported	7.7E−03	1.1E−05	364
Poly Vinyl Company Inc, Sheboygan Falls, WI	6.7	1.1E−02	Stack releases not reported	Stack releases not reported	296
Nov Fiber Glass Systems Burkburnett, Burkburnett, TX	Fugitive releases not reported	Fugitive releases not reported	91	0.12	365
Round Rock-Abbott Labs, Round Rock, TX	Fugitive releases not reported	Fugitive releases not reported	0.23	3.8E−04	296

Site Identity	Total Fugitive Air Release (kg/yr)	Daily Fugitive Air Release (kg/day)	Total Stack Air Release (kg/yr)	Daily Stack Air Release (kg/day)	Annual Release Days (days/yr)
SLP Lighting Center Sullivan, Sullivan, MO	0.68	1.1E−03	Stack releases not reported	Stack releases not reported	296
American Renolit Corporation, La Porte, In	Fugitive releases not reported	Fugitive releases not reported	Stack releases not reported	Stack releases not reported	296
Baxter Healthcare Corporation, Mountain Home, AR	10	1.7E−02	68	0.11	296
Achilles USA Inc, Everett, WA	Fugitive releases not reported	Fugitive releases not reported	915	1.5	296
Flexible Technologies Inc, Abbeville, SC	149	0.24	Stack releases not reported	Stack releases not reported	312
Viskase Corporation, Loudon, TN	Fugitive releases not reported	Fugitive releases not reported	Stack releases not reported	Stack releases not reported	296
Ascend Performance Materials LLC, Decatur, AL	Fugitive releases not reported	Fugitive releases not reported	0.2	3.4E−04	296

Table 3-24. Summary of Land Releases from TRI for Plastics Converting

Site Identity	Median Total Release (kg/yr)	Maximum Total Release (kg/yr)	Annual Release Days (days/yr)
American Renolit Corp, La Porte, IN	762	762	296
Baxter Healthcare Corp, Mountain Home, AR	2,870	4,558	296
Baxter Healthcare Corp., Cleveland, MS	3.2E04	6.5E04	296
Baxter Healthcare of Puerto Rico, Aibonito, PR	4.1	6.4	296
Contitech Inc., Marysville, OH	3,216	3,216	296
Danfoss Power Solutions, Forest City, NC	1,338	1,678	296
Danfoss Power Solutions II LLC, Newbern, TN	340	998	296
Danfoss-Mountain Home, Mountain Home, AR	3.2	113	296
Fiskars Brands Inc, Excelsior Springs, MO	1.8E04	2.0E04	296
Flexible Technologies Inc., Abbeville, SC	3,207	4,353	296

Site Identity	Median Total Release (kg/yr)	Maximum Total Release (kg/yr)	Annual Release Days (days/yr)
Gillig, Livermore, CA	34	34	296
Greif Packaging LLC, La Porte, TX	4,750	4,750	296
HBD Thermoid Inc., Oneida, TN	947	1,386	296
M-D Building Products Inc., Brooklet, GA	1,159	1,494	296
Natvar, Clayton, NC	340	340	296
Natvar, City of Industry, CA	340	340	296
Nov Fiber Glass Systems-Burkburnett, Burkburnett, TX	980	980	296
Oil States Industries Inc., Arlington, TX	484	484	296
Parker Hannifin Corp, Kennett, MO	661	781	296
Parker Hannifin Corp O-Ring Div, Lebanon, TN	35	115	296
Pass & Seymour Legrand, Concord, NC	340	340	296
Poly Vinyl Co Inc., Sheboygan Falls, WI	9.5	10	296
Ronken Industries Inc, Spring Valley, IL	140	140	296
Sioux Chief, Peculiar, MO	2,188	2,948	296
Snap-Tite Hose/ Union City, Union City, PA	1,701	2,495	296
Teel Plastics LLC, Baraboo, WI	581	767	296
Vytron, Terrell, TX	11	11	296
Vytron Corp, Loudon, TN	11	11	296
Westlake Dimex, Marietta, OH	267	267	296
Winchester Interconnect Cm Corp, Dayville, CT	89	268	296
Zimmer Surgical, Dover, OH	725	1,521	296

Table 3-25. Summary of Water Releases from DMR and TRI for Plastics Converting

Site Identity	Source-Discharge Type	Median Annual Discharge (kg/yr)	Daily Discharge (Corresponding to Median Annual Discharge) (kg/day)	Maximum Annual Discharge (kg/yr)	Daily Discharge (Corresponding to Maximum Daily Discharge) (kg/day)	Annual Release Days (days/yr)
Baxter Healthcare of Puerto Rico, Aibonito, PR	DMR-Direct Discharges	N/A – facility does not report DMRs	N/A – facility does not report DMRs	N/A – facility does not report DMRs	N/A – facility does not report DMRs	253
Baxter Healthcare of Puerto Rico, Aibonito, PR	TRI-Direct Discharges	0	0	0	0	253
Baxter Healthcare of Puerto Rico, Aibonito, PR	TRI-Transfers to POTW	3.6	1.4E−02	4.1	1.6E−02	253
Baxter Healthcare of Puerto Rico, Aibonito, PR	TRI-Transfers to non-POTW	0	0	0	0	253
Hishi Plastics USA Inc, Lincoln Park, NJ	DMR-Direct Discharges	N/A – facility does not report DMRs	N/A – facility does not report DMRs	N/A – facility does not report DMRs	N/A – facility does not report DMRs	253
Hishi Plastics USA Inc, Lincoln Park, NJ	TRI-Direct Discharges	227	0.9	227	0.9	253
Hishi Plastics USA Inc, Lincoln Park, NJ	TRI-Transfers to POTW	227	0.9	227	0.9	253
Hishi Plastics USA Inc, Lincoln Park, NJ	TRI-Transfers to non-POTW	227	0.9	227	0.9	253
Zimmer Surgical, Dover, OH	DMR-Direct Discharges	N/A – facility does not report DMRs	N/A – facility does not report DMRs	N/A – facility does not report DMRs	N/A – facility does not report DMRs	253
Zimmer Surgical, Dover, OH	TRI-Direct Discharges	0	0	0	0	253
Zimmer Surgical, Dover, OH	TRI-Transfers to POTW	2.3	9.0E−03	2.3	9.0E−03	253
Zimmer Surgical, Dover, OH	TRI-Transfers to non-POTW	0	0	0	0	253
Coleman Cable LLC East Facility, Bremen, IN	DMR-Direct Discharges	N/A – facility does not report DMRs	N/A – facility does not report DMRs	N/A – facility does not report DMRs	N/A – facility does not report DMRs	253
Coleman Cable LLC East Facility, Bremen, IN	TRI-Direct Discharges	227	0.9	227	0.9	253

Site Identity	Source-Discharge Type	Median Annual Discharge (kg/yr)	Daily Discharge (Corresponding to Median Annual Discharge) (kg/day)	Maximum Annual Discharge (kg/yr)	Daily Discharge (Corresponding to Maximum Daily Discharge) (kg/day)	Annual Release Days (days/yr)
Coleman Cable LLC East Facility, Bremen, IN	TRI-Transfers to POTW	227	0.9	227	0.9	253
Coleman Cable LLC East Facility, Bremen, IN	TRI-Transfers to non-POTW	227	0.9	227	0.9	253
Flexaust Co, Warsaw, IN	DMR-Direct Discharges	N/A – facility does not report DMRs	N/A – facility does not report DMRs	N/A – facility does not report DMRs	N/A – facility does not report DMRs	253
Flexaust Co, Warsaw, IN	TRI-Direct Discharges	227	0.9	227	0.9	253
Flexaust Co, Warsaw, IN	TRI-Transfers to POTW	227	0.9	227	0.9	253
Flexaust Co, Warsaw, IN	TRI-Transfers to non-POTW	227	0.9	227	0.9	253
Akwel Cadillac USA Inc., Cadillac, MI	DMR-Direct Discharges	N/A – facility does not report DMRs	N/A – facility does not report DMRs	N/A – facility does not report DMRs	N/A – facility does not report DMRs	253
Akwel Cadillac USA Inc., Cadillac, MI	TRI-Direct Discharges	0	0	0	0	253
Akwel Cadillac USA Inc., Cadillac, MI	TRI-Transfers to POTW	11	4.3E−02	15	5.8E−02	253
Akwel Cadillac USA Inc., Cadillac, MI	TRI-Transfers to non-POTW	0	0	0	0	253
Ronken Industries Inc, Spring Valley, IL	DMR-Direct Discharges	N/A – facility does not report DMRs	N/A – facility does not report DMRs	N/A – facility does not report DMRs	N/A – facility does not report DMRs	253
Ronken Industries Inc, Spring Valley, IL	TRI-Direct Discharges	0.31	1.2E−03	0.31	1.2E−03	253
Ronken Industries Inc, Spring Valley, IL	TRI-Transfers to POTW	0.48	1.9E−03	0.48	1.9E−03	253
Ronken Industries Inc, Spring Valley, IL	TRI-Transfers to non-POTW	0	0	0	0	253
Fiskars Brands Inc, Excelsior Springs, MO	DMR-Direct Discharges	N/A – facility does not report DMRs	N/A – facility does not report DMRs	N/A – facility does not report DMRs	N/A – facility does not report DMRs	253

Site Identity	Source-Discharge Type	Median Annual Discharge (kg/yr)	Daily Discharge (Corresponding to Median Annual Discharge) (kg/day)	Maximum Annual Discharge (kg/yr)	Daily Discharge (Corresponding to Maximum Daily Discharge) (kg/day)	Annual Release Days (days/yr)
Fiskars Brands Inc, Excelsior Springs, MO	TRI-Direct Discharges	0	0	0	0	253
Fiskars Brands Inc, Excelsior Springs, MO	TRI-Transfers to POTW	2	7.8E−03	2.3	9.0E−03	253
Fiskars Brands Inc, Excelsior Springs, MO	TRI-Transfers to non-POTW	0	0	0	0	253
Baxter Healthcare Corp, Mountain Home, AR	DMR-Direct Discharges	N/A – facility does not report DMRs	N/A – facility does not report DMRs	N/A – facility does not report DMRs	N/A – facility does not report DMRs	253
Baxter Healthcare Corp, Mountain Home, AR	TRI-Direct Discharges	0	0	0	0	253
Baxter Healthcare Corp, Mountain Home, AR	TRI-Transfers to POTW	31	0.12	59	0.23	253
Baxter Healthcare Corp, Mountain Home, AR	TRI-Transfers to non-POTW	0	0	0	0	253
Danfoss-Mountain Home, Mountain Home, AR	DMR-Direct Discharges	N/A – facility does not report DMRs	N/A – facility does not report DMRs	N/A – facility does not report DMRs	N/A – facility does not report DMRs	253
Danfoss-Mountain Home, Mountain Home, AR	TRI-Direct Discharges	0	0	0	0	253
Danfoss-Mountain Home, Mountain Home, AR	TRI-Transfers to POTW	1.8	7.2E−03	5	2.0E−02	253
Danfoss-Mountain Home, Mountain Home, AR	TRI-Transfers to non-POTW	0	0	0	0	253
Oil States Industries Inc., Arlington, TX	DMR-Direct Discharges	N/A – facility does not report DMRs	N/A – facility does not report DMRs	N/A – facility does not report DMRs	N/A – facility does not report DMRs	253
Oil States Industries Inc., Arlington, TX	TRI-Direct Discharges	227	0.9	227	0.9	253
Oil States Industries Inc., Arlington, TX	TRI-Transfers to POTW	227	0.9	227	0.9	253
Oil States Industries Inc., Arlington, TX	TRI-Transfers to non-POTW	227	0.9	227	0.9	253

Site Identity	Source-Discharge Type	Median Annual Discharge (kg/yr)	Daily Discharge (Corresponding to Median Annual Discharge) (kg/day)	Maximum Annual Discharge (kg/yr)	Daily Discharge (Corresponding to Maximum Daily Discharge) (kg/day)	Annual Release Days (days/yr)
Danfoss Power Solutions II LLC, Newbern, TN	DMR-Direct Discharges	N/A – facility does not report DMRs	N/A – facility does not report DMRs	N/A – facility does not report DMRs	N/A – facility does not report DMRs	253
Danfoss Power Solutions II LLC, Newbern, TN	TRI-Direct Discharges	2.3E−03	8.96428E−06	4.5E−03	1.8E−05	253
Danfoss Power Solutions II LLC, Newbern, TN	TRI-Transfers to POTW	4.3E−03	1.7E−05	8.6E−03	3.4E−05	253
Danfoss Power Solutions II LLC, Newbern, TN	TRI-Transfers to non-POTW	0	0	0	0	253
MGS, Germantown, WI	DMR-Direct Discharges	N/A – facility does not report DMRs	N/A – facility does not report DMRs	N/A – facility does not report DMRs	N/A – facility does not report DMRs	253
MGS, Germantown, WI	TRI-Direct Discharges	227	0.9	227	0.9	253
MGS, Germantown, WI	TRI-Transfers to POTW	227	0.9	227	0.9	253
MGS, Germantown, WI	TRI-Transfers to non-POTW	227	0.9	227	0.9	253

3.4.4 Occupational Exposure Assessment

3.4.4.1 Worker Activities

Workers are potentially exposed to DEHP via dust inhalation during the converting process and via inhalation or dermal contact with vapors or liquids during equipment cleaning. Additionally, workers may be exposed to DEHP via dermal contact with liquids and inhalation of vapors during unloading and loading, and trimming of excess plastic (U.S. EPA, 2021e).

During converting of DEHP-containing plastic, worker exposures may be reduced by the use of local exhaust ventilation in calendaring and laminating areas (Salisbury, 1984). EPA did not identify information on worker PPE used at plastics converting sites. Based on the Generic Scenario for Plastic converting, suitable PPE in the plastics industry includes gloves, hearing protection in high noise levels, eye protection, and respiratory protection in areas where ventilation is not used. The generic scenario also states that most plants use forced ventilation techniques to reduce worker exposures to vapors and local exhaust ventilation in areas where particulates or vapor may be formed (U.S. EPA, 2021e). EPA expects the types of PPE and controls used at each site to be based on the hazards present; therefore, the common PPE/controls presented in the GS/ESD may or may not apply when DEHP is being used.

ONUs include supervisors, managers, and other employees that work in the formulation area but do directly contact DEHP that is received or processed onsite or handle the finished product. ONUs are potentially exposed through the inhalation route while in the working area. EPA also assessed dermal exposures from contact with surfaces where dust has been deposited for ONUs.

3.4.4.2 Occupational Inhalation Exposure Results

EPA received occupational inhalation exposure data through public comment relevant to Plastic converting. In the draft risk evaluation, data from literature and from the OSHA CEHD were used for the occupational exposure estimates for Plastic converting. However, the data received through public comment was more recent, from multiple sites, and with metadata that indicated variability in the worker activities, operations, and resulting exposures. As a result, the exposure data received through public comment was incorporated into the occupational exposure assessment.

The inhalation exposure results for this OES are based on inhalation monitoring data from full and partial shift samples collected from three U.S. PVC compounding and processing (converting) facilities (Vinyl Institute, 2025) from workers involved in calendering and hose extrusion. These data had a data quality rating of high. EPA determined that all data were of acceptable quality without notable deficiencies and integrated the data into the final exposure assessment. Results of this analysis are presented in Table 3-26. In addition to these data, the following reference was not included in the analysis as it did not provide discrete sample data (Dirven et al., 1993). Additional discussion on the uncertainty and limitations of these data are included in the weight of scientific evidence 4.2. No data with full shift samples for ONUs was identified for this OES through systematic review. For this reason, the worker central tendency exposure concentration was used to assess both the ONU high-end and central tendency exposures. The *Occupational Inhalation Exposure Data for Diethylhexyl Phthalate (DEHP)* contains additional information about the calculation results; refer to Appendix J for a reference to this supplemental document.

Table 3-26. Summary of Estimated Worker Inhalation Exposures for Plastics Converting

Modeled Scenario	Exposure Concentration Type	Central Tendency	High-End
	8-hour TWA Exposure Concentration (mg/m^3)	5.1E−02 [a]	

Modeled Scenario	Exposure Concentration Type	Central Tendency	High-End
Average Adult Worker	Acute (AD, mg/kg-day)	6.4E−03	6.4E−03
	Intermediate (IADD, mg/kg-day)	4.7E−03	4.7E−03
	Chronic, Non-Cancer (ADD, mg/kg-day)	4.4E−03	4.4E−03
Female of Reproductive Age	8-hour TWA Exposure Concentration (mg/m^3)	5.1E−02 [a]	
	Acute (AD, mg/kg-day)	7.0E−03	7.03E−03
	Intermediate (IADD, mg/kg-day)	5.2E−03	5.2E−03
	Chronic, Non-Cancer (ADD, mg/kg-day)	4.8E−03	4.8E−03
ONU	8-hour TWA Exposure Concentration (mg/m^3)	5.1E−02 [a]	
	Acute (AD, mg/kg-day)	6.4E−03	
	Intermediate (IADD, mg/kg-day)	4.7E−03	
	Chronic, Non-Cancer (ADD, mg/kg-day)	4.4E−03	

[a] A single value representing the highest non-detect value provided for Plastic converting was used as both the central tendency and high-end exposure value (Vinyl Institute, 2025) for all populations. The underlying data was not provided in the public comment, therefore the highest value measured was used as a screening value.

3.4.4.3 Occupational Dermal Exposure Results

EPA estimated dermal exposures for this OES using the methodology outlined in Appendix C. The various "Exposure Concentration Types" from Table 3-27 are explained in Appendix A. Because dermal exposures to workers may occur in the solid form during converting, EPA assessed the absorptive flux of DEHP according to the dermal absorption data of solid DEHP (see Appendix C.2.1.2 for details). Table 3-27 summarizes the APDR, the AD, the IADD, and the ADD for both average adult workers and female workers of reproductive age. Because there is dust or mist expected to be deposited on surfaces from this OES, dermal exposures to ONUs from contact with surfaces are assessed. Dermal exposure parameters are described in Appendix C.

The *Occupational Dermal Exposure Modeling Results for Diethylhexyl Phthalate (DEHP)* also contains information about model equations and parameters and contains calculation results; refer to Appendix J for a reference to this supplemental document.

Table 3-27. Summary of Estimated Worker Dermal Exposures for Plastics Converting

Worker Population	Exposure Concentration Type	Central Tendency	High-End
Average Adult Worker	Dose Rate (APDR, mg/day)	0.21	0.41
	Acute (AD, mg/kg-day)	2.6E−03	5.1E−03
	Intermediate (IADD, mg/kg-day)	1.9E−03	3.8E−03
	Chronic, Non-Cancer (ADD, mg/kg-day)	1.8E−03	3.5E−03
Female of Reproductive Age	Dose Rate (APDR, mg/day)	0.17	0.34
	Acute (AD, mg/kg-day)	2.4E−03	4.7E−03
	Intermediate (IADD, mg/kg-day)	1.7E−03	3.5E−03
	Chronic, Non-Cancer (ADD, mg/kg-day)	1.6E−03	3.2E−03
ONU	Dose Rate (APDR, mg/day)	0.21	
	Acute (AD, mg/kg-day)	2.6E−03	
	Intermediate (IADD, mg/kg-day)	1.9E−03	
	Chronic, Non-Cancer (ADD, mg/kg-day)	1.8E−03	

3.4.4.4 Occupational Aggregate Exposure Results

Inhalation and dermal exposure estimates were aggregated based on the approach described in Appendix A to arrive at the aggregate worker and ONU exposure estimates in the table below. The *Occupational Risk Calculator for Diethylhexyl Phthalate (DEHP)* (U.S. EPA, 2025e) contains the calculations of aggregate exposure; refer to Appendix J for a reference to this supplemental document.

Table 3-28. Summary of Estimated Worker Aggregate Exposures for Plastics Converting

Modeled Scenario	Exposure Concentration Type (mg/kg/day)	Central Tendency	High-End
Average Adult Worker	Acute (AD, mg/kg-day)	1.0E−02	1.0E−02
	Intermediate (IADD, mg/kg-day)	1.0E−02	1.0E−02
	Chronic, Non-Cancer (ADD, mg/kg-day)	1.0E−02	1.0E−02
Female of Reproductive Age	Acute (AD, mg/kg-day)	1.0E−02	1.0E−02
	Intermediate (IADD, mg/kg-day)	1.0E−02	1.0E−02
	Chronic, Non-Cancer (ADD, mg/kg-day)	1.0E−02	1.0E−02
ONU	Acute (AD, mg/kg-day)	1.0E−02	
	Intermediate (IADD, mg/kg-day)	1.0E−02	
	Chronic, Non-Cancer (ADD, mg/kg-day)	1.0E−02	

3.5 Incorporation into Formulation, Mixture, or Reaction Product

3.5.1 Process Description

Incorporation into a formulation, mixture or reaction product refers to the process of mixing or blending several raw materials to obtain a single product or preparation. In the 2016 and 2020 CDR, companies reported use of DEHP as a plasticizer in organic chemical manufacturing; the custom compounding of resins; the manufacturing of paint and coating, adhesives, and synthetic dye; as well as in the manufacturing of plastic material, resin, synthetic rubber, and solid rocket motor insulation (U.S. EPA, 2020a, 2019b).

DEHP-specific formulation processes were not identified; however, EPA identified several ESDs published by the OECD and Generic Scenarios published by EPA that provide general process descriptions for these types of products. The manufacture of coatings involves four steps. The formulation of coatings and inks typically involves dispersion, milling, finishing and filling into final packages. Modern processes can combine the final steps by creating intermediate formulations during the first two steps. The intermediates are then dispensed directly into the shipping containers for the final blending in order to produce the end-product (OECD, 2010a, c). Waterborne coatings are produced with the same approach, using water as one of the liquid ingredients (OECD, 2009c). Adhesive formulation involves mixing volatile and non-volatile chemical components together in sealed, unsealed, or heated processes (OECD, 2009a). Sealed processes are most common for adhesive formulation because many adhesives are designed to set or react when exposed to ambient conditions (OECD, 2009a). The manufacturing process for radiation curable coating products is similar to adhesive formulation, with volatile and non-volatile chemical components being mixed in an open or sealed batch process, with the photoinitiator being added last. The high cost of radiation curable raw materials has led to the use of practices to reduce container residues, such as heating containers to reduce viscosity.

The concentration of DEHP in the formulation varies widely depending on the type of formulation (*e.g.*, paint, adhesive, dye, ink). The ESD on Adhesive Formulation estimates the number of operating days based on production volume information and an annual adhesive production rate of 1.6 kg/site-yr

(OECD, 2009a). Figure 3-5 provides an illustration of Incorporation into other formulations, mixtures, and reaction products.

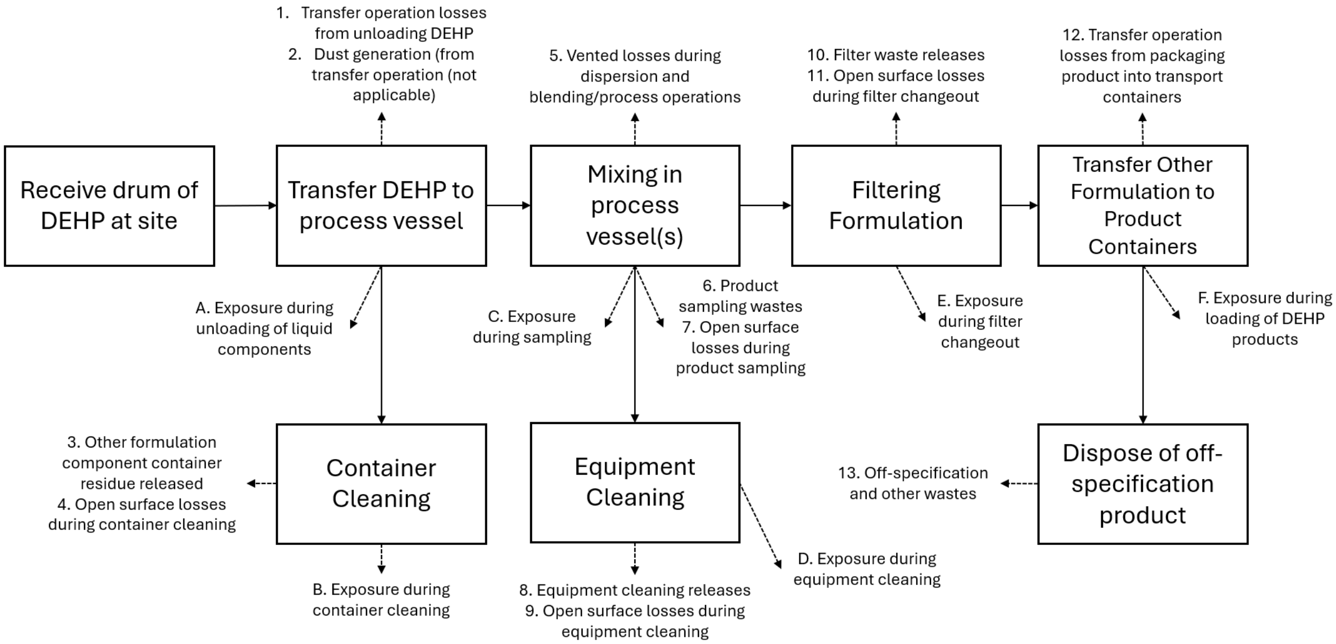


Figure 3-5. Incorporation into Other Formulations, Mixtures, and Reaction Products Flow Diagram (U.S. EPA, 2014b)

3.5.2 Facility Estimates

In the NEI (U.S. EPA, 2022e), DMR (U.S. EPA, 2022c), and TRI (U.S. EPA, 2022f) data that EPA analyzed, EPA identified 128 unique sites which it assessed as using DEHP in Incorporation into formulation, mixture, or reaction product. For air, 18 sites reported to TRI and 70 reported to NEI. For water, nine sites reported to TRI and 37 reported to DMR. For land, three sites reported to TRI. The total number of sites reporting air, water, and land releases can be larger than the number of unique sites due to the overlap of facilities between reporting databases. Due to the lack of data on the annual PV of DEHP in incorporation into formulation, mixture, or reaction products, EPA does not present annual or daily site throughputs. The ESD on Formulation of Radiation Curable Coatings, Inks and Adhesives estimates 250 operating days/yr and an annual production rate of 130,000 kg formulation/site-yr (OECD, 2010a). However, EPA identified operating days ranging from 309 to 365 days with an average of 360 days through NEI air release data. TRI/DMR data did not report operating days; therefore, EPA assumed 300 days/yr of operation as discussed in Section 2.3.2.

3.5.3 Release Assessment

3.5.3.1 Environmental Release Points

Based on TRI (U.S. EPA, 2022f), DMR (U.S. EPA, 2022c), and NEI data, Incorporation into formulation, mixture, or reaction product releases may go to stack air, fugitive air, surface water, POTW, and landfill. Additional releases may occur from transfers of wastes to off-site treatment facilities (assessed in the waste handling OES). Stack air releases may occur from vented losses during mixing, dust generation during transfer, and vented losses during process operations. POTW, incineration, or landfill releases may occur from container residue, sampling wastes, equipment cleaning wastes, and off-specification wastes. Incineration or landfill releases may occur from filter waste. Fugitive air, POTW, incineration, or landfill releases may occur from dust generation during transfer operations. Additional fugitive air releases may occur during leakage from pipes, flanges, and accessories used for transport.

3.5.3.2 Environmental Release Assessment Results

Table 3-29 presents fugitive and stack air releases per year and per day for Incorporation into formulation, mixture, or reaction product based on the 2017 to 2022 TRI (U.S. EPA, 2022f) database reporting years along with the number of release days per year, with medians and maxima presented from across the six-year reporting range. Table 3-30 presents fugitive and stack air releases per year and per day based on the 2020 NEI (U.S. EPA, 2022e) database along with the number of release days per year. Table 3-31 presents land releases per year based on the 2017 to 2022 TRI database along with the number of release days per year. Table 3-32 presents water releases per year and per day based on the 2017 to 2022 DMR (U.S. EPA, 2022c) and TRI databases along with the number of release days per year, with medians and maxima presented from across the six-year reporting range. The *Environmental Releases to Wastewater for Diethylhexyl Phthalate (DEHP)*, *Environmental Releases to Air for Diethylhexyl Phthalate (DEHP)*, and *Environmental Releases to Land for Diethylhexyl Phthalate (DEHP)* contain additional information about the calculation results; refer to Appendix J for a reference to these supplemental documents.

Table 3-29. Summary of Air Releases from TRI for Incorporation into Formulation, Mixture, or Reaction Product

Site Identity	Maximum Annual Fugitive Air Release (kg/yr)	Max. Annual Stack Air Release (kg/yr)	Median Annual Fugitive Air Release (kg/yr)	Median Annual Stack Air Release (kg/yr)	Max. Daily Fugitive Air Release (kg/day)	Max. Daily Stack Air Release (kg/day)	Median Daily Fugitive Air Release (kg/day)	Median Daily Stack Air Release (kg/day)	Annual Release Days (days/yr)
Grace Davison-Edison, Edison, NJ	2.3	4.1	2.3	4.1	6.2E−03	1.1E−02	6.2E−03	1.1E−02	364
Barnhardt Manufacturing Co NCFI Polyurethanes Div, Mount Airy, NC	6.4E−04	0	6.4E−04	0	1.7E−06	0	1.7E−06	0	364
Hallstar Co Memphis Solutions Facility, Memphis, TN	22	193	14	125	6.0E−02	0.53	3.9E−02	0.34	364
Republic Powdered Metals Inc, Medina, OH	227	227	227	227	0.62	0.62	0.62	0.62	364
Eftec Na LLC, Taylor, MI	227	227	227	227	0.62	0.62	0.62	0.62	364
Henkel Us Operations Corp, Oak Creek, WI	2.3	2.3	2.3	2.3	6.2E−03	6.2E−03	6.2E−03	6.2E−03	364
Lakeside Plastics Inc, Oshkosh, WI	227	227	227	227	0.62	0.62	0.62	0.62	364
Pico Chemical Corp, Chicago Heights, IL	227	227	227	227	0.62	0.62	0.62	0.62	364
Elpaco Coatings LLC, Pagedale, MO	0	0	0	0	0	0	0	0	364
The Dow Chemical Co - Louisiana Operations, Plaquemine, LA	0	0	0	0	0	0	0	0	364
Ralston Holdings QOZB LLC Dba Tolber Chemical, Hope, AR	0	0	0	0	0	0	0	0	364
Grace -Pasadena Catalyst Site, Pasadena, TX	227	227	227	227	0.62	0.62	0.62	0.62	364
International Coatings Co Inc., Cerritos, CA	227	227	227	227	0.62	0.62	0.62	0.62	364

Site Identity	Maximum Annual Fugitive Air Release (kg/yr)	Max. Annual Stack Air Release (kg/yr)	Median Annual Fugitive Air Release (kg/yr)	Median Annual Stack Air Release (kg/yr)	Max. Daily Fugitive Air Release (kg/day)	Max. Daily Stack Air Release (kg/day)	Median Daily Fugitive Air Release (kg/day)	Median Daily Stack Air Release (kg/day)	Annual Release Days (days/yr)
Ennis-Flint Salem, Salem, Or	4.5E−03	1.4E−02	0	9.1E−03	1.2E−05	3.7E−05	0	2.5E−05	364
Akron Dispersions Inc Copley Oh, Copley, OH	227	227	227	227	0.62	0.62	0.62	0.62	364
Greenfield Manufacturing Inc., Saratoga Springs, NY	2.3	2.3	2.3	2.3	6.2E−03	6.2E−03	6.2E−03	6.2E−03	364
Ennis-Flint North, Ennis, TX	0	0	0	0	0	0	0	0	364
Polycoat Products LLC, Bedford, TX	227	227	227	227	0.62	0.62	0.62	0.62	364

Table 3-30. Summary of Air Releases from NEI (2020) for Incorporation into Formulation, Mixture, or Reaction Product

Site Identity	Total Fugitive Air Release (kg/yr)	Daily Fugitive Air Release (kg/day)	Total Stack Air Release (kg/yr)	Daily Stack Air Release (kg/day)	Annual Release Days (days/yr)
Domtar Paper Co/Johnsonburg Mill, Johnsonburg, PA	Fugitive releases not reported	Fugitive releases not reported	Stack releases not reported	Stack releases not reported	364
PCS Phosphate Company, Inc. - Aurora, Aurora, NC	Fugitive releases not reported	Fugitive releases not reported	1.5	2.0E−03	364
International Paper - New Bern Mill, Vanceboro, NC	Fugitive releases not reported	Fugitive releases not reported	3.2E−03	4.4E−06	364
Domtar Paper Company, LLC, Plymouth, NC	Fugitive releases not reported	Fugitive releases not reported	4	5.5E−03	364
Savannah River Nuclear Solutions LLC, Aiken, SC	2.3E−04	3.8E−07	2.3E−03	3.7E−06	309
Domtar Paper Co LLC Marlboro Mill, Bennettsville, SC	Fugitive releases not reported	Fugitive releases not reported	3.7E−02	5.4E−05	347
Domtar Paper Company, LLC - Kingsport Mill, Kingsport, TN	Fugitive releases not reported	Fugitive releases not reported	0.69	9.5E−04	364

Site Identity	Total Fugitive Air Release (kg/yr)	Daily Fugitive Air Release (kg/day)	Total Stack Air Release (kg/yr)	Daily Stack Air Release (kg/day)	Annual Release Days (days/yr)
Resolute Forest Products - Calhoun Operations, Calhoun, TN	Fugitive releases not reported	Fugitive releases not reported	3	4.2E−03	364
GAF Materials Corp, Minneapolis, MN	Fugitive releases not reported	Fugitive releases not reported	9.9E−02	1.4E−04	364
Evergreen Packaging-Pine Bluff, Pine Bluff, AR	0.11	1.5E−04	4.3	5.9E−03	362
ExxonMobil Fuels & Lubricants Co - Baton Rouge Refinery, Baton Rouge, LA	Fugitive releases not reported	Fugitive releases not reported	76	1.0E−01	364
International Paper Co - Mansfield Mill, Mansfield, LA	Fugitive releases not reported	Fugitive releases not reported	1.0E−01	1.4E−04	364
Oxbow Calcining LLC - Baton Rouge Calcined Coke Plant, Baton Rouge, LA	Fugitive releases not reported	Fugitive releases not reported	104	0.14	364
Henkel Corporation, Oak Creek, WI	0	0	Stack releases not reported	Stack releases not reported	364
Westrock CP LLC - Hodge Mill, Hodge, LA	Fugitive releases not reported	Fugitive releases not reported	1.4	1.9E−03	364
Rain CII Carbon LLC - Lake Charles Calcining Plant, Sulphur, LA	Fugitive releases not reported	Fugitive releases not reported	72	0.11	322
Chalmette Refining LLC, Chalmette, LA	Fugitive releases not reported	Fugitive releases not reported	7.2	9.9E−03	364
Marathon Petroleum Company LP - Louisiana Refining Division - Garyville Refinery, Garyville, LA	2.2E−02	3.0E−05	Stack releases not reported	Stack releases not reported	364
Placid Refining Co LLC - Placid Refining Co, Port Allen, LA	0	0	0.5	6.9E−04	364
Rain CII Carbon LLC - Gramercy Coke Plant, Gramercy, LA	Fugitive releases not reported	Fugitive releases not reported	100	0.16	315
Big Spring Refinery, Big Spring, TX	Fugitive releases not reported	Fugitive releases not reported	Stack releases not reported	Stack releases not reported	365
Baytown Refinery, Baytown, TX	Fugitive releases not reported	Fugitive releases not reported	86	0.12	364

Site Identity	Total Fugitive Air Release (kg/yr)	Daily Fugitive Air Release (kg/day)	Total Stack Air Release (kg/yr)	Daily Stack Air Release (kg/day)	Annual Release Days (days/yr)
Orange Mill, Orange, TX	Fugitive releases not reported	Fugitive releases not reported	3.4	4.8E−03	349
Beaumont Refinery, Beaumont, TX	0.18	2.5E−04	56	7.7E−02	365
Sinnett-Elpaco Coatings Corp, Pagedale, MO	0	0	Stack releases not reported	Stack releases not reported	364
Ameron Protective Coat Div (EIS&NSR Use), Brea, CA	0	0	Stack releases not reported	Stack releases not reported	364
Ennis Paint Inc., Salem, Or	2.8	3.9E−03	190	0.26	364
Trumbull Asphalt, Portland, Or	Fugitive releases not reported	Fugitive releases not reported	Stack releases not reported	Stack releases not reported	364
Tesoro Northwest Company, Anacortes, WA	2053	2.8	Stack releases not reported	Stack releases not reported	365
Owens Corning Roofing and Asphalt, LLC, PORTLAND, OR	Fugitive releases not reported	Fugitive releases not reported	0.42	5.8E−04	364
Grace Davison Edison Facility, Edison, NJ	0	0	Stack releases not reported	Stack releases not reported	364
Bayer Crop Science - Institute, Institute, WV	0	0	Stack releases not reported	Stack releases not reported	364
Resolute FP US Inc., Coosa Pines, AL	Fugitive releases not reported	Fugitive releases not reported	2.5	3.5E−03	364
NCFI Polyurethanes, Division of Barnhardt Manufacturing Co., Mount Airy, NC	0	0	Stack releases not reported	Stack releases not reported	364
Georgia-Pacific Crossett Paper Operations, Crossett, AR	Fugitive releases not reported	Fugitive releases not reported	0	0	364
Equilon Enterprises LLC Dba Shell Oil Products US - Convent Refinery, Convent, LA	Fugitive releases not reported	Fugitive releases not reported	36	4.9E−02	364
Certainteed LLC, Jonesburg, MO	Fugitive releases not reported	Fugitive releases not reported	0.51	7.0E−04	364

Site Identity	Total Fugitive Air Release (kg/yr)	Daily Fugitive Air Release (kg/day)	Total Stack Air Release (kg/yr)	Daily Stack Air Release (kg/day)	Annual Release Days (days/yr)
New- Indy Ontario, LLC, Ontario, CA	0.3	4.1E−04	Stack releases not reported	Stack releases not reported	364
Certainteed Corporation, PORTLAND, OR	0.2	2.8E−04	0.22	3.0E−04	364
Tamko Building Products LLC, Tuscaloosa, AL	Fugitive releases not reported	Fugitive releases not reported	0.21	2.9E−04	364
FXI Terrell, Terrell, TX	Fugitive releases not reported	Fugitive releases not reported	0.54	7.5E−04	365
Blue Ridge Paper Products LLC, Canton, NC	Fugitive releases not reported	Fugitive releases not reported	18	2.5E−02	364
Pixelle Spec Solutions LLC/Spring Grove, Spring Grove, PA	Fugitive releases not reported	Fugitive releases not reported	3.6	5.6E−03	325
International Paper Riegelwood Mill, Riegelwood, NC	Fugitive releases not reported	Fugitive releases not reported	4.7E−02	6.4E−05	364
Mylan Technologies Inc, Saint Albans, VT	4.5E−03	6.2E−06	Stack releases not reported	Stack releases not reported	364
Westrock Charleston Kraft LLC, North Charleston, SC	Fugitive releases not reported	Fugitive releases not reported	6.5	9.3E−03	350
Sonoco Products Co, Hartsville, SC	Fugitive releases not reported	Fugitive releases not reported	6.8E−03	9.9E−06	345
International Paper Georgetown Mill, Georgetown, SC	Fugitive releases not reported	Fugitive releases not reported	0.14	1.9E−04	365
International Paper Eastover, Eastover, SC	Fugitive releases not reported	Fugitive releases not reported	7.0E−02	9.6E−05	365
WestRock CP LLC, Florence, SC	Fugitive releases not reported	Fugitive releases not reported	1	1.4E−03	365
New-Indy Catawba LLC, Catawba, SC	Fugitive releases not reported	Fugitive releases not reported	7.2E−02	9.8E−05	365
Blandin Paper Co/MN Power - Rapids Energy Center, Grand Rapids, MN	Fugitive releases not reported	Fugitive releases not reported	Stack releases not reported	Stack releases not reported	364
International Paper - Bogalusa Mill, Bogalusa, LA	Fugitive releases not reported	Fugitive releases not reported	0.14	1.9E−04	364

Site Identity	Total Fugitive Air Release (kg/yr)	Daily Fugitive Air Release (kg/day)	Total Stack Air Release (kg/yr)	Daily Stack Air Release (kg/day)	Annual Release Days (days/yr)
Graphic Packaging International Texarkana Mill, Queen City, TX	Fugitive releases not reported	Fugitive releases not reported	8.6	1.2E−02	365
Mckinley Paper Company, Port Angeles, WA	Fugitive releases not reported	Fugitive releases not reported	1.4E−02	1.9E−05	364
Packaging Corporation of America, Counce, TN	Fugitive releases not reported	Fugitive releases not reported	1.0E−01	1.4E−04	364
Pixelle Specialty Solutions LLC (0671010028), Chillicothe, OH	Fugitive releases not reported	Fugitive releases not reported	3.7E−02	5.2E−05	353
Boise White Paper LLC, International Falls, MN	Fugitive releases not reported	Fugitive releases not reported	0	0	364
International Paper, Pine Hill, AL	Fugitive releases not reported	Fugitive releases not reported	0.14	1.9E−04	364
Tamko Building Products LLC Rangeline Plant, Joplin, MO	Fugitive releases not reported	Fugitive releases not reported	0.28	3.9E−04	364
Chevron Products Company, Richmond, CA	2.8	3.8E−03	Stack releases not reported	Stack releases not reported	364
Muskogee Mill, Muskogee, OK	Fugitive releases not reported	Fugitive releases not reported	2.5	3.4E−03	365
Ahlstrom-Munksjo Na Specialty Solutions, LLC, Kaukauna, WI	Fugitive releases not reported	Fugitive releases not reported	8.9E−03	1.2E−05	364
Nd Paper Inc-Biron Division, Wisconsin Rapids, WI	Fugitive releases not reported	Fugitive releases not reported	1.1E−02	1.6E−05	364
Wisconsin Rapids Mill, Wisconsin Rapids, WI	Fugitive releases not reported	Fugitive releases not reported	1.8E−02	2.5E−05	364
Ahlstrom-Munksjo Mosinee LLC, Mosinee, WI	Fugitive releases not reported	Fugitive releases not reported	6.1E−03	8.4E−06	364
International Paper, Columbus Mill, Columbus, MS	Fugitive releases not reported	Fugitive releases not reported	4.4	6.3E−03	351
Shell Puget Sound Refinery, Anacortes, WA	Fugitive releases not reported	Fugitive releases not reported	13	1.8E−02	365
Pacific Ethanol Pekin Inc, Pekin, IL	Fugitive releases not reported	Fugitive releases not reported	Stack releases not reported	Stack releases not reported	364

Site Identity	Total Fugitive Air Release (kg/yr)	Daily Fugitive Air Release (kg/day)	Total Stack Air Release (kg/yr)	Daily Stack Air Release (kg/day)	Annual Release Days (days/yr)
Torrance Refining Company LLC, Torrance, CA	38	5.2E−02	Stack releases not reported	Stack releases not reported	364

Table 3-31. Summary of Land Releases from TRI for Incorporation into Formulation, Mixture, or Reaction Product

Site Identity	Median Total Release (kg/yr)	Maximum Total Release (kg/yr)	Annual Release Days (days/yr)
American Roller Co LLC, Union Grove, WI	1,161	1,550	364
Hallstar Co Memphis Solutions Facility, Memphis, TN	27	38	364
Henkel US Operations Corp, Oak Creek, WI	113	113	364

Table 3-32. Summary of Water Releases from DMR and TRI for Incorporation into Formulation, Mixture, or Reaction Product

Site Identity	Source-Discharge Type	Median Annual Discharge (kg/yr)	Daily Discharge (Corresponding to Median Annual Discharge) (kg/day)	Maximum Annual Discharge (kg/yr)	Daily Discharge (Corresponding to Maximum Daily Discharge) (kg/day)	Annual Release Days (days/yr)
Republic Powdered Metals Inc, Medina, OH	DMR-Direct Discharges	N/A – facility does not report DMRs	N/A – facility does not report DMRs	N/A – facility does not report DMRs	N/A – facility does not report DMRs	300
Republic Powdered Metals Inc, Medina, OH	TRI-Direct Discharges	227	0.76	227	0.76	300
Republic Powdered Metals Inc, Medina, OH	TRI-Transfers to POTW	227	0.76	227	0.76	300
Republic Powdered Metals Inc, Medina, OH	TRI-Transfers to non-POTW	227	0.76	227	0.76	300
Superior Materials 38, Ann Arbor, MI	DMR-Direct Discharges	N/A – facility does not report DMRs	N/A – facility does not report DMRs	N/A – facility does not report DMRs	N/A – facility does not report DMRs	300

Site Identity	Source-Discharge Type	Median Annual Discharge (kg/yr)	Daily Discharge (Corresponding to Median Annual Discharge) (kg/day)	Maximum Annual Discharge (kg/yr)	Daily Discharge (Corresponding to Maximum Daily Discharge) (kg/day)	Annual Release Days (days/yr)
Superior Materials 38, Ann Arbor, MI	TRI-Direct Discharges	227	0.76	227	0.76	300
Superior Materials 38, Ann Arbor, MI	TRI-Transfers to POTW	227	0.76	227	0.76	300
Superior Materials 38, Ann Arbor, MI	TRI-Transfers to non-POTW	227	0.76	227	0.76	300
EFTEC NA LLC, Taylor, MI	DMR-Direct Discharges	N/A – facility does not report DMRs	N/A – facility does not report DMRs	N/A – facility does not report DMRs	N/A – facility does not report DMRs	300
EFTEC NA LLC, Taylor, MI	TRI-Direct Discharges	227	0.76	227	0.76	300
EFTEC NA LLC, Taylor, MI	TRI-Transfers to POTW	227	0.76	227	0.76	300
EFTEC NA LLC, Taylor, MI	TRI-Transfers to non-POTW	227	0.76	227	0.76	300
Lakeside Plastics Inc, Oshkosh, WI	DMR-Direct Discharges	N/A – facility does not report DMRs	N/A – facility does not report DMRs	N/A – facility does not report DMRs	N/A – facility does not report DMRs	300
Lakeside Plastics Inc, Oshkosh, WI	TRI-Direct Discharges	227	0.76	227	0.76	300
Lakeside Plastics Inc, Oshkosh, WI	TRI-Transfers to POTW	227	0.76	227	0.76	300
Lakeside Plastics Inc, Oshkosh, WI	TRI-Transfers to non-POTW	227	0.76	227	0.76	300
Pico Chemical Corp, Chicago Heights, IL	DMR-Direct Discharges	N/A – facility does not report DMRs	N/A – facility does not report DMRs	N/A – facility does not report DMRs	N/A – facility does not report DMRs	300
Pico Chemical Corp, Chicago Heights, IL	TRI-Direct Discharges	227	0.76	227	0.76	300
Pico Chemical Corp, Chicago Heights, IL	TRI-Transfers to POTW	227	0.76	227	0.76	300

Site Identity	Source-Discharge Type	Median Annual Discharge (kg/yr)	Daily Discharge (Corresponding to Median Annual Discharge) (kg/day)	Maximum Annual Discharge (kg/yr)	Daily Discharge (Corresponding to Maximum Daily Discharge) (kg/day)	Annual Release Days (days/yr)
Pico Chemical Corp, Chicago Heights, IL	TRI-Transfers to non-POTW	227	0.76	227	0.76	300
Grace -Pasadena Catalyst Site, Pasadena, TX	DMR-Direct Discharges	N/A – facility does not report DMRs	N/A – facility does not report DMRs	N/A – facility does not report DMRs	N/A – facility does not report DMRs	300
Grace -Pasadena Catalyst Site, Pasadena, TX	TRI-Direct Discharges	227	0.76	227	0.76	300
Grace -Pasadena Catalyst Site, Pasadena, TX	TRI-Transfers to POTW	227	0.76	227	0.76	300
Grace -Pasadena Catalyst Site, Pasadena, TX	TRI-Transfers to non-POTW	227	0.76	227	0.76	300
International Coatings Co Inc., Cerritos, CA	DMR-Direct Discharges	N/A – facility does not report DMRs	N/A – facility does not report DMRs	N/A – facility does not report DMRs	N/A – facility does not report DMRs	300
International Coatings Co Inc., Cerritos, CA	TRI-Direct Discharges	227	0.76	227	0.76	300
International Coatings Co Inc., Cerritos, CA	TRI-Transfers to POTW	227	0.76	227	0.76	300
International Coatings Co Inc., Cerritos, CA	TRI-Transfers to non-POTW	227	0.76	227	0.76	300
Akron Dispersions Inc Copley Oh, Copley, OH	DMR-Direct Discharges	N/A – facility does not report DMRs	N/A – facility does not report DMRs	N/A – facility does not report DMRs	N/A – facility does not report DMRs	300
Akron Dispersions Inc Copley Oh, Copley, OH	TRI-Direct Discharges	227	0.76	227	0.76	300
Akron Dispersions Inc Copley Oh, Copley, OH	TRI-Transfers to POTW	227	0.76	227	0.76	300
Akron Dispersions Inc Copley Oh, Copley, OH	TRI-Transfers to non-POTW	227	0.76	227	0.76	300

Site Identity	Source-Discharge Type	Median Annual Discharge (kg/yr)	Daily Discharge (Corresponding to Median Annual Discharge) (kg/day)	Maximum Annual Discharge (kg/yr)	Daily Discharge (Corresponding to Maximum Daily Discharge) (kg/day)	Annual Release Days (days/yr)
Polycoat Products LLC, Bedford, TX	DMR-Direct Discharges	N/A – facility does not report DMRs	N/A – facility does not report DMRs	N/A – facility does not report DMRs	N/A – facility does not report DMRs	300
Polycoat Products LLC, Bedford, TX	TRI-Direct Discharges	227	0.76	227	0.76	300
Polycoat Products LLC, Bedford, TX	TRI-Transfers to POTW	227	0.76	227	0.76	300
Polycoat Products LLC, Bedford, TX	TRI-Transfers to non-POTW	227	0.76	227	0.76	300
Altivia Services, LLC, Kanawha, WV	DMR-Direct Discharges	1.4	4.8E−03	3.4	1.1E−02	300
Altivia Services, LLC, Kanawha, WV	TRI-Direct Discharges	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	300
Altivia Services, LLC, Kanawha, WV	TRI-Transfers to POTW	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	300
Altivia Services, LLC, Kanawha, WV	TRI-Transfers to non-POTW	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	300
Archroma Us Inc Martin Plant, Allendale, SC	DMR-Direct Discharges	7.6	2.5E−02	7.6	2.5E−02	300
Archroma Us Inc Martin Plant, Allendale, SC	TRI-Direct Discharges	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	300
Archroma Us Inc Martin Plant, Allendale, SC	TRI-Transfers to POTW	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	300
Archroma Us Inc Martin Plant, Allendale, SC	TRI-Transfers to non-POTW	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	300
Arkema Inc, Livingston, NY	DMR-Direct Discharges	0.54	1.8E−03	0.54	1.8E−03	300

Site Identity	Source-Discharge Type	Median Annual Discharge (kg/yr)	Daily Discharge (Corresponding to Median Annual Discharge) (kg/day)	Maximum Annual Discharge (kg/yr)	Daily Discharge (Corresponding to Maximum Daily Discharge) (kg/day)	Annual Release Days (days/yr)
Arkema Inc, Livingston, NY	TRI-Direct Discharges	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	300
Arkema Inc, Livingston, NY	TRI-Transfers to POTW	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	300
Arkema Inc, Livingston, NY	TRI-Transfers to non-POTW	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	300
BASF Corp, Washington, AL	DMR-Direct Discharges	100	0.33	100	0.33	300
BASF Corp, Washington, AL	TRI-Direct Discharges	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	300
BASF Corp, Washington, AL	TRI-Transfers to POTW	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	300
BASF Corp, Washington, AL	TRI-Transfers to non-POTW	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	300
Bio-Lab, Inc., A Chemtura Company, Calcasieu, LA	DMR-Direct Discharges	2.8	9.3E−03	2.8	9.3E−03	300
Bio-Lab, Inc., A Chemtura Company, Calcasieu, LA	TRI-Direct Discharges	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	300
Bio-Lab, Inc., A Chemtura Company, Calcasieu, LA	TRI-Transfers to POTW	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	300
Bio-Lab, Inc., A Chemtura Company, Calcasieu, LA	TRI-Transfers to non-POTW	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	300
Chemours-Chambers Works, Salem, NJ	DMR-Direct Discharges	3.6	1.2E−02	3.9	1.3E−02	300
Chemours-Chambers Works, Salem, NJ	TRI-Direct Discharges	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	300

Site Identity	Source-Discharge Type	Median Annual Discharge (kg/yr)	Daily Discharge (Corresponding to Median Annual Discharge) (kg/day)	Maximum Annual Discharge (kg/yr)	Daily Discharge (Corresponding to Maximum Daily Discharge) (kg/day)	Annual Release Days (days/yr)
Chemours-Chambers Works, Salem, NJ	TRI-Transfers to POTW	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	300
Chemours-Chambers Works, Salem, NJ	TRI-Transfers to non-POTW	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	300
Chemtura Corp - North Plant, Monongalia, WV	DMR-Direct Discharges	0.46	1.5E−03	0.46	1.5E−03	300
Chemtura Corp - North Plant, Monongalia, WV	TRI-Direct Discharges	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	300
Chemtura Corp - North Plant, Monongalia, WV	TRI-Transfers to POTW	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	300
Chemtura Corp - North Plant, Monongalia, WV	TRI-Transfers to non-POTW	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	300
Chevron Oronite Co LLC - Oak Point Plant, Plaquemines, LA	DMR-Direct Discharges	0.3	1.0E−03	0.3	1.0E−03	300
Chevron Oronite Co LLC - Oak Point Plant, Plaquemines, LA	TRI-Direct Discharges	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	300
Chevron Oronite Co LLC - Oak Point Plant, Plaquemines, LA	TRI-Transfers to POTW	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	300
Chevron Oronite Co LLC - Oak Point Plant, Plaquemines, LA	TRI-Transfers to non-POTW	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	300
Conroe Facility, Montgomery, TX	DMR-Direct Discharges	1.4	4.7E−03	1.9	6.3E−03	300
Conroe Facility, Montgomery, TX	TRI-Direct Discharges	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	300

Site Identity	Source-Discharge Type	Median Annual Discharge (kg/yr)	Daily Discharge (Corresponding to Median Annual Discharge) (kg/day)	Maximum Annual Discharge (kg/yr)	Daily Discharge (Corresponding to Maximum Daily Discharge) (kg/day)	Annual Release Days (days/yr)
Conroe Facility, Montgomery, TX	TRI-Transfers to POTW	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	300
Conroe Facility, Montgomery, TX	TRI-Transfers to non-POTW	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	300
Detrex Corporation, Ashtabula Plant (0204010192), Ashtabula, OH	DMR-Direct Discharges	19	6.4E−02	19	6.4E−02	300
Detrex Corporation, Ashtabula Plant (0204010192), Ashtabula, OH	TRI-Direct Discharges	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	300
Detrex Corporation, Ashtabula Plant (0204010192), Ashtabula, OH	TRI-Transfers to POTW	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	300
Detrex Corporation, Ashtabula Plant (0204010192), Ashtabula, OH	TRI-Transfers to non-POTW	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	300
E I Dupont De Nemours - Agricultural Products, Mobile, AL	DMR-Direct Discharges	4.0	1.3E−02	4.2	1.4E−02	300
E I Dupont De Nemours - Agricultural Products, Mobile, AL	TRI-Direct Discharges	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	300

Site Identity	Source-Discharge Type	Median Annual Discharge (kg/yr)	Daily Discharge (Corresponding to Median Annual Discharge) (kg/day)	Maximum Annual Discharge (kg/yr)	Daily Discharge (Corresponding to Maximum Daily Discharge) (kg/day)	Annual Release Days (days/yr)
E I Dupont De Nemours - Agricultural Products, Mobile, AL	TRI-Transfers to POTW	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	300
E I Dupont De Nemours - Agricultural Products, Mobile, AL	TRI-Transfers to non-POTW	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	300
Eastman Chemical - Texas Operations, Harrison and Gregg Counties, TX	DMR-Direct Discharges	5.0	1.7E−02	6.6	2.2E−02	300
Eastman Chemical - Texas Operations, Harrison and Gregg Counties, TX	TRI-Direct Discharges	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	300
Eastman Chemical - Texas Operations, Harrison and Gregg Counties, TX	TRI-Transfers to POTW	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	300
Eastman Chemical - Texas Operations, Harrison and Gregg Counties, TX	TRI-Transfers to non-POTW	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	300
Elementis Specialties, Inc., Kanawha, WV	DMR-Direct Discharges	7.9	2.6E−02	8.5	2.8E−02	300
Elementis Specialties, Inc., Kanawha, WV	TRI-Direct Discharges	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	300
Elementis Specialties, Inc., Kanawha, WV	TRI-Transfers to POTW	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	300
Elementis Specialties, Inc., Kanawha, WV	TRI-Transfers to non-POTW	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	300
Enterprise Mont Belvieu Fm 1942 Complex, Chambers, TX	DMR-Direct Discharges	0.55	1.8E−03	0.55	1.8E−03	300

Site Identity	Source-Discharge Type	Median Annual Discharge (kg/yr)	Daily Discharge (Corresponding to Median Annual Discharge) (kg/day)	Maximum Annual Discharge (kg/yr)	Daily Discharge (Corresponding to Maximum Daily Discharge) (kg/day)	Annual Release Days (days/yr)
Enterprise Mont Belvieu Fm 1942 Complex, Chambers, TX	TRI-Direct Discharges	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	300
Enterprise Mont Belvieu Fm 1942 Complex, Chambers, TX	TRI-Transfers to POTW	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	300
Enterprise Mont Belvieu Fm 1942 Complex, Chambers, TX	TRI-Transfers to non-POTW	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	300
Enterprise Pasadena Plant, Harris, TX	DMR-Direct Discharges	0.83	2.8E−03	0.83	2.8E−03	300
Enterprise Pasadena Plant, Harris, TX	TRI-Direct Discharges	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	300
Enterprise Pasadena Plant, Harris, TX	TRI-Transfers to POTW	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	300
Enterprise Pasadena Plant, Harris, TX	TRI-Transfers to non-POTW	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	300
Evonik Degussa Corp, Mobile, AL	DMR-Direct Discharges	2.5	8.3E−03	4.6	1.5E−02	300
Evonik Degussa Corp, Mobile, AL	TRI-Direct Discharges	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	300
Evonik Degussa Corp, Mobile, AL	TRI-Transfers to POTW	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	300
Evonik Degussa Corp, Mobile, AL	TRI-Transfers to non-POTW	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	300
Great Lakes Chemical Corp., Putnam, WV	DMR-Direct Discharges	0.46	1.5E−03	0.46	1.5E−03	300

Site Identity	Source-Discharge Type	Median Annual Discharge (kg/yr)	Daily Discharge (Corresponding to Median Annual Discharge) (kg/day)	Maximum Annual Discharge (kg/yr)	Daily Discharge (Corresponding to Maximum Daily Discharge) (kg/day)	Annual Release Days (days/yr)
Great Lakes Chemical Corp., Putnam, WV	TRI-Direct Discharges	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	300
Great Lakes Chemical Corp., Putnam, WV	TRI-Transfers to POTW	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	300
Great Lakes Chemical Corp., Putnam, WV	TRI-Transfers to non-POTW	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	300
Hexion Inc., Louisville, KY, Jefferson, KY	DMR-Direct Discharges	1.2	4.1E−03	1.2	4.1E−03	300
Hexion Inc., Louisville, KY, Jefferson, KY	TRI-Direct Discharges	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	300
Hexion Inc., Louisville, KY, Jefferson, KY	TRI-Transfers to POTW	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	300
Hexion Inc., Louisville, KY, Jefferson, KY	TRI-Transfers to non-POTW	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	300
ICL-North America Inc - Gallipolis Ferry Plant, Mason, WV	DMR-Direct Discharges	0.44	1.5E−03	1.2	4.1E−03	300
ICL -North America Inc - Gallipolis Ferry Plant, Mason, WV	TRI-Direct Discharges	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	300
ICL -North America Inc - Gallipolis Ferry Plant, Mason, WV	TRI-Transfers to POTW	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	300
ICL -North America Inc - Gallipolis Ferry Plant, Mason, WV	TRI-Transfers to non-POTW	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	300

Site Identity	Source-Discharge Type	Median Annual Discharge (kg/yr)	Daily Discharge (Corresponding to Median Annual Discharge) (kg/day)	Maximum Annual Discharge (kg/yr)	Daily Discharge (Corresponding to Maximum Daily Discharge) (kg/day)	Annual Release Days (days/yr)
Indorama Ventures Olefins LLC - Westlake Ethylene Plant, Calcasieu, LA	DMR-Direct Discharges	0.33	1.1E−03	0.33	1.1E−03	300
Indorama Ventures Olefins LLC - Westlake Ethylene Plant, Calcasieu, LA	TRI-Direct Discharges	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	300
Indorama Ventures Olefins LLC - Westlake Ethylene Plant, Calcasieu, LA	TRI-Transfers to POTW	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	300
Indorama Ventures Olefins LLC - Westlake Ethylene Plant, Calcasieu, LA	TRI-Transfers to non-POTW	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	300
KMTEX, Jefferson, TX	DMR-Direct Discharges	0.22	7.2E−04	0.22	7.2E−04	300
KMTEX, Jefferson, TX	TRI-Direct Discharges	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	300
KMTEX, Jefferson, TX	TRI-Transfers to POTW	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	300
KMTEX, Jefferson, TX	TRI-Transfers to non-POTW	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	300
Koppers Follansbee Tar Plant, Brooke, WV	DMR-Direct Discharges	0.40	1.3E−03	0.54	1.8E−03	300
Koppers Follansbee Tar Plant, Brooke, WV	TRI-Direct Discharges	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	300
Koppers Follansbee Tar Plant, Brooke, WV	TRI-Transfers to POTW	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	300
Koppers Follansbee Tar Plant, Brooke, WV	TRI-Transfers to non-POTW	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	300

Site Identity	Source-Discharge Type	Median Annual Discharge (kg/yr)	Daily Discharge (Corresponding to Median Annual Discharge) (kg/day)	Maximum Annual Discharge (kg/yr)	Daily Discharge (Corresponding to Maximum Daily Discharge) (kg/day)	Annual Release Days (days/yr)
Millennium Inorganic Chemicals, Inc, Ashtabula, OH	DMR-Direct Discharges	323	1.1	891	3.0	300
Millennium Inorganic Chemicals, Inc, Ashtabula, OH	TRI-Direct Discharges	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	300
Millennium Inorganic Chemicals, Inc, Ashtabula, OH	TRI-Transfers to POTW	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	300
Millennium Inorganic Chemicals, Inc, Ashtabula, OH	TRI-Transfers to non-POTW	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	300
Mittal Steel USA Weirton Inc, Hancock, WV	DMR-Direct Discharges	15	4.9E−02	7,986	27	300
Mittal Steel USA Weirton Inc, Hancock, WV	TRI-Direct Discharges	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	300
Mittal Steel USA Weirton Inc, Hancock, WV	TRI-Transfers to POTW	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	300
Mittal Steel USA Weirton Inc, Hancock, WV	TRI-Transfers to non-POTW	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	300
Nova Chemicals Olefins LLC - Geismar Ethylene Plant, Ascension, LA	DMR-Direct Discharges	23	7.7E−02	23	7.7E−02	300
Nova Chemicals Olefins LLC - Geismar Ethylene Plant, Ascension, LA	TRI-Direct Discharges	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	300

Site Identity	Source-Discharge Type	Median Annual Discharge (kg/yr)	Daily Discharge (Corresponding to Median Annual Discharge) (kg/day)	Maximum Annual Discharge (kg/yr)	Daily Discharge (Corresponding to Maximum Daily Discharge) (kg/day)	Annual Release Days (days/yr)
Nova Chemicals Olefins LLC - Geismar Ethylene Plant, Ascension, LA	TRI-Transfers to POTW	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	300
Nova Chemicals Olefins LLC - Geismar Ethylene Plant, Ascension, LA	TRI-Transfers to non-POTW	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	300
Pactiv Corp, Tehama, CA	DMR-Direct Discharges	0.25	8.3E−04	0.25	8.3E−04	300
Pactiv Corp, Tehama, CA	TRI-Direct Discharges	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	300
Pactiv Corp, Tehama, CA	TRI-Transfers to POTW	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	300
Pactiv Corp, Tehama, CA	TRI-Transfers to non-POTW	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	300
Radford Army Ammunition Plant, Montgomery, VA	DMR-Direct Discharges	37	0.12	37	0.12	300
Radford Army Ammunition Plant, Montgomery, VA	TRI-Direct Discharges	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	300
Radford Army Ammunition Plant, Montgomery, VA	TRI-Transfers to POTW	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	300
Radford Army Ammunition Plant, Montgomery, VA	TRI-Transfers to non-POTW	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	300
Sappi North America, Inc. - Westbrook, Cumberland, ME	DMR-Direct Discharges	4.1	1.4E−02	11	3.7E−02	300

Site Identity	Source-Discharge Type	Median Annual Discharge (kg/yr)	Daily Discharge (Corresponding to Median Annual Discharge) (kg/day)	Maximum Annual Discharge (kg/yr)	Daily Discharge (Corresponding to Maximum Daily Discharge) (kg/day)	Annual Release Days (days/yr)
Sappi North America, Inc. - Westbrook, Cumberland, ME	TRI-Direct Discharges	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	300
Sappi North America, Inc. - Westbrook, Cumberland, ME	TRI-Transfers to POTW	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	300
Sappi North America, Inc. - Westbrook, Cumberland, ME	TRI-Transfers to non-POTW	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	300
Sasol Chem USA LLC/Oil City, Venango, PA	DMR-Direct Discharges	0.38	1.3E−03	0.38	1.3E−03	300
Sasol Chem USA LLC/Oil City, Venango, PA	TRI-Direct Discharges	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	300
Sasol Chem USA LLC/Oil City, Venango, PA	TRI-Transfers to POTW	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	300
Sasol Chem USA LLC/Oil City, Venango, PA	TRI-Transfers to non-POTW	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	300
Sochem Solutions Inc - Sochem Naphthenic Acid Recovery Facility, West Baton Rouge, LA	DMR-Direct Discharges	2.1	7.1E−03	4.1	1.4E−02	300
Sochem Solutions Inc - Sochem Naphthenic Acid Recovery Facility, West Baton Rouge, LA	TRI-Direct Discharges	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	300

Site Identity	Source-Discharge Type	Median Annual Discharge (kg/yr)	Daily Discharge (Corresponding to Median Annual Discharge) (kg/day)	Maximum Annual Discharge (kg/yr)	Daily Discharge (Corresponding to Maximum Daily Discharge) (kg/day)	Annual Release Days (days/yr)
Sochem Solutions Inc - Sochem Naphthenic Acid Recovery Facility, West Baton Rouge, LA	TRI-Transfers to POTW	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	300
Sochem Solutions Inc - Sochem Naphthenic Acid Recovery Facility, West Baton Rouge, LA	TRI-Transfers to non-POTW	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	300
South Louisiana Ethanol LLC, Plaquemines, LA	DMR-Direct Discharges	3.4	1.1E−02	3.4	1.1E−02	300
South Louisiana Ethanol LLC, Plaquemines, LA	TRI-Direct Discharges	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	300
South Louisiana Ethanol LLC, Plaquemines, LA	TRI-Transfers to POTW	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	300
South Louisiana Ethanol LLC, Plaquemines, LA	TRI-Transfers to non-POTW	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	300
Stepan Co, Will, IL	DMR-Direct Discharges	2.2	7.2E−03	3.4	1.1E−02	300
Stepan Co, Will, IL	TRI-Direct Discharges	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	300
Stepan Co, Will, IL	TRI-Transfers to POTW	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	300
Stepan Co, Will, IL	TRI-Transfers to non-POTW	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	300
Total Petrochemicals Styrene Monomer Plant, Iberville, LA	DMR-Direct Discharges	0.66	2.2E−03	0.66	2.2E−03	300

Site Identity	Source-Discharge Type	Median Annual Discharge (kg/yr)	Daily Discharge (Corresponding to Median Annual Discharge) (kg/day)	Maximum Annual Discharge (kg/yr)	Daily Discharge (Corresponding to Maximum Daily Discharge) (kg/day)	Annual Release Days (days/yr)
Total Petrochemicals Styrene Monomer Plant, Iberville, LA	TRI-Direct Discharges	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	300
Total Petrochemicals Styrene Monomer Plant, Iberville, LA	TRI-Transfers to POTW	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	300
Total Petrochemicals Styrene Monomer Plant, Iberville, LA	TRI-Transfers to non-POTW	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	300
Tronox LLC, Clark, NV	DMR-Direct Discharges	3.6	1.2E−02	4.1	1.4E−02	300
Tronox LLC, Clark, NV	TRI-Direct Discharges	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	300
Tronox LLC, Clark, NV	TRI-Transfers to POTW	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	300
Tronox LLC, Clark, NV	TRI-Transfers to non-POTW	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	300
U.S. Amines (Bucks) LLC, Mobile, AL	DMR-Direct Discharges	5.7	1.9E−02	7.6	2.5E−02	300
U.S. Amines (Bucks) LLC, Mobile, AL	TRI-Direct Discharges	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	300
U.S. Amines (Bucks) LLC, Mobile, AL	TRI-Transfers to POTW	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	300
U.S. Amines (Bucks) LLC, Mobile, AL	TRI-Transfers to non-POTW	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	300
U.S. Steel Corporation - Fairfield Works, Jefferson, AL	DMR-Direct Discharges	7.5	2.5E−02	15	5.1E−02	300

Site Identity	Source-Discharge Type	Median Annual Discharge (kg/yr)	Daily Discharge (Corresponding to Median Annual Discharge) (kg/day)	Maximum Annual Discharge (kg/yr)	Daily Discharge (Corresponding to Maximum Daily Discharge) (kg/day)	Annual Release Days (days/yr)
U.S. Steel Corporation - Fairfield Works, Jefferson, AL	TRI-Direct Discharges	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	300
U.S. Steel Corporation - Fairfield Works, Jefferson, AL	TRI-Transfers to POTW	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	300
U.S. Steel Corporation - Fairfield Works, Jefferson, AL	TRI-Transfers to non-POTW	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	300
USS-Posco Industries, Contra Costa, CA	DMR-Direct Discharges	0.23	7.8E−04	0.23	7.8E−04	300
USS-Posco Industries, Contra Costa, CA	TRI-Direct Discharges	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	300
USS-Posco Industries, Contra Costa, CA	TRI-Transfers to POTW	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	300
USS-Posco Industries, Contra Costa, CA	TRI-Transfers to non-POTW	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	300

3.5.4 Occupational Exposure Assessment

3.5.4.1 Worker Activities

During the incorporation of DEHP into formulation, mixture, or reaction product, workers may be exposed to DEHP when unloading transport containers, packaging final products, cleaning transport containers, product sampling, cleaning reaction vessels or other equipment, and during filter media change out (U.S. EPA, 2014b). These activities are all potential sources of worker exposure via inhalation of vapor or dermal contact with liquids. EPA did not find information that indicates the extent that engineering controls and worker PPE are used at facilities that incorporate DEHP into formulations, mixtures, or reaction products.

For this OES, ONUs may include supervisors, managers, and other employees that work in the formulation area but do not directly contact DEHP that is received or processed onsite or handle the formulated product. ONUs are potentially exposed via inhalation routes to airborne and settled dust while in the working area.

3.5.4.2 Occupational Inhalation Exposure Results

No references with full shift samples were identified for this OES through systematic review; however, data were available for a similar OES (Manufacturing). The Manufacturing and Incorporation into formulation, mixture, or reaction product OESs are expected to have similar exposure potential based on the similarity of worker activities and chemical physical form. Therefore, EPA assessed worker and ONU exposures using monitoring data for the Manufacturing OES as a surrogate for the Incorporation into formulation, mixture, or reaction product OES. These data had data quality ratings ranging from medium to high, meaning they are of acceptable quality. These results are presented in Table 3-33. There is some uncertainty in how well these surrogate data approximate exposures for this OES such as the throughputs, chemical concentrations, process conditions (temperatures, pressures, feed rates), and engineering controls used; however, EPA does not expect these differences to significantly impact exposure results. Additional discussion on the uncertainty and limitations of these data are included in the weight of scientific evidence 4.2. The *Occupational Inhalation Exposure Data for Diethylhexyl Phthalate (DEHP)* contains additional information about the calculation results; refer to Appendix J for a reference to this supplemental document.

Table 3-33. Summary of Estimated Worker Inhalation Exposures for Incorporation into Formulation, Mixture, or Reaction Product

Worker Population	Exposure Concentration Type	Central Tendency	High-End
Average Adult Worker	8-hour TWA Exposure Concentration (mg/m^3)	1.2E−02	2.2E−02
	Acute (AD, mg/kg-day)	1.5E−03	2.8E−03
	Intermediate (IADD, mg/kg-day)	1.1E−03	2.0E−03
	Chronic, Non-Cancer (ADD, mg/kg-day)	1.0E−03	1.9E−03
Female of Reproductive Age	8-hour TWA Exposure Concentration (mg/m^3)	1.2E−02	2.2E−02
	Acute (AD, mg/kg-day)	1.7E−03	3.0E−03
	Intermediate (IADD, mg/kg-day)	1.2E−03	2.2E−03
	Chronic, Non-Cancer (ADD, mg/kg-day)	1.1E−03	2.1E−03
ONU	8-hour TWA Exposure Concentration (mg/m^3)	1.2E−02	1.2E−02
	Acute (AD, mg/kg-day)	1.5E−03	
	Intermediate (IADD, mg/kg-day)	1.1E−03	

Worker Population	Exposure Concentration Type	Central Tendency	High-End
	Chronic, Non-Cancer (ADD, mg/kg-day)	1.0E−03	

3.5.4.3 Occupational Dermal Exposure Results

EPA estimated dermal exposures for this OES using the methodology outlined in Appendix C. The various "Exposure Concentration Types" from Table 3-34 are explained in Appendix A. Because dermal exposures to workers may occur in the neat liquid form during incorporation into formulations, mixtures, or reaction products, EPA assessed the absorptive flux of DEHP according to the dermal absorption data of liquid DEHP (see Appendix C.2.1.1 for details). Table 3-34 summarizes the APDR, the AD, the IADD, and the ADD for both average adult workers and female workers of reproductive age. Because dust or mist are not expected to be deposited on surfaces from this OES, EPA did not assess dermal exposures to ONUs from contact with surfaces. Dermal exposure parameters are described in Appendix C. The *Occupational Dermal Exposure Modeling Results for Diethylhexyl Phthalate (DEHP)* also contains information about model equations and parameters and contains calculation results; refer to Appendix J for a reference to this supplemental document.

Table 3-34. Summary of Estimated Worker Dermal Exposures for Incorporation into Formulation, Mixture, or Reaction Product

Worker Population	Exposure Concentration Type	Central Tendency	High-End
Average Adult Worker	Dose Rate (APDR, mg/day)	5.6E−03	1.1E−02
	Acute (AD, mg/kg-day)	7.0E−05	1.4E−04
	Intermediate (IADD, mg/kg-day)	5.1E−05	1.0E−04
	Chronic, Non-Cancer (ADD, mg/kg-day)	4.8E−05	9.5E−05
Female of Reproductive Age	Dose Rate (APDR, mg/day)	5.6E−03	1.0E−02
	Acute (AD, mg/kg-day)	6.4E−05	1.3E−04
	Intermediate (IADD, mg/kg-day)	4.7E−05	9.4E−05
	Chronic, Non-Cancer (ADD, mg/kg-day)	4.4E−05	8.8E−05

3.5.4.4 Occupational Aggregate Exposure Results

Inhalation and dermal exposure estimates were aggregated based on the approach described in Appendix A to arrive at the aggregate worker and ONU exposure estimates in the table below. The *Occupational Risk Calculator for Diethylhexyl Phthalate (DEHP)* (U.S. EPA, 2025e) contains the calculations of aggregate exposure; refer to Appendix J for a reference to this supplemental document.

Table 3-35. Summary of Estimated Worker Aggregate Exposures for Incorporation into Formulation, Mixture, or Reaction Product

Modeled Scenario	Exposure Concentration Type (mg/kg/day)	Central Tendency	High-End
Average Adult Worker	Acute (AD, mg/kg-day)	1.6E−03	2.9E−03
	Intermediate (IADD, mg/kg-day)	1.2E−03	2.1E−03
	Chronic, Non-Cancer (ADD, mg/kg-day)	1.1E−03	2.0E−03
Female of Reproductive Age	Acute (AD, mg/kg-day)	1.7E−03	3.2E−03
	Intermediate (IADD, mg/kg-day)	1.3E−03	2.3E−03
	Chronic, Non-Cancer (ADD, mg/kg-day)	1.2E−03	2.2E−03
ONU	Acute (AD, mg/kg-day)	1.5E−03	
	Intermediate (IADD, mg/kg-day)	1.1E−03	
	Chronic, Non-Cancer (ADD, mg/kg-day)	1.0E−03	

3.6 Repackaging

3.6.1 Process Description

In general, chemicals 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. Chemicals may be repackaged by wholesalers for resale, from bulk packaging into smaller containers, such as drums or bottles. Chemicals can be received via import or through domestic manufacturers. The type and size of the container will vary depending on customer requirement. In some cases, QC samples may be taken at import and repackaging sites for analyses. Some import facilities may only serve as storage and distribution locations, and repackaging/sampling may not occur at all import facilities (U.S. EPA, 2022a; Tomer and Kane, 2015).

The quantity of DEHP imported into the United States varied by year as follows: 570,000 pounds (1977), 11,290,000 pounds (1978), and 3,246,000 pounds (1979) (Kozumbo et al., 1982). More recent data puts the amount of imported DEHP at 4,000,000 pounds in 1998 and approximately 10,000,000 pounds in 2019 (U.S. EPA, 2020a; ATSDR, 2002). The 2020 CDR reports the import of DEHP by 17 importers (U.S. EPA, 2020a). Of the sites reporting to the 2020 CDR, 14 indicated importing DEHP in liquid form. DEHP was reported to be imported at concentrations ranging from 1 to 100 percent by weight. The physical form of the repackaged DEHP end product is liquid or pellets/large crystals (U.S. CPSC, 2015). Sources indicate that the purity of commercial DEHP is 99.0 to 99.6 percent (IARC, 1982). EPA did not identify data on facility operating schedules; therefore, EPA assumed 250 days/yr of operation. The physical form and concentration of DEHP reported by import facilities in the 2020 CDR are summarized in Table 3-36 below (U.S. EPA, 2020a).

Table 3-36. DEHP Concentrations Reported in 2020 CDR

Data Source	DEHP Concentration (wt%)	Physical Form	Number of Facilities Reporting this Concentration	Reported Activity (Manufacture or Import)
2020 CDR	90%+	Liquid	7	Import
		NKRA or left blank	1	
2020 CDR	60–90%	Liquid	1	Import
2020 CDR	30–60%	Pellets or Large Crystals	1	Import
2020 CDR	1–30%	Liquid	1	Import
2020 CDR	NKRA or left blank	Liquid	5	Import
		NKRA or left blank	1	

The container sizes are not included in CDR. According to the 2021 Chemical Repackaging GS DEHP can be imported in drums or larger bulk containers such as, supersacks, totes, or railcars. At typical repackaging sites, chemicals, including DEHP, were repackaged at rates ranging from 1 to 315,479 kg/site-year, with a 50th percentile of 7,000 kg/site-year and a 95th percentile of 42,000 kg/site-year (U.S. EPA, 2022a).

The 2021 Chemical Repackaging GS presents a generic flowchart for chemical repackaging scenarios and shows the different exposure and release points in the process. Repackaging operations for liquid chemicals typically involve pumping or pouring the chemical from the original larger container into a new smaller container (U.S. EPA, 2022a). Chemicals are typically received at repackaging sites in larger bulk containers or drums. Exposures and releases are expected to occur at facilities that repackage domestically manufactured DEHP, as well as at facilities that repackage and import DEHP. Exposures and releases during repackaging are not expected to occur at facilities that import but do not repackage DEHP. Figure 3-6 provides an illustration of the import and repackaging process.

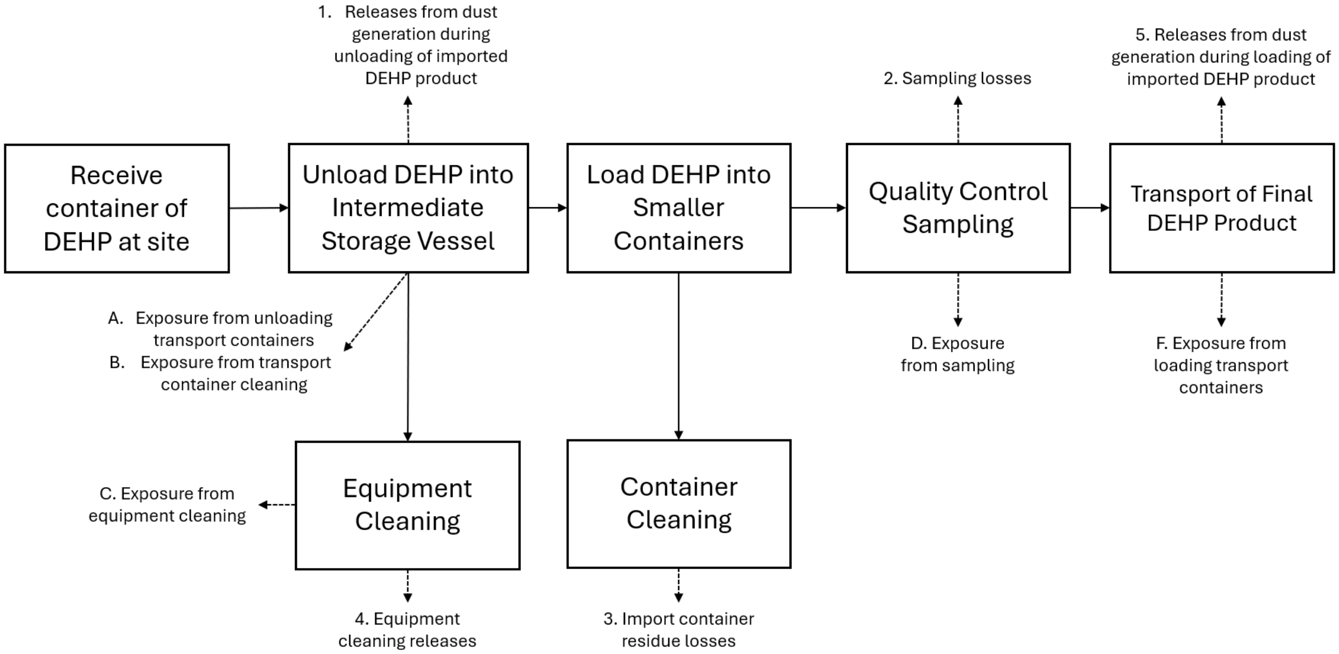


Figure 3-6. Import and Repackaging Flow Diagram (U.S. EPA, 2022a)

3.6.2 Facility Estimates

In the 2020 CDR, 5 sites – Shrieve Chemical Company, LLC; Brenntag Mid-South Inc, Elyria Distribution Ctr.; Tricon International, LTD; and GJ Chemical CO Inc – reported using DEHP in repackaging. In the NEI (U.S. EPA, 2022e), DMR (U.S. EPA, 2022c), and TRI (U.S. EPA, 2022f) data that EPA analyzed, EPA identified an additional 46 unique sites which it assessed as repackaging DEHP. For air, 24 sites reported to TRI and 16 reported to NEI. For water, 19 sites reported to TRI and eight reported to DMR. For land, one site reported to TRI. The total number of sites reporting air, water, and land releases can be larger than the number of unique sites due to the overlap of facilities between reporting databases. EPA identified operating days ranging from 350 to 365 days/yr through NEI air release data. TRI/DMR do not report operating days; therefore, EPA assumed 260 days/yr of operation based on the *Repackaging GS Revised Draft*, as discussed in Section 2.3.2 (U.S. EPA, 2022a). Table 3-37 presents the production volume of DEHP repackaging sites.

Table 3-37. Production Volume of DEHP Repackaging Sites, 2020 CDR

DEHP Repackaging Site, Site Location	2019 Reported Production Volume (kg/yr)
GJ Chemical Co Inc, Newark, NJ	260,596
Brenntag Mid-South Inc, Henderson, KY	172,096
Elyria Distribution Ctr, Elyria, OH	–
Shrieve Chemical Company LLC, Spring, TX	CBI
Tricon International LTD, Houston, TX	–

EPA evaluated the production volumes for sites that reported this information as CBI by subtracting known production volumes for other manufacturing and import sites from the total DEHP production volume reported to the 2020 CDR. EPA considered production volumes for both import and manufacturing sites because the annual DEHP production volume in the CDR includes both domestic manufacture and repackaging. The 2020 CDR reported a range of national production volume for DEHP; therefore, EPA provided the import and repackaging production volume as a range. EPA split the remaining production volume range evenly across all sites that reported this information as CBI. The calculated production volume range for the unknown sites resulted in 186,653 to 1,002,979 kg/site-yr. Releases from these sites are not included in the release estimates due to a lack of DEHP repackaging facilities reporting releases.

3.6.3 Release Assessment

3.6.3.1 Environmental Release Points

Based on TRI (U.S. EPA, 2022f), DMR (U.S. EPA, 2022c), and NEI (U.S. EPA, 2022e) data, Repackaging releases may go to stack air, fugitive air, surface water, and POTW. Additional releases may occur from transfers of wastes to off-site treatment facilities (assessed in the waste handling OES). Releases to POTW or incineration may occur from sampling, container residue, and equipment cleaning. Fugitive air, stack air, surface water, and incineration releases may occur from loading and unloading transport containers. Additional fugitive air releases may occur from leakage of pipes, flanges, and accessories used for transport.

3.6.3.2 Environmental Release Assessment

Table 3-38 presents fugitive and stack air releases per year and per day for repackaging based on the 2017 to 2022 TRI (U.S. EPA, 2022f) database reporting years along with the number of release days per year, with medians and maxima presented from across the six-year reporting range. Table 3-39 presents fugitive and stack air releases per year and per day based on 2020 NEI (U.S. EPA, 2022e) database along with the number of release days per year. Table 3-40 presents land releases per year based on the 2017 to 2022 TRI database along with the number of release days per year. Table 3-41 presents water releases per year and per day based on the 2017 to 2022 DMR (U.S. EPA, 2022c) and TRI databases along with the number of release days per year, with medians and maxima presented from across the six-year reporting range. The *Environmental Releases to Wastewater for Diethylhexyl Phthalate (DEHP)*, *Environmental Releases to Air for Diethylhexyl Phthalate (DEHP)*, and *Environmental Releases to Land for Diethylhexyl Phthalate (DEHP)* contain additional information about the calculation results; refer to Appendix J for a reference to these supplemental documents.

Table 3-38. Summary of Air Releases from TRI for Repackaging

Site Identity	Maximum Annual Fugitive Air Release (kg/yr)	Max. Annual Stack Air Release (kg/yr)	Median Annual Fugitive Air Release (kg/yr)	Median Annual Stack Air Release (kg/yr)	Max. Daily Fugitive Air Release (kg/day)	Max. Daily Stack Air Release (kg/day)	Median Daily Fugitive Air Release (kg/day)	Median Daily Stack Air Release (kg/day)	Annual Release Days (days/yr)
Monson Cos Inc, Leominster, MA	227	227	227	227	0.62	0.62	0.62	0.62	364
Pride Solvents & Chemical Co of New Jersey, Avenel, NJ	227	227	227	227	0.62	0.62	0.62	0.62	364
Doremus Terminal LLC, Newark, NJ	0.91	0	0.45	0	2.5E−03	0	1.2E−03	0	364
R.E. Carroll Inc., Trenton, NJ	227	227	227	227	0.62	0.62	0.62	0.62	364
Brenntag Mid-South, Charlotte, NC	227	227	227	227	0.62	0.62	0.62	0.62	364
Superior Industrial Solutions Inc, Cowpens, SC	227	227	227	227	0.62	0.62	0.62	0.62	364
Univar Solutions-Doraville, Doraville, GA	85	0	40	0	0.23	0	0.11	0	364
Univar Solutions Doraville Alchemy, Doraville, GA	227	227	227	227	0.62	0.62	0.62	0.62	364
Greenchem Industries LLC, West Palm Beach, FL	227	227	227	227	0.62	0.62	0.62	0.62	364
Superior Industrial Solutions Inc, Old Hickory, TN	227	227	227	227	0.62	0.62	0.62	0.62	364
Univar Solutions USA Inc, Twinsburg, OH	59	0	58	0	0.16	0	0.16	0	364
Technical Products Inc., Cleveland, OH	227	227	227	227	0.62	0.62	0.62	0.62	364
Harwick Standard Distribution Corp, Akron, OH	3.2	0	1.8	0	8.7E−03	0	5.0E−03	0	364

Site Identity	Maximum Annual Fugitive Air Release (kg/yr)	Max. Annual Stack Air Release (kg/yr)	Median Annual Fugitive Air Release (kg/yr)	Median Annual Stack Air Release (kg/yr)	Max. Daily Fugitive Air Release (kg/day)	Max. Daily Stack Air Release (kg/day)	Median Daily Fugitive Air Release (kg/day)	Median Daily Stack Air Release (kg/day)	Annual Release Days (days/yr)
Univar USA Inc. Romulus Branch, Romulus, MI	2.7E−02	2.7E−02	2.7E−02	2.7E−02	7.5E−05	7.5E−05	7.5E−05	7.5E−05	364
Nexeo Solutions LLC (Dba Univar Solutions USA Inc.), Lansing, MI	227	227	227	227	0.62	0.62	0.62	0.62	364
Brenntag Great Lakes LLC, Menomonee Falls, WI	227	227	227	227	0.62	0.62	0.62	0.62	364
Nexeo Solutions LLC (Dba Univar Solutions USA Inc.), Willow Springs, IL	2.9	0	2.9	0	8.0E−03	0	8.0E−03	0	364
Superior Industrial Solutions Inc., Arnold, MO	227	227	227	227	0.62	0.62	0.62	0.62	364
Nexeo Solutions LLC, Garland, TX	113	0.15	58	7.5E−02	0.31	4.1E−04	0.16	2.1E−04	364
Univar USA Inc Dallas Dan Morton Facility, Dallas, TX	227	227	227	227	0.62	0.62	0.62	0.62	364
K-Solv Chemicals LLC, Channelview, TX	227	227	227	227	0.62	0.62	0.62	0.62	364
Univar Solutions USA Inc., Commerce, CA	227	227	227	227	0.62	0.62	0.62	0.62	364
Univar Solutions Carson Ca, Carson, CA	227	227	227	227	0.62	0.62	0.62	0.62	364
Univar Solutions Kent, Kent, WA	5	113	4.9	22	1.4E−02	0.31	1.4E−02	6.0E−02	364

Table 3-39. Summary of Air Releases from NEI (2020) for Repackaging

Site Identity	Total Fugitive Air Release (kg/yr)	Daily Fugitive Air Release (kg/day)	Total Stack Air Release (kg/yr)	Daily Stack Air Release (kg/day)	Annual Release Days (days/yr)
Doremus Terminal Operation, LLC, Newark, NJ	0.45	6.2E−04	Stack releases not reported	Stack releases not reported	364
Pride Solvents & Chemical Co. of NJ Inc., Avenel, NJ	1.4	1.9E−03	Stack releases not reported	Stack releases not reported	364
Nexeo Solutions LLC Doraville, Doraville, GA	0	0	Stack releases not reported	Stack releases not reported	364
Frontier Logistical Services, LLC, Nashville, TN	0	0	Stack releases not reported	Stack releases not reported	365
Ester Solutions, Bedford Park, IL	Fugitive releases not reported	Fugitive releases not reported	32	4.4E−02	364
Ronken Industries Inc, Spring Valley, IL	Fugitive releases not reported	Fugitive releases not reported	9.1	1.3E−02	350
Univar USA Inc. - Romulus Branch, Romulus, MI	0	0	Stack releases not reported	Stack releases not reported	364
Nexeo Solutions LLC Twinsburg Enterprise, Twinsburg, OH	0	0	Stack releases not reported	Stack releases not reported	364
Univar Solutions USA, Inc. (1677130036), Twinsburg, OH	45	6.1E−02	5.5	7.6E−03	365
Harwick Standard Distribution Corp, Akron, OH	1.8	2.5E−03	Stack releases not reported	Stack releases not reported	364
Colonial Pipeline Co, Jackson, LA	3.2	4.3E−03	11	1.5E−02	364
Rawlins Yard, Carbon, WY	0	0	Stack releases not reported	Stack releases not reported	364
Nexeo Solutions, LLC, Fairfield, CA	0	0	Stack releases not reported	Stack releases not reported	364
Univar USA Inc. (Formerly Vopak USA Inc), Kent, WA	0	0	Stack releases not reported	Stack releases not reported	364
Indianhead Renewable Forest Products, Barron, WI	Fugitive releases not reported	Fugitive releases not reported	2.2	3.1E−03	364
T2, Inc., Sweet Home, OR	Fugitive releases not reported	Fugitive releases not reported	2.5	3.4E−03	364

Table 3-40. Summary of Land Releases from TRI for Repackaging

Site Identity	Median Total Release (kg/yr)	Maximum Total Release (kg/yr)	Annual Release Days (days/yr)
Harwick Standard Distribution Corp, Akron, OH	170	325	364

Table 3-41. Summary of Water Releases from DMR and TRI for Repackaging

Site Identity	Source-Discharge Type	Median Annual Discharge (kg/yr)	Daily Discharge (Corresponding to Median Annual Discharge) (kg/day)	Maximum Annual Discharge (kg/yr)	Daily Discharge (Corresponding to Maximum Daily Discharge) (kg/day)	Annual Release Days (days/yr)
Monson Cos Inc, Leominster, MA	DMR-Direct Discharges	N/A – facility does not report DMRs	N/A – facility does not report DMRs	N/A – facility does not report DMRs	N/A – facility does not report DMRs	260
Monson Cos Inc, Leominster, MA	TRI-Direct Discharges	227	0.87	227	0.87	260
Monson Cos Inc, Leominster, MA	TRI-Transfers to POTW	227	0.87	227	0.87	260
Monson Cos Inc, Leominster, MA	TRI-Transfers to non-POTW	227	0.87	227	0.87	260
Pride Solvents & Chemical Co of New Jersey, Avenel, NJ	DMR-Direct Discharges	N/A – facility does not report DMRs	N/A – facility does not report DMRs	N/A – facility does not report DMRs	N/A – facility does not report DMRs	260
Pride Solvents & Chemical Co of New Jersey, Avenel, NJ	TRI-Direct Discharges	227	0.87	227	0.87	260
Pride Solvents & Chemical Co of New Jersey, Avenel, NJ	TRI-Transfers to POTW	227	0.87	227	0.87	260
Pride Solvents & Chemical Co of New Jersey, Avenel, NJ	TRI-Transfers to non-POTW	227	0.87	227	0.87	260
Brenntag Mid-South, Charlotte, NC	DMR-Direct Discharges	N/A – facility does not report DMRs	N/A – facility does not report DMRs	N/A – facility does not report DMRs	N/A – facility does not report DMRs	260

Site Identity	Source-Discharge Type	Median Annual Discharge (kg/yr)	Daily Discharge (Corresponding to Median Annual Discharge) (kg/day)	Maximum Annual Discharge (kg/yr)	Daily Discharge (Corresponding to Maximum Daily Discharge) (kg/day)	Annual Release Days (days/yr)
Brenntag Mid-South, Charlotte, NC	TRI-Direct Discharges	227	0.87	227	0.87	260
Brenntag Mid-South, Charlotte, NC	TRI-Transfers to POTW	227	0.87	227	0.87	260
Brenntag Mid-South, Charlotte, NC	TRI-Transfers to non-POTW	227	0.87	227	0.87	260
Univar Solutions Doraville Alchemy, Doraville, GA	DMR-Direct Discharges	N/A – facility does not report DMRs	N/A – facility does not report DMRs	N/A – facility does not report DMRs	N/A – facility does not report DMRs	260
Univar Solutions Doraville Alchemy, Doraville, GA	TRI-Direct Discharges	227	0.87	227	0.87	260
Univar Solutions Doraville Alchemy, Doraville, GA	TRI-Transfers to POTW	227	0.87	227	0.87	260
Univar Solutions Doraville Alchemy, Doraville, GA	TRI-Transfers to non-POTW	227	0.87	227	0.87	260
Technical Products Inc., Cleveland, OH	DMR-Direct Discharges	N/A – facility does not report DMRs	N/A – facility does not report DMRs	N/A – facility does not report DMRs	N/A – facility does not report DMRs	260
Technical Products Inc., Cleveland, OH	TRI-Direct Discharges	227	0.87	227	0.87	260
Technical Products Inc., Cleveland, OH	TRI-Transfers to POTW	227	0.87	227	0.87	260
Technical Products Inc., Cleveland, OH	TRI-Transfers to non-POTW	227	0.87	227	0.87	260
Nexeo Solutions LLC (Dba Univar Solutions USA Inc.), Lansing, MI	DMR-Direct Discharges	N/A – facility does not report DMRs	N/A – facility does not report DMRs	N/A – facility does not report DMRs	N/A – facility does not report DMRs	260
Nexeo Solutions LLC (Dba Univar Solutions USA Inc.), Lansing, MI	TRI-Direct Discharges	227	0.87	227	0.87	260

Site Identity	Source-Discharge Type	Median Annual Discharge (kg/yr)	Daily Discharge (Corresponding to Median Annual Discharge) (kg/day)	Maximum Annual Discharge (kg/yr)	Daily Discharge (Corresponding to Maximum Daily Discharge) (kg/day)	Annual Release Days (days/yr)
Nexeo Solutions LLC (Dba Univar Solutions USA Inc.), Lansing, MI	TRI-Transfers to POTW	227	0.87	227	0.87	260
Nexeo Solutions LLC (Dba Univar Solutions USA Inc.), Lansing, MI	TRI-Transfers to non-POTW	227	0.87	227	0.87	260
Brenntag Great Lakes LLC, Menomonee Falls, WI	DMR-Direct Discharges	N/A – facility does not report DMRs	N/A – facility does not report DMRs	N/A – facility does not report DMRs	N/A – facility does not report DMRs	260
Brenntag Great Lakes LLC, Menomonee Falls, WI	TRI-Direct Discharges	227	0.87	227	0.87	260
Brenntag Great Lakes LLC, Menomonee Falls, WI	TRI-Transfers to POTW	227	0.87	227	0.87	260
Brenntag Great Lakes LLC, Menomonee Falls, WI	TRI-Transfers to non-POTW	227	0.87	227	0.87	260
Univar USA Inc Dallas Dan Morton Facility, Dallas, TX	DMR-Direct Discharges	N/A – facility does not report DMRs	N/A – facility does not report DMRs	N/A – facility does not report DMRs	N/A – facility does not report DMRs	260
Univar USA Inc Dallas Dan Morton Facility, Dallas, TX	TRI-Direct Discharges	227	0.87	227	0.87	260
Univar USA Inc Dallas Dan Morton Facility, Dallas, TX	TRI-Transfers to POTW	227	0.87	227	0.87	260
Univar USA Inc Dallas Dan Morton Facility, Dallas, TX	TRI-Transfers to non-POTW	227	0.87	227	0.87	260
Univar Solutions USA Inc., Commerce, CA	DMR-Direct Discharges	N/A – facility does not report DMRs	N/A – facility does not report DMRs	N/A – facility does not report DMRs	N/A – facility does not report DMRs	260
Univar Solutions USA Inc., Commerce, CA	TRI-Direct Discharges	227	0.87	227	0.87	260
Univar Solutions USA Inc., Commerce, CA	TRI-Transfers to POTW	227	0.87	227	0.87	260
Univar Solutions USA Inc., Commerce, CA	TRI-Transfers to non-POTW	227	0.87	227	0.87	260

Site Identity	Source-Discharge Type	Median Annual Discharge (kg/yr)	Daily Discharge (Corresponding to Median Annual Discharge) (kg/day)	Maximum Annual Discharge (kg/yr)	Daily Discharge (Corresponding to Maximum Daily Discharge) (kg/day)	Annual Release Days (days/yr)
Univar USA Inc. Romulus Branch, Romulus, MI	DMR-Direct Discharges	N/A – facility does not report DMRs	N/A – facility does not report DMRs	N/A – facility does not report DMRs	N/A – facility does not report DMRs	260
Univar USA Inc. Romulus Branch, Romulus, MI	TRI-Direct Discharges	227	0.87	227	0.87	260
Univar USA Inc. Romulus Branch, Romulus, MI	TRI-Transfers to POTW	227	0.87	227	0.87	260
Univar USA Inc. Romulus Branch, Romulus, MI	TRI-Transfers to non-POTW	227	0.87	227	0.87	260
Univar Solutions Carson CA, Carson, CA	DMR-Direct Discharges	N/A – facility does not report DMRs	N/A – facility does not report DMRs	N/A – facility does not report DMRs	N/A – facility does not report DMRs	260
Univar Solutions Carson CA, Carson, CA	TRI-Direct Discharges	227	0.87	227	0.87	260
Univar Solutions Carson CA, Carson, CA	TRI-Transfers to POTW	227	0.87	227	0.87	260
Univar Solutions Carson CA, Carson, CA	TRI-Transfers to non-POTW	227	0.87	227	0.87	260
K-Solv Chemicals LLC, Channelview, TX	DMR-Direct Discharges	N/A – facility does not report DMRs	N/A – facility does not report DMRs	N/A – facility does not report DMRs	N/A – facility does not report DMRs	260
K-Solv Chemicals LLC, Channelview, TX	TRI-Direct Discharges	227	0.87	227	0.87	260
K-Solv Chemicals LLC, Channelview, TX	TRI-Transfers to POTW	227	0.87	227	0.87	260
K-Solv Chemicals LLC, Channelview, TX	TRI-Transfers to non-POTW	227	0.87	227	0.87	260
Univar Solutions-Doraville, Doraville, GA	DMR-Direct Discharges	N/A – facility does not report DMRs	N/A – facility does not report DMRs	N/A – facility does not report DMRs	N/A – facility does not report DMRs	260
Univar Solutions-Doraville, Doraville, GA	TRI-Direct Discharges	227	0.87	227	0.87	260
Univar Solutions-Doraville, Doraville, GA	TRI-Transfers to POTW	227	0.87	227	0.87	260

Site Identity	Source-Discharge Type	Median Annual Discharge (kg/yr)	Daily Discharge (Corresponding to Median Annual Discharge) (kg/day)	Maximum Annual Discharge (kg/yr)	Daily Discharge (Corresponding to Maximum Daily Discharge) (kg/day)	Annual Release Days (days/yr)
Univar Solutions-Doraville, Doraville, GA	TRI-Transfers to non-POTW	227	0.87	227	0.87	260
Superior Industrial Solutions Inc, Old Hickory, TN	DMR-Direct Discharges	N/A – facility does not report DMRs	N/A – facility does not report DMRs	N/A – facility does not report DMRs	N/A – facility does not report DMRs	260
Superior Industrial Solutions Inc, Old Hickory, TN	TRI-Direct Discharges	227	0.87	227	0.87	260
Superior Industrial Solutions Inc, Old Hickory, TN	TRI-Transfers to POTW	227	0.87	227	0.87	260
Superior Industrial Solutions Inc, Old Hickory, TN	TRI-Transfers to non-POTW	227	0.87	227	0.87	260
Univar Solutions USA Inc, Twinsburg, OH	DMR-Direct Discharges	N/A – facility does not report DMRs	N/A – facility does not report DMRs	N/A – facility does not report DMRs	N/A – facility does not report DMRs	260
Univar Solutions USA Inc, Twinsburg, OH	TRI-Direct Discharges	227	0.87	227	0.87	260
Univar Solutions USA Inc, Twinsburg, OH	TRI-Transfers to POTW	227	0.87	227	0.87	260
Univar Solutions USA Inc, Twinsburg, OH	TRI-Transfers to non-POTW	227	0.87	227	0.87	260
R.E. Carroll Inc., Trenton, NJ	DMR-Direct Discharges	N/A – facility does not report DMRs	N/A – facility does not report DMRs	N/A – facility does not report DMRs	N/A – facility does not report DMRs	260
R.E. Carroll Inc., Trenton, NJ	TRI-Direct Discharges	227	0.87	227	0.87	260
R.E. Carroll Inc., Trenton, NJ	TRI-Transfers to POTW	227	0.87	227	0.87	260
R.E. Carroll Inc., Trenton, NJ	TRI-Transfers to non-POTW	227	0.87	227	0.87	260

Site Identity	Source-Discharge Type	Median Annual Discharge (kg/yr)	Daily Discharge (Corresponding to Median Annual Discharge) (kg/day)	Maximum Annual Discharge (kg/yr)	Daily Discharge (Corresponding to Maximum Daily Discharge) (kg/day)	Annual Release Days (days/yr)
Superior Industrial Solutions Inc., Arnold, MO	DMR-Direct Discharges	N/A – facility does not report DMRs	N/A – facility does not report DMRs	N/A – facility does not report DMRs	N/A – facility does not report DMRs	260
Superior Industrial Solutions Inc., Arnold, MO	TRI-Direct Discharges	227	0.87	227	0.87	260
Superior Industrial Solutions Inc., Arnold, MO	TRI-Transfers to POTW	227	0.87	227	0.87	260
Superior Industrial Solutions Inc., Arnold, MO	TRI-Transfers to non-POTW	227	0.87	227	0.87	260
Superior Industrial Solutions Inc, Cowpens, SC	DMR-Direct Discharges	N/A – facility does not report DMRs	N/A – facility does not report DMRs	N/A – facility does not report DMRs	N/A – facility does not report DMRs	260
Superior Industrial Solutions Inc, Cowpens, SC	TRI-Direct Discharges	227	0.87	227	0.87	260
Superior Industrial Solutions Inc, Cowpens, SC	TRI-Transfers to POTW	227	0.87	227	0.87	260
Superior Industrial Solutions Inc, Cowpens, SC	TRI-Transfers to non-POTW	227	0.87	227	0.87	260
Greenchem Industries LLC, West Palm Beach, FL	DMR-Direct Discharges	N/A – facility does not report DMRs	N/A – facility does not report DMRs	N/A – facility does not report DMRs	N/A – facility does not report DMRs	260
Greenchem Industries LLC, West Palm Beach, FL	TRI-Direct Discharges	227	0.87	227	0.87	260
Greenchem Industries LLC, West Palm Beach, FL	TRI-Transfers to POTW	227	0.87	227	0.87	260
Greenchem Industries LLC, West Palm Beach, FL	TRI-Transfers to non-POTW	227	0.87	227	0.87	260
Bayonne Plant Holding LLC, Hudson, NJ	DMR-Direct Discharges	2.3	8.9E−03	2.3	8.9E−03	260
Bayonne Plant Holding LLC, Hudson, NJ	TRI-Direct Discharges	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	260
Bayonne Plant Holding LLC, Hudson, NJ	TRI-Transfers to POTW	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	260

Site Identity	Source-Discharge Type	Median Annual Discharge (kg/yr)	Daily Discharge (Corresponding to Median Annual Discharge) (kg/day)	Maximum Annual Discharge (kg/yr)	Daily Discharge (Corresponding to Maximum Daily Discharge) (kg/day)	Annual Release Days (days/yr)
Bayonne Plant Holding LLC, Hudson, NJ	TRI-Transfers to non-POTW	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	260
Chemical Leaman Tank Lines Inc, Gloucester, NJ	DMR-Direct Discharges	0.18	7.1E−04	0.18	7.1E−04	260
Chemical Leaman Tank Lines Inc, Gloucester, NJ	TRI-Direct Discharges	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	260
Chemical Leaman Tank Lines Inc, Gloucester, NJ	TRI-Transfers to POTW	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	260
Chemical Leaman Tank Lines Inc, Gloucester, NJ	TRI-Transfers to non-POTW	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	260
IMTT-Bayonne LLC, Hudson, NJ	DMR-Direct Discharges	0.87	3.4E−03	71	0.27	260
IMTT -Bayonne LLC, Hudson, NJ	TRI-Direct Discharges	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	260
IMTT -Bayonne LLC, Hudson, NJ	TRI-Transfers to POTW	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	260
IMTT -Bayonne LLC, Hudson, NJ	TRI-Transfers to non-POTW	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	260
Intercontinental Terminals Deer Park Terminal, Harris, TX	DMR-Direct Discharges	0.48	1.8E−03	1	3.9E−03	260
Intercontinental Terminals Deer Park Terminal, Harris, TX	TRI-Direct Discharges	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	260
Intercontinental Terminals Deer Park Terminal, Harris, TX	TRI-Transfers to POTW	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	260
Intercontinental Terminals Deer Park Terminal, Harris, TX	TRI-Transfers to non-POTW	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	260

Site Identity	Source-Discharge Type	Median Annual Discharge (kg/yr)	Daily Discharge (Corresponding to Median Annual Discharge) (kg/day)	Maximum Annual Discharge (kg/yr)	Daily Discharge (Corresponding to Maximum Daily Discharge) (kg/day)	Annual Release Days (days/yr)
San Jacinto River and Rail, Harris, TX	DMR-Direct Discharges	24	9.2E−02	39	0.15	260
San Jacinto River and Rail, Harris, TX	TRI-Direct Discharges	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	260
San Jacinto River and Rail, Harris, TX	TRI-Transfers to POTW	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	260
San Jacinto River and Rail, Harris, TX	TRI-Transfers to non-POTW	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	260
Stolthaven Houston, Inc., Harris, TX	DMR-Direct Discharges	0.79	3.1E−03	1.9	7.2E−03	260
Stolthaven Houston, Inc., Harris, TX	TRI-Direct Discharges	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	260
Stolthaven Houston, Inc., Harris, TX	TRI-Transfers to POTW	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	260
Stolthaven Houston, Inc., Harris, TX	TRI-Transfers to non-POTW	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	260
Stolthaven New Orleans, LLC - Braithwaite Terminal, Orleans, LA	DMR-Direct Discharges	0.65	2.5E−03	0.69	2.7E−03	260
Stolthaven New Orleans, LLC - Braithwaite Terminal, Orleans, LA	TRI-Direct Discharges	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	260
Stolthaven New Orleans, LLC - Braithwaite Terminal, Orleans, LA	TRI-Transfers to POTW	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	260
Stolthaven New Orleans, LLC - Braithwaite Terminal, Orleans, LA	TRI-Transfers to non-POTW	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	260
Vopak Terminal Los Angeles, Los Angeles, CA	DMR-Direct Discharges	0.27	1.0E−03	0.27	1.0E−03	260

Site Identity	Source-Discharge Type	Median Annual Discharge (kg/yr)	Daily Discharge (Corresponding to Median Annual Discharge) (kg/day)	Maximum Annual Discharge (kg/yr)	Daily Discharge (Corresponding to Maximum Daily Discharge) (kg/day)	Annual Release Days (days/yr)
Vopak Terminal Los Angeles, Los Angeles, CA	TRI-Direct Discharges	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	260
Vopak Terminal Los Angeles, Los Angeles, CA	TRI-Transfers to POTW	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	260
Vopak Terminal Los Angeles, Los Angeles, CA	TRI-Transfers to non-POTW	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	260

3.6.4 Occupational Exposure Assessment

3.6.4.1 Workers Activities

During repackaging, worker exposures to DEHP occur when transferring DEHP from the import vessels (*e.g.*, chemical tankers, rail cars, intermodal tank containers) into smaller containers. Worker exposures also occur via inhalation of vapors or dermal contact with liquids when cleaning import vessels, loading and unloading DEHP, sampling, and cleaning equipment.

EPA did not find any information on the extent to which engineering controls and worker PPE are used at facilities that repackage DEHP from import vessels into smaller containers. Based on the Generic Scenario for Repackaging, PPE may include safety glasses, face shields, aprons, and gloves. The generic scenario also states that engineering controls at repackaging sites may include vacuum systems and centrifugal degassing (U.S. EPA, 2022a). EPA expects the types of PPE and controls used at each site to be based on the hazards present; therefore, the common PPE/controls presented in the GS/ESD may or may not apply when DEHP is being used.

ONUs include employees (*e.g.*, supervisors, managers) that work at the import site where repackaging occurs but do not directly handle DEHP. Therefore, EPA expects the ONUs to have lower inhalation exposures and *di minimis* dermal exposures.

3.6.4.2 Occupational Inhalation Exposure Results

No references with discrete full shift samples were identified for this OES through systematic review; however, the European Union Risk Assessment Report on DEHP (ECJRC, 2008, 2003) provided a minimum, maximum, and mean based on area samples collected from a DEHP manufacturing facility and the European Union Risk Assessment Report on DINP (ECJRC, 2008, 2003) provided a mean concentration for DEHP based on personal samples collected from a phthalate ester producer . EPA assessed the high-end worker inhalation exposure result for this OES using the maximum concentration from the European Union Risk Assessment on DEHP and the central tendency worker inhalation exposure result for this OES using the mean concentration from the European Union Risk Assessment on DINP (ECJRC, 2008, 2003). This report contained DEHP-specific exposure data as well as diisononyl phthalate (DINP) exposure data. These data had data quality ratings of high, meaning they are of acceptable quality. These results are presented in Table 3-42. Additional discussion on the uncertainty and limitations of these data are included in the weight of scientific evidence 4.2. No data with full shift samples for ONUs was identified for this OES through systematic review. For this reason, the worker central tendency exposure concentration was used to assess both the ONU high-end and central tendency exposures. The *Occupational Inhalation Exposure Data for Diethylhexyl Phthalate (DEHP)* contains additional information about the calculation results; refer to Appendix J for a reference to this supplemental document.

Table 3-42. Summary of Estimated Worker Inhalation Exposures for Repackaging of DEHP

Worker Population	Exposure Concentration Type	Central Tendency	High-End
Average Adult Worker	8-hour TWA Exposure Concentration (mg/m^3)	0.14	0.52
	Acute (AD, mg/kg-day)	1.8E−02	6.5E−02
	Intermediate (IADD, mg/kg-day)	1.3E−02	4.8E−02
	Chronic, Non-Cancer (ADD, mg/kg-day)	1.2E−02	4.5E−02
Female of Reproductive Age	8-hour TWA Exposure Concentration (mg/m^3)	0.14	0.52
	Acute (AD, mg/kg-day)	1.9E−02	7.2E−02
	Intermediate (IADD, mg/kg-day)	1.4E−02	5.3E−02

Worker Population	Exposure Concentration Type	Central Tendency	High-End
	Chronic, Non-Cancer (ADD, mg/kg-day)	1.3E−02	4.9E−02
ONU	8-hour TWA Exposure Concentration (mg/m^3)	0.14	
	Acute (AD, mg/kg-day)	1.8E−02	
	Intermediate (IADD, mg/kg-day)	1.3E−02	
	Chronic, Non-Cancer (ADD, mg/kg-day)	1.2E−02	

3.6.4.3 Occupational Dermal Exposure Results

EPA estimated dermal exposures for this OES using the methodology outlined in Appendix C. The various "Exposure Concentration Types" from Table 3-43 are explained in Appendix A. Because dermal exposures to workers may occur via DEHP in the liquid form during repackaging, EPA assessed the absorptive flux of DEHP according to the dermal absorption data of DEHP (see Appendix C.2.1.1 for details). Table 3-43 summarizes the APDR, the AD, the IADD, and the ADD for both average adult workers and female workers of reproductive age. Because dust or mist are not expected to be deposited on surfaces from this OES, EPA did not assess dermal exposures to ONUs from contact with surfaces. Dermal exposure parameters are described in Appendix C. The *Occupational Dermal Exposure Modeling Results for Diethylhexyl Phthalate (DEHP)* also contains information about model equations and parameters and contains calculation results; refer to Appendix J for a reference to this supplemental document.

Table 3-43. Summary of Estimated Worker Dermal Exposures for Repackaging of DEHP

Worker Population	Exposure Concentration Type	Central Tendency	High-End
Average Adult Worker	Dose Rate (APDR, mg/day)	5.6E−03	1.1E−02
	Acute (AD, mg/kg-day)	7.0E−05	1.4E−04
	Intermediate (IADD, mg/kg-day)	5.1E−05	1.0E−04
	Chronic, Non-Cancer (ADD, mg/kg-day)	4.8E−05	9.5E−05
Female of Reproductive Age	Dose Rate (APDR, mg/day)	5.0E−03	1.0E−02
	Acute (AD, mg/kg-day)	6.4E−05	1.3E−04
	Intermediate (IADD, mg/kg-day)	4.7E−05	9.4E−05
	Chronic, Non-Cancer (ADD, mg/kg-day)	4.4E−05	8.8E−05

3.6.4.4 Occupational Aggregate Exposure Results

Inhalation and dermal exposure estimates were aggregated based on the approach described in Appendix A to arrive at the aggregate worker and ONU exposure estimates in the table below. The *Occupational Risk Calculator for Diethylhexyl Phthalate (DEHP)* (U.S. EPA, 2025e) contains the calculations of aggregate exposure; refer to Appendix J for a reference to this supplemental document.

Table 3-44. Summary of Estimated Worker Aggregate Exposures for Repackaging of DEHP

Worker Population	Exposure Concentration Type	Central Tendency	High-End
Average Adult Worker	Acute (AD, mg/kg-day)	1.8E−02	6.5E−02
	Intermediate (IADD, mg/kg-day)	1.3E−02	4.8E−02
	Chronic, Non-Cancer (ADD, mg/kg-day)	1.2E−02	4.5E−02
Female of Reproductive Age	Acute (AD, mg/kg-day)	1.9E−02	7.2E−02
	Intermediate (IADD, mg/kg-day)	1.4E−02	5.3E−02
	Chronic, Non-Cancer (ADD, mg/kg-day)	1.3E−02	4.9E−02
ONU	Acute (AD, mg/kg-day)	1.8E−02	
	Intermediate (IADD, mg/kg-day)	1.3E−02	
	Chronic, Non-Cancer (ADD, mg/kg-day)	1.2E−02	

3.7 Application of Paints, Coatings, Adhesives, and Sealants

3.7.1 Process Description

EPA identified DEHP in multiple paint, coating, adhesive, and sealant products, including polishes, lacquers, sealants, gloss finishes, two-part encapsulants, electrical tape adhesives, pool paints, and adhesive putties (Valspar, 2024; Axalta, 2021; Lord Corporation, 2021; Chemsol, 2020; Lord Corporation, 2020; 3M Company, 2019; Sherwin Williams, 2019; Dupli-Color Products Company, 2017; Valspar, 2017; Imperial Tools, 2015; Tremco, 2015; CETCO, 2014; 3M, 2011; Ramuc Specialty Pools, 2010; Airserco Manufacturing Company LLC, 2009; StatSpin, 2004; Republic Powdered Metals, 2002; Glidden, 1999). In 2016 CDR, DEHP was reported to be used in paints, coatings, and adhesives used on plastic and rubber products, toys, playground, and sporting equipment, and other products (U.S. EPA, 2019a).

The application procedure depends on the type of adhesive, sealant, paint, or coating formulation and the type of substrate. Typically, the formulation is loaded into the application reservoir or apparatus and applied to the substrate via brush, spray, roll, dip, curtain, or syringe or bead application (OECD, 2015b). Trowel or spot application directly from containers may also be used for paste-like and putty formulations. Application may be manual or automated. After application, the adhesive, sealant, paint, or coating is allowed to dry or cure (OECD, 2015b). The drying/curing process may be promoted through the use of heat or radiation (radiation can include ultraviolet (UV) and electron beam radiation) (OECD, 2010a). Identified safety data sheets (SDSs) indicate these products are typically a paste or liquid, with one solid powder paint additive identified. These products are typically available in small container sizes, including tubes, 4-ounce cans, 8-ounce cans, and 1-gallon containers (Valspar, 2024; 3M Company, 2019; Valspar, 2017; Imperial Tools, 2015).

EPA identified DEHP in the above products at concentrations ranging from 0.01 to 70 percent by weight (Valspar, 2024; Axalta, 2021; Lord Corporation, 2021; Chemsol, 2020; Lord Corporation, 2020; 3M Company, 2019; Sherwin Williams, 2019; Dupli-Color Products Company, 2017; Valspar, 2017; Imperial Tools, 2015; Tremco, 2015; CETCO, 2014; 3M, 2011; Ramuc Specialty Pools, 2010; Airserco Manufacturing Company LLC, 2009; StatSpin, 2004; Republic Powdered Metals, 2002; Glidden, 1999). The central tendency (50th percentile) concentration was 4.5 percent and high-end (95th percentile) concentration was 36 percent, calculated using the middle of the range where concentrations were provided as a range.

Figure 3-7 provides an illustration of the application of adhesives and sealants process, and Figure 3-8 provides an illustration of the application of paints and coatings process.

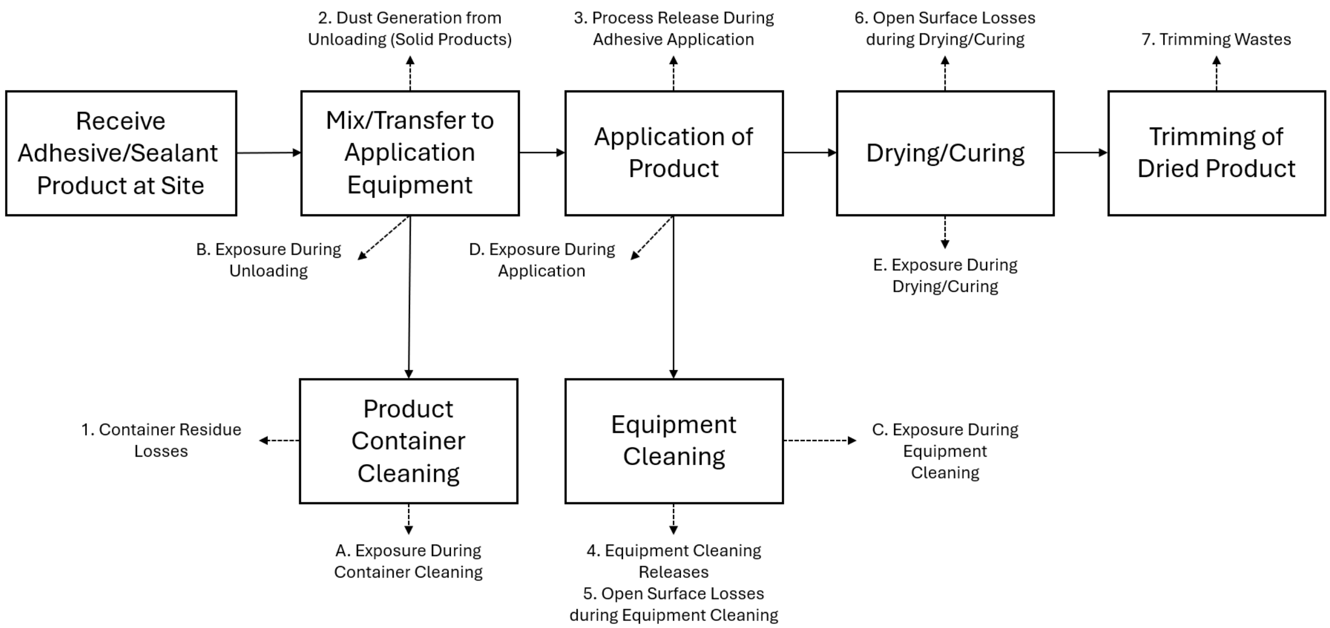


Figure 3-7. Application of Adhesives and Sealants Flow Diagram (OECD, 2015a)

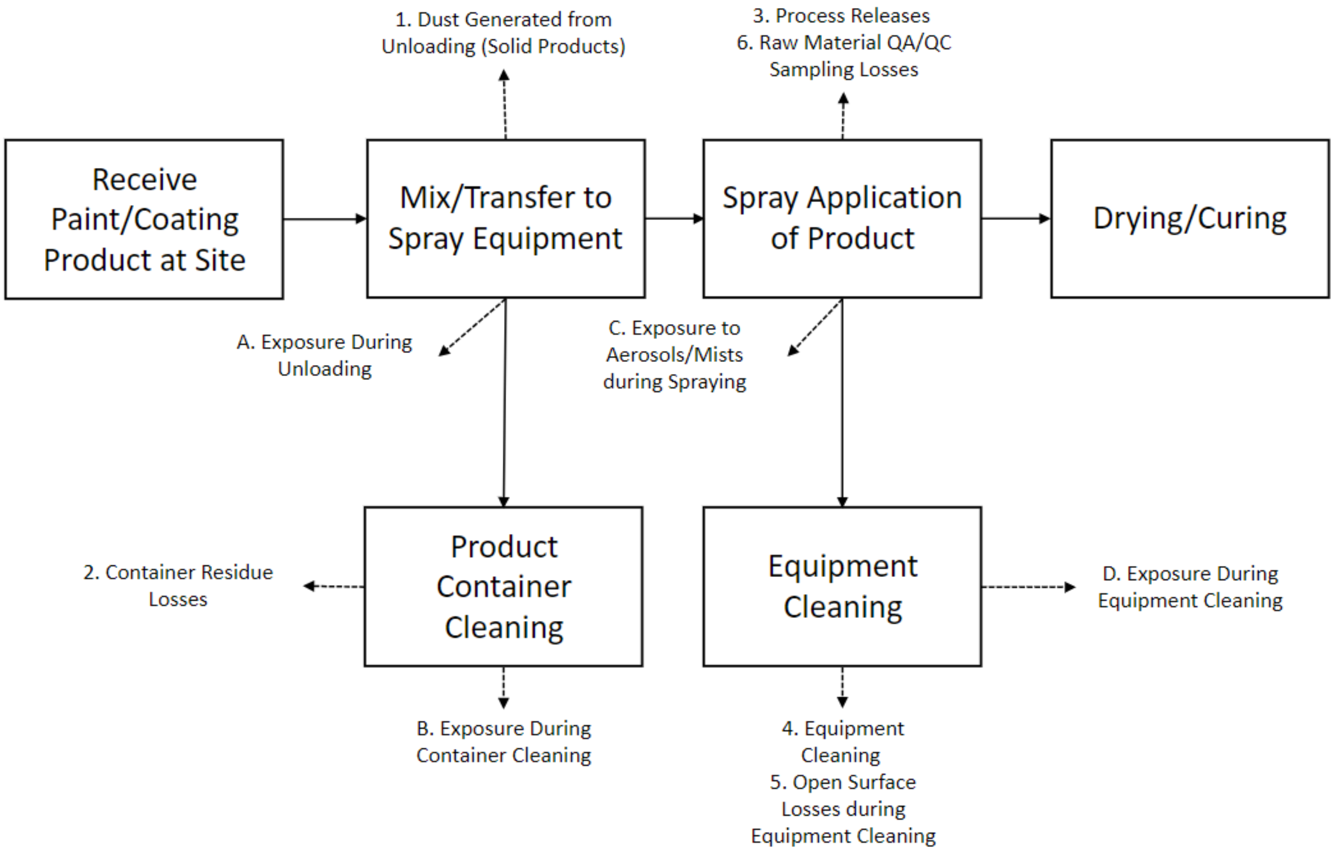


Figure 3-8. Application of Paints and Coatings Flow Diagram (U.S. EPA, 2014d; OECD, 2011b, 2009c; U.S. EPA, 2004)

3.7.2 Facility Estimates

EPA identified 140 unique sites which it assessed for use of DEHP in the application of paints, coatings, adhesives, and sealants through the NEI (U.S. EPA, 2022e), DMR (U.S. EPA, 2022c), and TRI (U.S. EPA, 2022f) data that EPA analyzed. For air, two sites reported to TRI and 117 reported to NEI. For water, all 21 sites reported to DMR. For land, one site reported to TRI. The total number of sites reporting air, water, and land releases can be larger than the number of unique sites due to the overlap of facilities between reporting databases. No sites were identified under the 2020 CDR. Due to the lack of data on the annual PV of DEHP in the application of paints, coatings, adhesives, and sealants, EPA does not present annual or daily site throughputs.

EPA identified operating days ranging from 1 to 365 days/year with an average of 340 days through NEI air release data. TRI/DMR did not report operating days; therefore, EPA assumed 250 days/yr of operation per the ESD on Radiation Curable Coatings, Inks, and Adhesives (OECD, 2010b). The ESD on the Use of Adhesives (OECD, 2015b) provides an average of 171 working days for general assembly, but provides 250 days for use in specific industries such as motor and non-motor vehicle, vehicle parts, and tire manufacturing (except retreading), and labels and tapes manufacturing.

3.7.3 Release Assessment

3.7.3.1 Environmental Release Points

Based on TRI (U.S. EPA, 2022f), DMR (U.S. EPA, 2022c), and NEI (U.S. EPA, 2022e) data, Applications of paints, coatings, adhesives, and sealants releases may go to stack air, fugitive air, surface water, and landfill. Fugitive air and stack air releases may occur during unloading of containers, sampling, container cleaning, equipment cleaning, and drying or curing of adhesives. Sites may utilize overspray control technology to prevent additional air releases during spray application in which case stack air would account for approximately 10 percent of process related operational losses, with the remainder going to surface water, incineration, or landfill. Surface water or landfill releases may occur from small container residue, equipment cleaning waste, adhesive application process waste, and trimming waste. Additional fugitive air releases may occur during leakage of pipes, flanges, and accessories used for transport.

3.7.3.2 Environmental Release Assessment Results

Table 3-45 presents fugitive and stack air releases per year and per day for application of paints, coatings, adhesives, and sealants based on the 2017 to 2022 TRI (U.S. EPA, 2022f) database reporting years along with the number of release days per year, with medians and maxima presented from across the six-year reporting range. Table 3-46 presents fugitive and stack air releases per year and per day based on the 2020 NEI (U.S. EPA, 2022e) database, along with the number of release days per year. Table 3-47 presents land releases per year based on the 2017 to 2022 TRI database, along with the number of release days per year. Table 3-48 presents water releases per year and per day based on the 2017 to 2022 DMR (U.S. EPA, 2022c) and TRI databases, along with the number of release days per year, with medians and maxima presented from across the six-year reporting range. The *Environmental Releases to Wastewater for Diethylhexyl Phthalate (DEHP), Environmental Releases to Air for Diethylhexyl Phthalate (DEHP)*, and *Environmental Releases to Land for Diethylhexyl Phthalate (DEHP)* contains additional information about the calculation results; refer to Appendix J for a reference to this supplemental document.

Table 3-45. Summary of Air Releases from TRI for Application of Paints, Coatings, Adhesives, and Sealants

Site Identity	Maximum Annual Fugitive Air Release (kg/yr)	Max. Annual Stack Air Release (kg/yr)	Median Annual Fugitive Air Release (kg/yr)	Median Annual Stack Air Release (kg/yr)	Max. Daily Fugitive Air Release (kg/day)	Max. Daily Stack Air Release (kg/day)	Median Daily Fugitive Air Release (kg/day)	Median Daily Stack Air Release (kg/day)	Annual Release Days (days/yr)
Honda Development & Manufacturing of America LLC - Alabama, Lincoln, AL	2,980	8,940	2,945	8,836	8.2	25	8.1	24	364
Kohler Co, Union City, TN	0	0	0	0	0	0	0	0	364

Table 3-46. Summary of Air Releases from NEI (2020) for Application of Paints, Coatings, Adhesives, and Sealants

Site Identity	Total Fugitive Air Release (kg/yr)	Daily Fugitive Air Release (kg/day)	Total Stack Air Release (kg/yr)	Daily Stack Air Release (kg/day)	Annual Release Days (days/yr)
Goodyear Dunlop Tires North America Ltd, Tonawanda, NY	4.3	6.0E−03	28	3.9E−02	364
Eagle Natrium, LLC, Proctor, WV	Fugitive releases not reported	Fugitive releases not reported	11	1.5E−02	352
Brown-Forman Cooperage, Louisville, KY	Fugitive releases not reported	Fugitive releases not reported	3.6E−04	1.2E−06	153
Premier Custom Built Inc/E Earl Twp, New Holland, PA	Fugitive releases not reported	Fugitive releases not reported	Stack releases not reported	Stack releases not reported	364
Nessco Ent LLC Dba Meridian Prod/East Earl, New Holland, PA	Fugitive releases not reported	Fugitive releases not reported	Stack releases not reported	Stack releases not reported	249
Georgia-Pacific Wood Products LLC, Brookneal, VA OSB Facilit, Gladys, VA	Fugitive releases not reported	Fugitive releases not reported	Stack releases not reported	Stack releases not reported	364
Cardone Ind Inc/Auto Parts Remfg PLT 11-14, Philadelphia, PA	Fugitive releases not reported	Fugitive releases not reported	Stack releases not reported	Stack releases not reported	248
Weyerhaeuser NR Company - Sutton OSB, Heaters, WV	Fugitive releases not reported	Fugitive releases not reported	3.0E−02	4.6E−05	327
Naval Sea Systems Command - Allegany Ballistics Laboratory, Rocket Center, WV	6.2	1.8E−02	56	0.17	168
The Goodyear Tire & Rubber Company, Gadsden, AL	4	5.5E−03	2.9	4.0E−03	364

Site Identity	Total Fugitive Air Release (kg/yr)	Daily Fugitive Air Release (kg/day)	Total Stack Air Release (kg/yr)	Daily Stack Air Release (kg/day)	Annual Release Days (days/yr)
Georgia Pacific Wood Products LLC, Fayette, AL	5.4E−03	7.5E−06	Stack releases not reported	Stack releases not reported	364
Georgia-Pacific Panel Products LLC, Monroeville, AL	Fugitive releases not reported	Fugitive releases not reported	Stack releases not reported	Stack releases not reported	364
Georgia-Pacific Wood Products, LLC, Frisco City, AL	4.5E−03	6.2E−06	Stack releases not reported	Stack releases not reported	364
Kepler Processing - Pocahontas No. 51 Preparation Plant, Pineville, WV	Fugitive releases not reported	Fugitive releases not reported	0.13	2.9E−04	228
Michelin Tire Corporation, Midland City, AL	8.7	1.2E−02	3.7	5.0E−03	364
Honda Manufacturing of Alabama LLC, Lincoln, AL	Fugitive releases not reported	Fugitive releases not reported	Stack releases not reported	Stack releases not reported	364
Fort Rucker, Fort Rucker, AL	8.2	1.1E−02	0	0	364
BFGoodrich Tire Co, Tuscaloosa, AL	9.8	1.3E−02	38	5.3E−02	364
Georgia-Pacific Wood Products LLC - Dudley Plywood/CNS Plant, Dudley, NC	Fugitive releases not reported	Fugitive releases not reported	0.14	2.0E−04	364
Rockwell Collins, Inc., Melbourne, FL	0	0	Stack releases not reported	Stack releases not reported	365
Georgia Pacific Wood Products LLC, Hosford, FL	Fugitive releases not reported	Fugitive releases not reported	Stack releases not reported	Stack releases not reported	364
Canfor Southern Pine - Camden Plant, Cassatt, SC	Fugitive releases not reported	Fugitive releases not reported	1.7E−02	2.4E−05	353
Lockheed Martin Aeronautics Company, Pinellas Park, FL	Fugitive releases not reported	Fugitive releases not reported	0	0	312
Langdale Forest Products Co., Valdosta, GA	0	0	Stack releases not reported	Stack releases not reported	364
Georgia-Pacific Wood Products LLC (Sterling), Brunswick, GA	0	0	Stack releases not reported	Stack releases not reported	364
Georgia-Pacific Panel Products LLC - Thomson Particleboard Plant, Thomson, GA	Fugitive releases not reported	Fugitive releases not reported	Stack releases not reported	Stack releases not reported	364
Georgia-Pacific Wood Products South LLC Lumber Plant, Rome, GA	Fugitive releases not reported	Fugitive releases not reported	Stack releases not reported	Stack releases not reported	364

Site Identity	Total Fugitive Air Release (kg/yr)	Daily Fugitive Air Release (kg/day)	Total Stack Air Release (kg/yr)	Daily Stack Air Release (kg/day)	Annual Release Days (days/yr)
Tri-State Brick LLC, Jackson, MS	Fugitive releases not reported	Fugitive releases not reported	26	3.6E−02	365
Roseburg Forest Products - Taylorsville Composites, Taylorsville, MS	Fugitive releases not reported	Fugitive releases not reported	Stack releases not reported	Stack releases not reported	364
Toyota Motor Manufacturing, Kentucky, Georgetown (Scott), KY	Fugitive releases not reported	Fugitive releases not reported	5,361	7.4	364
United Taconite LLC - Fairlane Plant, Forbes, MN	Fugitive releases not reported	Fugitive releases not reported	0.86	1.2E−03	364
HAECO Airframe Services, LLC, Greensboro, NC	0	0	Stack releases not reported	Stack releases not reported	364
Northshore Mining Co, Silver Bay, MN	Fugitive releases not reported	Fugitive releases not reported	Stack releases not reported	Stack releases not reported	364
Georgia Pacific Wood Products LLC, Bay S, Bay Springs, MS	Fugitive releases not reported	Fugitive releases not reported	Stack releases not reported	Stack releases not reported	364
Georgia Pacific Diboll Lumber Operations, Diboll, TX	Fugitive releases not reported	Fugitive releases not reported	5.6	8.6E−03	326
Victaulic Company, Leland, NC	0	0	Stack releases not reported	Stack releases not reported	364
DENSO Manufacturing North Carolina, Inc. - Statesville Plant, Statesville, NC	0	0	Stack releases not reported	Stack releases not reported	255
Mann+Hummel Filtration Technology - Allen Plant, Gastonia, NC	Fugitive releases not reported	Fugitive releases not reported	1.6	3.2E−03	250
Johnson Breeders, Inc., Warsaw, NC	Fugitive releases not reported	Fugitive releases not reported	Stack releases not reported	Stack releases not reported	364
High Point Fibers, Inc., High Point, NC	Fugitive releases not reported	Fugitive releases not reported	Stack releases not reported	Stack releases not reported	364
USCG Base Support Unit Elizabeth City, Elizabeth City, NC	0	0	Stack releases not reported	Stack releases not reported	364
Canfor Southern Pine Darlington, Darlington, SC	Fugitive releases not reported	Fugitive releases not reported	5.3E−03	7.3E−06	364
Louisiana-Pacific Corporation - Roxboro, Roxboro, NC	Fugitive releases not reported	Fugitive releases not reported	2.7E−02	3.8E−05	350

Site Identity	Total Fugitive Air Release (kg/yr)	Daily Fugitive Air Release (kg/day)	Total Stack Air Release (kg/yr)	Daily Stack Air Release (kg/day)	Annual Release Days (days/yr)
Canfor Southern Pine - Conway Mill, Conway, SC	Fugitive releases not reported	Fugitive releases not reported	1.7E−02	2.4E−05	353
West Fraser - Seaboard Lumber Mill, Seaboard, NC	Fugitive releases not reported	Fugitive releases not reported	Stack releases not reported	Stack releases not reported	364
Parton Lumber Company, Inc., Rutherfordton, NC	Fugitive releases not reported	Fugitive releases not reported	Stack releases not reported	Stack releases not reported	364
Unilin Flooring, N.V., Mount Gilead, NC	Fugitive releases not reported	Fugitive releases not reported	Stack releases not reported	Stack releases not reported	364
H. W. Culp Lumber Co, Inc., New London, NC	6.5E−04	9.4E−07	8.1E−03	1.2E−05	350
Weyerhaeuser NR Company - New Bern Lumber Facility, Vanceboro, NC	0	0	Stack releases not reported	Stack releases not reported	364
Woodgrain Millwork, Inc., La Grande, OR	Fugitive releases not reported	Fugitive releases not reported	4.3E−04	5.9E−07	364
Charles Ingram Lumber Co, Effingham, SC	1.1E−02	1.6E−05	8.2E−03	1.1E−05	365
Altec Industries, Inc. - Burnsville Facility, Burnsville, NC	Fugitive releases not reported	Fugitive releases not reported	Stack releases not reported	Stack releases not reported	364
Interfor Georgetown Division, Georgetown, SC	0	0	6.6E−03	9.1E−06	365
Elliott Sawmilling Company LLC, Estill, SC	Fugitive releases not reported	Fugitive releases not reported	1.5E−02	2.2E−05	338
Enviva Pellets Sampson, LLC, Faison, NC	Fugitive releases not reported	Fugitive releases not reported	1.7E−03	2.7E−06	322
Mine Safety Appliances, Jacksonville, NC	Fugitive releases not reported	Fugitive releases not reported	Stack releases not reported	Stack releases not reported	364
Westrock Charleston Kraft LLC-Summerville, Summerville, SC	Fugitive releases not reported	Fugitive releases not reported	6.6E−03	9.1E−06	365
Gibson USA, Nashville, TN	Fugitive releases not reported	Fugitive releases not reported	236	0.32	364
Georgia-Pacific Wood Products LLC (McCormick Sawmill), McCormick, SC	0	0	Stack releases not reported	Stack releases not reported	364
West Fraser Inc Newberry Lumber Mill, Newberry, SC	Fugitive releases not reported	Fugitive releases not reported	1.0E−02	1.5E−05	358

Site Identity	Total Fugitive Air Release (kg/yr)	Daily Fugitive Air Release (kg/day)	Total Stack Air Release (kg/yr)	Daily Stack Air Release (kg/day)	Annual Release Days (days/yr)
Polyone Corp, Jonesborough, TN	0	0	Stack releases not reported	Stack releases not reported	364
Olin Winchester LLC, East Alton, IL	Fugitive releases not reported	Fugitive releases not reported	Stack releases not reported	Stack releases not reported	1.0
Armstrong Flooring Inc, Kankakee, IL	Fugitive releases not reported	Fugitive releases not reported	369	0.87	211
Owens Corning - Minneapolis Plant, Minneapolis, MN	Fugitive releases not reported	Fugitive releases not reported	0.18	2.5E−04	364
Plato Woodwork Inc, Plato, MN	0	0	Stack releases not reported	Stack releases not reported	364
CertainTeed Corp, Shakopee, MN	Fugitive releases not reported	Fugitive releases not reported	0.22	3.0E−04	364
Georgia-Pacific Panel Products LLC - Hope Particle Board Mill, HOPE, AR	Fugitive releases not reported	Fugitive releases not reported	Stack releases not reported	Stack releases not reported	364
Roseburg Forest Products - El Dorado MDF, El Dorado, AR	Fugitive releases not reported	Fugitive releases not reported	Stack releases not reported	Stack releases not reported	364
Anthony Forest Products Company, LLC -Urbana Mill, El Dorado, AR	Fugitive releases not reported	Fugitive releases not reported	Stack releases not reported	Stack releases not reported	364
Georgia Pacific Wood Products LLC - DeQuincy Lumber Operations, Dequincy, LA	Fugitive releases not reported	Fugitive releases not reported	Stack releases not reported	Stack releases not reported	364
Jeld-Wen, Dodson, LA	Fugitive releases not reported	Fugitive releases not reported	9.1E−03	1.2E−05	364
Fort Hood, Fort Hood, TX	9.2	1.8E−02	Stack releases not reported	Stack releases not reported	260
Brownwood Plant, Brownwood, TX	0	0	Stack releases not reported	Stack releases not reported	300
Camden Plywood & Lumber Complex, Camden, TX	0	0	Stack releases not reported	Stack releases not reported	364
Pineland Manufacturing Complex, Pineland, TX	Fugitive releases not reported	Fugitive releases not reported	Stack releases not reported	Stack releases not reported	364
Spirit Aerosystems - Wichita, KS	0.91	1.2E−03	Stack releases not reported	Stack releases not reported	364

Site Identity	Total Fugitive Air Release (kg/yr)	Daily Fugitive Air Release (kg/day)	Total Stack Air Release (kg/yr)	Daily Stack Air Release (kg/day)	Annual Release Days (days/yr)
Confluence Energy - Walden, Walden Area, Co	Fugitive releases not reported	Fugitive releases not reported	129	0.18	364
Wastequip Manufacturing Company LLC, Arvada, Co	Fugitive releases not reported	Fugitive releases not reported	277	0.38	364
Roseburg Forest Products, Missoula, Mt	Fugitive releases not reported	Fugitive releases not reported	Stack releases not reported	Stack releases not reported	364
St. Louis Airport Authority Lambert International Blvd, St. Louis, MO	0	0	Stack releases not reported	Stack releases not reported	364
Colony Plant, Crook, WY	Fugitive releases not reported	Fugitive releases not reported	0.73	1.0E−03	359
Lovell Grinding Plant, Big Horn, WY	Fugitive releases not reported	Fugitive releases not reported	Stack releases not reported	Stack releases not reported	364
Big Island Mine & Refinery, Sweetwater, WY	Fugitive releases not reported	Fugitive releases not reported	628	0.87	362
Westvaco Facility, Sweetwater, WY	Fugitive releases not reported	Fugitive releases not reported	Stack releases not reported	Stack releases not reported	364
Brigham Young University- Main Campus, Provo, UT	Fugitive releases not reported	Fugitive releases not reported	15	2.9E−02	260
Tesla, Inc, Fremont, CA	0	0	Stack releases not reported	Stack releases not reported	364
Innovative Coatings Technology Corporation, Mojave, CA	0	0	1.9E−02	2.6E−05	364
Lockheed Martin Aeronautics Company Palmdale, Palmdale, CA	2.3E−02	3.3E−05	Stack releases not reported	Stack releases not reported	350
Brannon Tire, Stockton, CA	1.2E−03	2.4E−06	Stack releases not reported	Stack releases not reported	260
Naval Base Ventura County, Port Hueneme, CA	0	0	Stack releases not reported	Stack releases not reported	260
Boise Cascade Wood Products, LLC Kettle Falls Plywood, Kettle Falls, WA	Fugitive releases not reported	Fugitive releases not reported	0	0	320
Flakeboard America Limited, Albany, Or	Fugitive releases not reported	Fugitive releases not reported	Stack releases not reported	Stack releases not reported	364

Site Identity	Total Fugitive Air Release (kg/yr)	Daily Fugitive Air Release (kg/day)	Total Stack Air Release (kg/yr)	Daily Stack Air Release (kg/day)	Annual Release Days (days/yr)
Timber Products Co. Limited Partnership, Medford, Or	Fugitive releases not reported	Fugitive releases not reported	Stack releases not reported	Stack releases not reported	364
Georgia-Pacific - Monticello MDF, Monticello, GA	Fugitive releases not reported	Fugitive releases not reported	Stack releases not reported	Stack releases not reported	364
Huntington Ingalls Inc, Ingalls Shipbuil, Pascagoula, MS	0	0	Stack releases not reported	Stack releases not reported	364
National Coatings Restoration Inc, Blooming Prairie, MN	Fugitive releases not reported	Fugitive releases not reported	Stack releases not reported	Stack releases not reported	364
Edwards Wood Products, Inc.- Liberty Dry Kilns, Liberty, NC	Fugitive releases not reported	Fugitive releases not reported	Stack releases not reported	Stack releases not reported	364
Custom Wood Products Inc, New Paris, IN	Fugitive releases not reported	Fugitive releases not reported	4.5E−03	6.2E−06	364
3M - R & D Facility - Maplewood Bldg 201, Maplewood, MN	Fugitive releases not reported	Fugitive releases not reported	24	3.3E−02	364
Georgia-Pacific Wood Products, LLC (Fordyce OSB), Fordyce, AR	Fugitive releases not reported	Fugitive releases not reported	Stack releases not reported	Stack releases not reported	202
Kirtland Air Force Base, Albuquerque, NM	0	0	Stack releases not reported	Stack releases not reported	364
Ft Bliss Army Installation, El Paso, TX	0	0	Stack releases not reported	Stack releases not reported	364
Curries Division of AADG, Inc - 12th St NW, Mason City, IA	18	3.5E−02	Stack releases not reported	Stack releases not reported	260
Freeport-McMoran Morenci Inc., Morenci, AZ	0	0	Stack releases not reported	Stack releases not reported	364
Portsmouth Naval Shipyard - Kittery, Kittery, ME	7.3E−03	1.0E−05	Stack releases not reported	Stack releases not reported	364
Plant 5a, Grand Prairie, TX	8.1	1.1E−02	Stack releases not reported	Stack releases not reported	365
Schlagel, Inc., Cambridge, MN	Fugitive releases not reported	Fugitive releases not reported	0.67	9.2E−04	364
Curtis-Wright Surface Technologies, New Brighton, MN	Fugitive releases not reported	Fugitive releases not reported	2.0	2.7E−03	364

Site Identity	Total Fugitive Air Release (kg/yr)	Daily Fugitive Air Release (kg/day)	Total Stack Air Release (kg/yr)	Daily Stack Air Release (kg/day)	Annual Release Days (days/yr)
Us Air Force Plant 4, Fort Worth, TX	0.27	3.7E−04	Stack releases not reported	Stack releases not reported	365
PTMW Inc. - Topeka, Topeka, KS	6.4	1.2E−02	Stack releases not reported	Stack releases not reported	260
Artistic Frame Company, Kannapolis, NC	Fugitive releases not reported	Fugitive releases not reported	2.4	4.6E−03	260
Federal-Mogul Motorparts, Smithville, TN	14	1.9E−02	58	8.0E−02	364
Nissan North America, Inc. - Smyrna, Smyrna, TN	Fugitive releases not reported	Fugitive releases not reported	308	0.42	364
Green River Works, Sweetwater, WY	Fugitive releases not reported	Fugitive releases not reported	399	0.55	365
Imerys Perlite USA, Inc., Lakeview, Or	Fugitive releases not reported	Fugitive releases not reported	0.27	3.7E−04	364
Northrop Grumman Corp Aircraft Integration Center, Palmdale, CA	Fugitive releases not reported	Fugitive releases not reported	3.4E−03	4.8E−06	350
Vigor Industrial, LLC, Portland, Or	2.4	3.4E−03	Stack releases not reported	Stack releases not reported	364

Table 3-47. Summary of Land Releases from TRI for Application of Paints, Coatings, Adhesives, and Sealants

Site Identity	Median Total Release (kg/yr)	Maximum Total Release (kg/yr)	Annual Release Days (days/yr)
Kohler Co, Union City, TN	249	274	364

Table 3-48. Summary of Water Releases from DMR and TRI for Application of Paints, Coatings, Adhesives, and Sealants

Site Identity	Source-Discharge Type	Median Annual Discharge (kg/yr)	Daily Discharge (Corresponding to Median Annual Discharge) (kg/day)	Maximum Annual Discharge (kg/yr)	Daily Discharge (Corresponding to Maximum Daily Discharge) (kg/day)	Annual Release Days (days/yr)
AES Alamitos, LLC, Los Angeles, CA	DMR-Direct Discharges	2,262	9.0	2,262	9.0	250
AES Alamitos, LLC, Los Angeles, CA	TRI-Direct Discharges	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	250
AES Alamitos, LLC, Los Angeles, CA	TRI-Transfers to POTW	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	250
AES Alamitos, LLC, Los Angeles, CA	TRI-Transfers to non-POTW	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	250
Amusement & Water Park, Bergen, NJ	DMR-Direct Discharges	1.2	4.7E−03	1.2	4.7E−03	250
Amusement & Water Park, Bergen, NJ	TRI-Direct Discharges	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	250
Amusement & Water Park, Bergen, NJ	TRI-Transfers to POTW	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	250
Amusement & Water Park, Bergen, NJ	TRI-Transfers to non-POTW	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	250
Bourg Dry Dock & Service Co, Terrebonne, LA	DMR-Direct Discharges	0.67	2.7E−03	1.1	4.3E−03	250
Bourg Dry Dock & Service Co, Terrebonne, LA	TRI-Direct Discharges	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	250
Bourg Dry Dock & Service Co, Terrebonne, LA	TRI-Transfers to POTW	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	250
Bourg Dry Dock & Service Co, Terrebonne, LA	TRI-Transfers to non-POTW	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	250
Carrier Foundation, Somerset, NJ	DMR-Direct Discharges	3.9	1.6E−02	18	7.2E−02	250

Site Identity	Source-Discharge Type	Median Annual Discharge (kg/yr)	Daily Discharge (Corresponding to Median Annual Discharge) (kg/day)	Maximum Annual Discharge (kg/yr)	Daily Discharge (Corresponding to Maximum Daily Discharge) (kg/day)	Annual Release Days (days/yr)
Carrier Foundation, Somerset, NJ	TRI-Direct Discharges	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	250
Carrier Foundation, Somerset, NJ	TRI-Transfers to POTW	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	250
Carrier Foundation, Somerset, NJ	TRI-Transfers to non-POTW	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	250
Castaic, Los Angeles, CA	DMR-Direct Discharges	0.51	2.1E−03	0.82	3.3E−03	250
Castaic, Los Angeles, CA	TRI-Direct Discharges	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	250
Castaic, Los Angeles, CA	TRI-Transfers to POTW	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	250
Castaic, Los Angeles, CA	TRI-Transfers to non-POTW	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	250
Coastal Tank Cleaning, LLC, St Mary, LA	DMR-Direct Discharges	0.64	2.6E−03	0.64	2.6E−03	250
Coastal Tank Cleaning, LLC, St Mary, LA	TRI-Direct Discharges	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	250
Coastal Tank Cleaning, LLC, St Mary, LA	TRI-Transfers to POTW	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	250
Coastal Tank Cleaning, LLC, St Mary, LA	TRI-Transfers to non-POTW	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	250
El Centro Generating Station, Imperial, CA	DMR-Direct Discharges	0.44	1.8E−03	0.49	2.0E−03	250
El Centro Generating Station, Imperial, CA	TRI-Direct Discharges	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	250
El Centro Generating Station, Imperial, CA	TRI-Transfers to POTW	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	250

Site Identity	Source-Discharge Type	Median Annual Discharge (kg/yr)	Daily Discharge (Corresponding to Median Annual Discharge) (kg/day)	Maximum Annual Discharge (kg/yr)	Daily Discharge (Corresponding to Maximum Daily Discharge) (kg/day)	Annual Release Days (days/yr)
El Centro Generating Station, Imperial, CA	TRI-Transfers to non-POTW	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	250
Eleanor Slater Hospital - Zambarano Unit, Providence, RI	DMR-Direct Discharges	0.49	2.0E−03	0.49	2.0E−03	250
Eleanor Slater Hospital - Zambarano Unit, Providence, RI	TRI-Direct Discharges	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	250
Eleanor Slater Hospital - Zambarano Unit, Providence, RI	TRI-Transfers to POTW	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	250
Eleanor Slater Hospital - Zambarano Unit, Providence, RI	TRI-Transfers to non-POTW	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	250
Granite Rock Wilson, Monterey, CA	DMR-Direct Discharges	0.90	3.6E−03	1.2	5.0E−03	250
Granite Rock Wilson, Monterey, CA	TRI-Direct Discharges	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	250
Granite Rock Wilson, Monterey, CA	TRI-Transfers to POTW	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	250
Granite Rock Wilson, Monterey, CA	TRI-Transfers to non-POTW	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	250
Harbor Generating Station, Los Angeles, CA	DMR-Direct Discharges	1,057	4.2	1,057	4.2	250
Harbor Generating Station, Los Angeles, CA	TRI-Direct Discharges	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	250
Harbor Generating Station, Los Angeles, CA	TRI-Transfers to POTW	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	250
Harbor Generating Station, Los Angeles, CA	TRI-Transfers to non-POTW	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	250

Site Identity	Source-Discharge Type	Median Annual Discharge (kg/yr)	Daily Discharge (Corresponding to Median Annual Discharge) (kg/day)	Maximum Annual Discharge (kg/yr)	Daily Discharge (Corresponding to Maximum Daily Discharge) (kg/day)	Annual Release Days (days/yr)
Kahala Hotel & Resort, Honolulu, Hi	DMR-Direct Discharges	34	0.13	34	0.13	250
Kahala Hotel & Resort, Honolulu, Hi	TRI-Direct Discharges	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	250
Kahala Hotel & Resort, Honolulu, Hi	TRI-Transfers to POTW	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	250
Kahala Hotel & Resort, Honolulu, Hi	TRI-Transfers to non-POTW	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	250
National Western Center 3.01b - Rail Realignment, Denver, Co	DMR-Direct Discharges	0.14	5.4E−04	0.14	5.4E−04	250
National Western Center 3.01b - Rail Realignment, Denver, Co	TRI-Direct Discharges	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	250
National Western Center 3.01b - Rail Realignment, Denver, Co	TRI-Transfers to POTW	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	250
National Western Center 3.01b - Rail Realignment, Denver, Co	TRI-Transfers to non-POTW	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	250
Natl Steel & Shipbuilding A General Dynamics Co, San Diego, CA	DMR-Direct Discharges	0.87	3.5E−03	0.87	3.5E−03	250
Natl Steel & Shipbuilding A General Dynamics Co, San Diego, CA	TRI-Direct Discharges	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	250
Natl Steel & Shipbuilding A General Dynamics Co, San Diego, CA	TRI-Transfers to POTW	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	250

Site Identity	Source-Discharge Type	Median Annual Discharge (kg/yr)	Daily Discharge (Corresponding to Median Annual Discharge) (kg/day)	Maximum Annual Discharge (kg/yr)	Daily Discharge (Corresponding to Maximum Daily Discharge) (kg/day)	Annual Release Days (days/yr)
Natl Steel & Shipbuilding A General Dynamics Co, San Diego, CA	TRI-Transfers to non-POTW	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	250
Nrg Energy Center Harrisburg LLC, Dauphin, PA	DMR-Direct Discharges	143	0.57	143	0.57	250
Nrg Energy Center Harrisburg LLC, Dauphin, PA	TRI-Direct Discharges	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	250
Nrg Energy Center Harrisburg LLC, Dauphin, PA	TRI-Transfers to POTW	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	250
Nrg Energy Center Harrisburg LLC, Dauphin, PA	TRI-Transfers to non-POTW	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	250
Ormond Beach Generating Station, Ventura, CA	DMR-Direct Discharges	489	2.0	489	2.0	250
Ormond Beach Generating Station, Ventura, CA	TRI-Direct Discharges	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	250
Ormond Beach Generating Station, Ventura, CA	TRI-Transfers to POTW	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	250
Ormond Beach Generating Station, Ventura, CA	TRI-Transfers to non-POTW	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	250
Owens-Brockway Glass Container Inc, Los Angeles, CA	DMR-Direct Discharges	0.11	4.4E−04	0.11	4.4E−04	250
Owens-Brockway Glass Container Inc, Los Angeles, CA	TRI-Direct Discharges	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	250
Owens-Brockway Glass Container Inc, Los Angeles, CA	TRI-Transfers to POTW	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	250
Owens-Brockway Glass Container Inc, Los Angeles, CA	TRI-Transfers to non-POTW	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	250

Site Identity	Source-Discharge Type	Median Annual Discharge (kg/yr)	Daily Discharge (Corresponding to Median Annual Discharge) (kg/day)	Maximum Annual Discharge (kg/yr)	Daily Discharge (Corresponding to Maximum Daily Discharge) (kg/day)	Annual Release Days (days/yr)
PA Transformer Tech, Washington, PA	DMR-Direct Discharges	11	4.5E−02	11	4.5E−02	250
PA Transformer Tech, Washington, PA	TRI-Direct Discharges	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	250
PA Transformer Tech, Washington, PA	TRI-Transfers to POTW	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	250
PA Transformer Tech, Washington, PA	TRI-Transfers to non-POTW	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	250
Scattergood Generating Station, Los Angeles, CA	DMR-Direct Discharges	0.53	2.1E−03	0.79	3.1E−03	250
Scattergood Generating Station, Los Angeles, CA	TRI-Direct Discharges	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	250
Scattergood Generating Station, Los Angeles, CA	TRI-Transfers to POTW	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	250
Scattergood Generating Station, Los Angeles, CA	TRI-Transfers to non-POTW	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	250
Seaworld San Diego, San Diego, CA	DMR-Direct Discharges	37	0.15	72	0.29	250
Seaworld San Diego, San Diego, CA	TRI-Direct Discharges	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	250
Seaworld San Diego, San Diego, CA	TRI-Transfers to POTW	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	250
Seaworld San Diego, San Diego, CA	TRI-Transfers to non-POTW	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	250
Sussex Cnty Mua Hampton Commons STP, Sussex, NJ	DMR-Direct Discharges	0.13	5.3E−04	0.13	5.3E−04	250

Site Identity	Source-Discharge Type	Median Annual Discharge (kg/yr)	Daily Discharge (Corresponding to Median Annual Discharge) (kg/day)	Maximum Annual Discharge (kg/yr)	Daily Discharge (Corresponding to Maximum Daily Discharge) (kg/day)	Annual Release Days (days/yr)
Sussex Cnty Mua Hampton Commons STP, Sussex, NJ	TRI-Direct Discharges	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	250
Sussex Cnty Mua Hampton Commons STP, Sussex, NJ	TRI-Transfers to POTW	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	250
Sussex Cnty Mua Hampton Commons STP, Sussex, NJ	TRI-Transfers to non-POTW	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	250
William E. Warne Power Plant, Los Angeles, CA	DMR-Direct Discharges	1.2	4.7E−03	1.2	4.7E−03	250
William E. Warne Power Plant, Los Angeles, CA	TRI-Direct Discharges	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	250
William E. Warne Power Plant, Los Angeles, CA	TRI-Transfers to POTW	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	250
William E. Warne Power Plant, Los Angeles, CA	TRI-Transfers to non-POTW	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	250

3.7.4 Occupational Exposure Assessment

3.7.4.1 Worker Activities

During the use of paints, coatings, adhesives, and sealants containing DEHP, workers exposures to DEHP mist may occur during roll or curtain coating of paints and coatings, spray coating of paints and coatings (due to overspray), and spray or roll coating of adhesives and sealants. EPA separately assessed inhalation exposures for workers who work with the spray application of paints, coatings, adhesives, and sealants, and workers who work with the non-spray application.

Worker exposures may also occur via inhalation of vapors or dermal contact with liquids during product unloading into application equipment, container and application equipment cleaning, and curing or drying or applied product (OECD, 2015a, 2011b).

EPA identified two NIOSH surveys at autobody repair shops that apply paint to automobiles using spray painting methods. Both autobody repair shops used spray painting booths to decrease worker exposures to paints and coatings during the spray painting of vehicles (Heitbrink, 1993; Heitbrink et al., 1993). PPE used at the two autobody repair shops included half-facepiece, air-purifying respirators that were equipped with organic vapor cartridges and spray painting prefilters. In addition, painters routinely wore rubber gloves and disposable clothing at one of the autobody repair shops during painting operations (Heitbrink et al., 1993). Based on the Emission Scenario Document on the Application of Radiation Curable Coatings, Inks, and Adhesives Via Spray, Vacuum, Roll, and Curtain Coating and the Emission Scenario Document on the Use of Adhesives, PPE may include fabric or non-woven long sleeved shirts and pants, coveralls, neoprene or rubber gloves, barrier creams, rubber aprons or suits, rubber boots, chemical-resistant gloves, heat-resistant gloves, safety glasses or goggles, and respiratory protection where necessary (OECD, 2015a, 2011b). EPA expects the types of PPE and controls used at each site to be based on the hazards present; therefore, the common PPE/controls presented in the GS/ESD may or may not apply when DEHP is being used.

ONUs include supervisors, managers, and other employees that work in the application area but do not directly contact paints, coatings, adhesives, or sealants or handle or apply products. ONUs are potentially exposed through the inhalation route while in the application area. For spray-applied paints, coatings, adhesives, and sealants, EPA assessed dermal exposures from contact with surfaces where mist has been deposited for ONUs.

3.7.4.2 Occupational Inhalation Exposure Results

Spray application

EPA did not identify inhalation monitoring specific to the spray application of DEHP-containing paints, coatings, adhesives and sealants during systematic review of literature sources. EPA assessed exposures from spray application using the Automotive Refinishing Spray Coating Mist Inhalation Model which estimates worker inhalation exposure based on the concentration of the chemical of interest in the nonvolatile portion of the sprayed product and the concentration of over sprayed mist/particles (OECD, 2011a). The model is based on PBZ monitoring data for mists during automotive refinishing. EPA used the 50th and 95th percentile mist concentrations along with the maximum and central tendency concentration of DEHP identified in the application of paints, coatings, adhesives, and sealants to estimate the central tendency and high-end inhalation exposures, respectively. Effectively, the difference in the central tendency and high-end value is representative of the difference in the spray equipment, engineering controls, and resulting exposure reduction. Equations and parameters used to calculate inhalation exposures using the Automotive Refinishing Spray Coating Mist Inhalation Model are included in Appendix D.6. The Occupational Inhalation Exposures from Application of Paints, Coatings, Adhesives, and Sealants for Diethylhexyl Phthalate (DEHP) also contains information about model equations and parameters and contains calculation results; refer to Appendix J for a reference to this supplemental document.

Table 3-49. Summary of Estimated Worker Inhalation Exposures for Spray Application of Paints, Coatings, Adhesives, and Sealants

Modeled Scenario	Exposure Concentration Type	Central Tendency	High-End
Average Adult Worker	8-hour TWA Exposure Concentration (mg/m^3)	0.30	22
	Acute (AD, mg/kg-day)	3.8E−02	2.8
	Intermediate (IADD, mg/kg-day)	2.8E−02	2.03
	Chronic, Non-Cancer (ADD, mg/kg-day)	2.6E−02	1.9
Female of Reproductive Age	8-hour TWA Exposure Concentration (mg/m^3)	0.30	22
	Acute (AD, mg/kg-day)	4.2E−02	3.05
	Intermediate (IADD, mg/kg-day)	3.1E−02	2.2
	Chronic, Non-Cancer (ADD, mg/kg-day)	2.9E−02	2.1
ONU	8-hour TWA Exposure Concentration (mg/m^3)	0.30	
	Acute (AD, mg/kg-day)	3.8E−02	
	Intermediate (IADD, mg/kg-day)	2.8E−02	
	Chronic, Non-Cancer (ADD, mg/kg-day)	2.6E−02	

Non-Spray application

No references with discrete full shift samples were identified for the non-spray application of paints, coatings, adhesives, and sealants through systematic review. However, the Rubber manufacturing OES was selected as a surrogate as it represented the highest air concentration of DEHP across all scenarios with monitoring data relevant to non-spray applications, given that volatilization is the primary contributor to the air concentration for both OES and no inhalation monitoring data were identified specifically for the non-spray application OES. A European Commission document provided maximum concentrations based on time-weighted average personal and area samples from a plant performing rubber calendering (ECB, 2003). These data included the highest air concentration values for each sampling event along with the sampling duration. EPA assessed the inhalation exposures for this OES using surrogate monitoring data from the rubber manufacturing OES as it represented the highest vapor concentration of DEHP across all scenarios.

EPA assessed high-end worker inhalation exposures for this OES by calculating the 8-hour TWA using the sampling event with highest air concentration. Similarly, EPA assessed the central tendency exposures using the sampling event with lowest reported air concentration. The reported range for these data was 0.04 mg/m^3 to 26.7 mg/m^3. However, the actual individual measurements (concentration and duration) were not presented. These data had a data quality rating of high, meaning they are of acceptable quality. These results are presented in Table 3-50.

EPA acknowledges that rubber manufacturing (calendering) employs high temperatures (200°C) which likely result in higher air concentrations compared to other non-spray OES. Therefore, EPA compared the dose from non-spray application of application of paints, coatings, adhesives, and sealants for DEHP (based on rubber calendering) to another phthalate (DBP) which had inhalation monitoring data for non-spray application of paints, coatings, adhesives, and sealants from operations at ambient temperatures. Importantly, the DEHP inhalation dose to females of reproductive age using rubber calendering data as a surrogate for non-spray applications of paints, coatings, adhesives, and sealants (0.23 mg/kg-day at central tendency and 1.12 mg/kg-day for high-end; Table 3-50) is very similar to DBP for this same OES (0.21 mg/kg-day at central tendency and 1.02 mg/kg-day for high-end (U.S. EPA, 2025b), thereby increasing EPA's confidence in the use of rubber manufacturing inhalation monitoring data as a surrogate for non-spray application of paints, coatings, adhesives, and sealants. Additional discussion on the uncertainty and limitations of these data are included in the weight of scientific evidence (Section 4.2). No data with full shift samples for ONUs were identified for this OES through systematic review. For this reason, worker central tendency exposure concentrations were used to assess ONU exposures.

Table 3-50. Summary of Estimated Worker Inhalation Exposures for Non-Spray Application of Paints, Coatings, Adhesives, and Sealants[a]

Modeled Scenario	Exposure Concentration Type	Central Tendency	High-End
Average Adult Worker	8-hour TWA Exposure Concentration (mg/m^3)	1.7	10
	Acute (AD, mg/kg-day)	0.21	1.02
	Intermediate (IADD, mg/kg-day)	0.15	0.75
	Chronic, Non-Cancer (ADD, mg/kg-day)	0.14	0.70
Female of Reproductive Age	8-hour TWA Exposure Concentration (mg/m^3)	1.7	10
	Acute (AD, mg/kg-day)	0.23 [b]	1.1 [b]
	Intermediate (IADD, mg/kg-day)	0.17	0.82
	Chronic, Non-Cancer (ADD, mg/kg-day)	0.16	0.77
ONU	8-hour TWA Exposure Concentration (mg/m^3)	1.7	
	Acute (AD, mg/kg-day)	0.21	
	Intermediate (IADD, mg/kg-day)	0.15	
	Chronic, Non-Cancer (ADD, mg/kg-day)	0.14	

[a] Monitoring data for the rubber manufacturing OES is being used as a surrogate for non-spray application of paints, coatings, adhesives, and sealants.
[b] EPA used inhalation monitoring data from rubber manufacturing as a surrogate for the non-spray application of paints, coatings, adhesives, and sealants, given that volatilization is the primary contributor to the air concentration for both OES and no inhalation monitoring data were identified specifically for the non-spray application OES. EPA acknowledges that rubber manufacturing (calendering) employs high temperatures (200°C) which likely result in higher air concentrations compared to other non-spray OES. Therefore, EPA compared the dose from non-spray application of application of paints, coatings, adhesives, and sealants for DEHP (based on rubber calendering) to another phthalate (DBP) which had inhalation monitoring data for non-spray application of paints, coatings, adhesives from operations that did not entail elevated temperatures. Importantly, the DEHP inhalation dose to females of reproductive age using rubber calendering data for non-spray applications (0.23 mg/kg-day at central tendency and 1.12 mg/kg-day for high-end) is very similar to DBP for non-spray applications (0.21 mg/kg-day at central tendency and 1.02 mg/kg-day for high-end), thereby increasing EPA's confidence in the use of rubber manufacturing inhalation monitoring data as a surrogate for non-spray application of adhesives, sealants, paints, and coatings.

3.7.4.3 Occupational Dermal Exposure Results

EPA estimated dermal exposures for this OES using the methodology outlined in Appendix C. The various "Exposure Concentration Types" from Table 3-51 are explained in Appendix A. Because workers may be exposed to DEHP-containing liquid during the application of paints, coatings, adhesives, and sealants, EPA assessed the absorptive flux of DEHP using the dermal absorption data for liquid DEHP (see Appendix C.2.1.1 for details). Table 3-51 summarizes the APDR, AD, IADD, and ADD for both average adult workers and female workers of reproductive age. The dermal exposure potential for average adult workers and female workers of reproductive age are estimated similarly across both spray and non-spray application methods. However, EPA only assessed ONU exposures from spray application since mist may be deposited on surfaces during spray application. Dermal exposure parameters are described in Appendix C. The *Occupational Dermal Exposure Modeling Results for Diethylhexyl Phthalate (DEHP)* also contains information about model equations and parameters and contains calculation results; refer to Appendix J for a reference to this supplemental document.

Table 3-51. Summary of Estimated Worker Dermal Exposures for Application of Paints, Coatings, Adhesives, and Sealants

Worker Population	Exposure Concentration Type	Central Tendency	High-End
Average Adult Worker – Spray Application	Dose Rate (APDR, mg/day)	0.11	0.21
	Acute (AD, mg/kg-day)	1.3E−03	2.7E−03
	Intermediate (IADD, mg/kg-day)	9.8E−04	2.0E−03
	Chronic, Non-Cancer (ADD, mg/kg-day)	9.2E−04	1.8E−03
Female of Reproductive Age – Spray Application	Dose Rate (APDR, mg/day)	9.0E−02	0.18
	Acute (AD, mg/kg-day)	1.2E−03	2.5E−03
	Intermediate (IADD, mg/kg-day)	9.0E−04	1.8E−03
	Chronic, Non-Cancer (ADD, mg/kg-day)	8.4E−04	1.7E−03
ONU – Spray Application	Dose Rate (APDR, mg/day)	0.11	
	Acute (AD, mg/kg-day)	1.3E−03	
	Intermediate (IADD, mg/kg-day)	9.8E−04	
	Chronic, Non-Cancer (ADD, mg/kg-day)	9.2E−04	
Average Adult Worker – Non-Spray Application	Dose Rate (APDR, mg/day)	0.11	0.21
	Acute (AD, mg/kg-day)	1.3E−03	2.7E−03
	Intermediate (IADD, mg/kg-day)	9.8E−04	2.0E−03
	Chronic, Non-Cancer (ADD, mg/kg-day)	9.2E−04	1.8E−03
Female of Reproductive Age – Non-Spray Application	Dose Rate (APDR, mg/day)	9.0E−02	0.18
	Acute (AD, mg/kg-day)	1.2E−03	2.5E−03
	Intermediate (IADD, mg/kg-day)	9.0E−04	1.8E−03
	Chronic, Non-Cancer (ADD, mg/kg-day)	8.4E−04	1.7E−03

3.7.4.4 Occupational Aggregate Exposure Results

Inhalation and dermal exposure estimates were aggregated based on the approach described in Appendix A to arrive at the aggregate worker and ONU exposure estimates in the table below. The *Occupational Risk Calculator for Diethylhexyl Phthalate (DEHP)* (U.S. EPA, 2025e) contains the calculations of aggregate exposure; refer to Appendix J for a reference to this supplemental document.

Table 3-52. Summary of Estimated Worker Aggregate Exposures for Application of Paints, Coatings, Adhesives, and Sealants

Modeled Scenario	Exposure Concentration Type (mg/kg/day)	Central Tendency	High-End
Average Adult Worker – Spray Application	Acute (AD, mg/kg-day)	3.9E−02	2.8
	Intermediate (IADD, mg/kg-day)	2.9E−02	2.03
	Chronic, Non-Cancer (ADD, mg/kg-day)	2.7E−02	1.9
Female of Reproductive Age – Spray Application	Acute (AD, mg/kg-day)	4.3E−02	3.05
	Intermediate (IADD, mg/kg-day)	3.2E−02	2.2

Modeled Scenario	Exposure Concentration Type (mg/kg/day)	Central Tendency	High-End
	Chronic, Non-Cancer (ADD, mg/kg-day)	3.0E−02	2.09
ONU – Spray Application	Acute (AD, mg/kg-day)	3.8E−02	
	Intermediate (IADD, mg/kg-day)	2.8E−02	
	Chronic, Non-Cancer (ADD, mg/kg-day)	2.6E−02	
Average Adult Worker – Non-Spray Application	Acute (AD, mg/kg-day)	0.21	1.02
	Intermediate (IADD, mg/kg-day)	0.15	0.75
	Chronic, Non-Cancer (ADD, mg/kg-day)	0.14	0.70
Female of Reproductive Age – Non-Spray Application	Acute (AD, mg/kg-day)	0.23	1.1
	Intermediate (IADD, mg/kg-day)	0.17	0.82
	Chronic, Non-Cancer (ADD, mg/kg-day)	0.16	0.77
ONU – Non-Spray Application	Acute (AD, mg/kg-day)	0.21	
	Intermediate (IADD, mg/kg-day)	0.15	
	Chronic, Non-Cancer (ADD, mg/kg-day)	0.14	

3.8 Textile Finishing

3.8.1 Process Description

Textile or fabric finishing may consist of either mechanical or chemical treatment of the fabric to impart or improve certain chemical or physical properties. Due to the complexity of the textile manufacturing process, pre-treatment, dyeing and finishing generally occur at specialized facilities that are separate from yarn and fabric manufacturers; however, finishing operations can also occur at integrated textile mills. Plasticizers, such as DEHP, are used in textile finishing as a fabric coating to impart fluidity to the coating formulation (OECD, 2024). EPA identified DEHP concentrations of up to 17 percent in children's clothing, up to 1.8 percent in body stockings, and up to 1.1 percent in printings on shirts, with concentrations as high as 21.3 percent in loose reflector pieces attached to the jackets (ECHA, 2010). EPA also identified DEHP concentrations in mitten labels of up to 14.7 percent (ECHA, 2010).

Facilities may receive textile finishing and coating chemicals in a variety of physical forms and container sizes. Chemicals may be sold as liquid concentrates, emulsions, dispersions, pastes, powders, pellets, or solid flakes. Containers likely range in size based upon the throughput of the processing facility as well as the physical state of the specific chemical (OECD, 2024).

The textile finishing or coating chemical is likely stored in its original container as received at the facility, with minimal transfer during reception or storage. The received chemical is likely diluted, solubilized, dispersed, or emulsified into a liquid formulation and charged to a tank or coating equipment for use during application. Handling the raw chemical additives represents the greatest potential for worker exposure via the dermal route because the chemicals are at their highest concentrations during this stage. In most cases, the finishing chemical is dissolved, emulsified, or dispersed in some form of application media (*e.g.*, water, foam, aerosol), before being applied to the fabric. After the final finishing or coating formulation has been prepared, the formulation may be applied to the fabric. Excess application media, typically aqueous media, is produced as a waste or byproduct of the finishing process. The excess application media may require treatment prior to recycling or disposal as a wastewater or liquid waste (OECD, 2024).

One of several coating methods may be used to apply the desired finishing agent to fabric. All coating methods are continuous processes that also enable a finishing chemical to be applied to a single side of the fabric, if desired. During coating, the finishing chemical is typically dissolved, emulsified, or dispersed in a liquid (similar to padding methods) and stored in a reservoir prior to application as a liquid, foam, or spray. Coating methods include roll coating, kiss roll coating, indirect coating, direct coating, spray coating, or foam coating. Roll coating application methods involve controlled application of the finishing chemical to one or both sides of the fabric using rollers. In kiss roll coating, a roller continuously takes up the liquid media containing the finishing chemical and transfers it to the fabric. The liquid media is typically highly viscous so that it remains on the rolling roller until it contacts the fabric and gets transferred to it. Indirect coating is similar to kiss roll coating, except a release paper is used to transfer the finishing chemical to the fabric instead of a liquid media. For indirect coating, the release paper is coated with the finishing chemical, which is then transferred to the fabric when rollers bring the fabric and coated release paper into contact. In direct coating systems, the media containing the finishing chemicals is applied directly to the fabric, not through transfer, with the help of rollers, which regulate the amount of finishing chemical applied. In kiss roll or direct coating systems, excess liquid media may be scraped off using doctor blades. In spray coating, the finishing chemical is contained within an aerosolized liquid media that gets applied to the fabric without direct contact between the fabric and any spray nozzles discharging the aerosolized liquid media. Foam coating application methods involve the use of a foam as the media for applying the finishing chemical to the fabric (OECD, 2024).

Waste textile material is generated during various steps of the textile manufacturing process and includes disposing of defective yarns/threads/fibers, defective fabrics, roll ends, surplus fabric, and offcuts. Some of these losses occur prior to fabric finishing and do not result in a release of the finishing chemical. Following the finishing process, the fabric contains the finishing chemical, which may be released if the finished fabric is disposed to landfill or incinerated. Disposal of finished fabric can be attributed to fabric cutting operations in preparation of the final textile product. In some cases, the finishing chemical may be cured, crosslinked, or chemically altered in some way during application, such that subsequent disposal of fabric offcuts does not present a significant release of the finishing chemical itself (OECD, 2024).

Figure 3-9 presents the textile finishing process flow diagram.

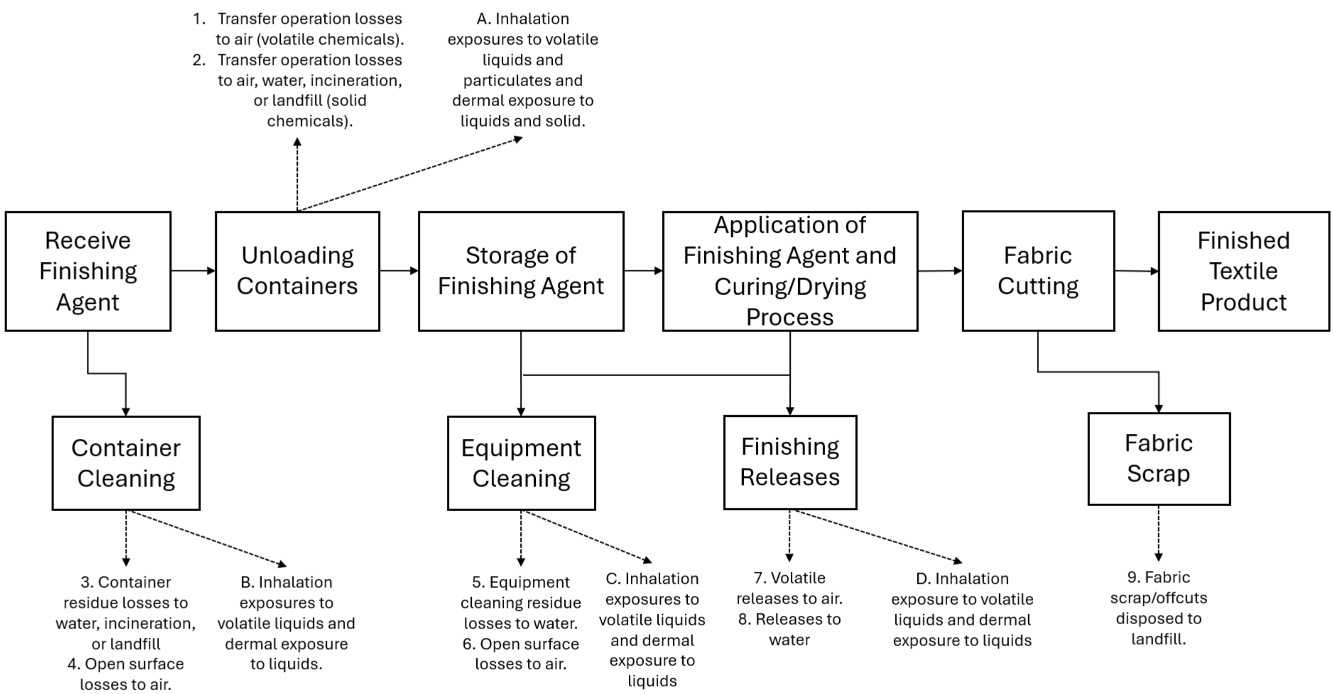


Figure 3-9. Textile Finishing Process Flow Diagram

3.8.2 Facility Estimates

EPA identified 11 unique sites which it assessed for use of DEHP in textile finishing in the NEI (U.S. EPA, 2022e), DMR (U.S. EPA, 2022c), and TRI (U.S. EPA, 2022f) data that EPA analyzed. For air, one site reported to TRI and nine reported to NEI. For water, one site reported to TRI and one reported to DMR. No sites reported land releases. The total number of sites reporting air and water releases can be larger than the number of unique sites due to the overlap of facilities between reporting databases. No sites were identified in the 2020 CDR, as none of the CDR facility data mapped to this OES. Due to the lack of data on the annual PV of DEHP in textile finishing, EPA does not present annual or daily site throughputs. EPA identified operating days ranging from 15 to 364 days/yr with an average of 215 days using the NEI air release data. TRI/DMR did not report operating days; therefore, EPA assumed 225 days/yr of operation per the *Textile Finishing GS*, as discussed in Section 2.3.2 (OECD, 2004b).

3.8.3 Release Assessment

3.8.3.1 Environmental Release Points

Based on TRI (U.S. EPA, 2022f), DMR (U.S. EPA, 2022c), and NEI (U.S. EPA, 2022e) data, textile finishing releases may go to stack air, fugitive air, surface water, or POTW. Fugitive and stack air releases may occur during container unloading, container cleaning, equipment cleaning, and finishing operations. Surface water or POTW releases may occur from container residue, equipment cleaning, or finishing operations.

3.8.3.2 Environmental Release Assessment Results

Table 3-53 presents annual and daily fugitive and stack air releases for Textile finishing based on the 2017 to 2022 TRI (U.S. EPA, 2022f) database reporting years, along with the number of release days per year, with medians and maxima presented from across the six-year reporting range. Table 3-54 presents fugitive and stack air releases per year and per day based on 2020 NEI (U.S. EPA, 2022e) database along with the number of release days per year. Table 3-55 presents water releases per year and per day based on the 2017 to 2022 DMR (U.S. EPA, 2022c) and TRI databases, along with the number of release days per year, with medians and maxima presented from across the six-year reporting range. There were no DEHP land releases for textile finishing identified through 2017 to 2022 TRI data. The *Environmental Releases to Wastewater for Diethylhexyl Phthalate (DEHP)*, *Environmental Releases to Air for Diethylhexyl Phthalate (DEHP)*, and *Environmental Releases to Land for Diethylhexyl Phthalate (DEHP)* contain additional information about the calculation results; refer to Appendix J for a reference to these supplemental documents.

Table 3-53. Summary of Air Releases from TRI for Textile Finishing

Site Identity	Maximum Annual Fugitive Air Release (kg/yr)	Max. Annual Stack Air Release (kg/yr)	Median Annual Fugitive Air Release (kg/yr)	Median Annual Stack Air Release (kg/yr)	Max. Daily Fugitive Air Release (kg/day)	Max. Daily Stack Air Release (kg/day)	Median Daily Fugitive Air Release (kg/day)	Median Daily Stack Air Release (kg/day)	Annual Release Days (days/yr)
Graniteville Specialty Fabrics, Graniteville, SC	0	0	0	0	0	0	0	0	215

Table 3-54. Summary of Air Releases from NEI (2020) for Textile Finishing

Site Identity	Total Fugitive Air Release (kg/yr)	Daily Fugitive Air Release (kg/day)	Total Stack Air Release (kg/yr)	Daily Stack Air Release (kg/day)	Annual Release Days (days/yr)
Saint-Gobain Technical Fabrics Group, Albion, NY	0.45	1.1E−03	Stack releases not reported	Stack releases not reported	215
Kimberly Clark Corporation, Corinth Mill, Corinth, MS	Fugitive releases not reported	Fugitive releases not reported	86	0.12	361
Halyard North Carolina, LLC, Linwood, NC	Fugitive releases not reported	Fugitive releases not reported	60	8.3E−02	364
Kimberly-Clark Corporation, Berkeley Mills, Hendersonville, NC	Fugitive releases not reported	Fugitive releases not reported	Stack releases not reported	Stack releases not reported	215
Milliken & Co Magnolia PLT, Blacksburg, SC	Fugitive releases not reported	Fugitive releases not reported	0.89	1.4E−03	312
Milliken Pendleton, Pendleton, SC	Fugitive releases not reported	Fugitive releases not reported	4.1E−03	1.4E−04	15
Deep River Dyeing Company, Inc., Randleman, NC	Fugitive releases not reported	Fugitive releases not reported	Stack releases not reported	Stack releases not reported	215
Sage Automotive Interiors Abbeville PLT, Abbeville, SC	Fugitive releases not reported	Fugitive releases not reported	1.5E−02	3.2E−04	23
Carlisle Finishing LLC, Carlisle, SC	Fugitive releases not reported	Fugitive releases not reported	Stack releases not reported	Stack releases not reported	215

Table 3-55. Summary of Water Releases from DMR and TRI for Textile Finishing

Site Identity	Source-Discharge Type	Median Annual Discharge (kg/yr)	Daily Discharge (Corresponding to Median Annual Discharge) (kg/day)	Maximum Annual Discharge (kg/yr)	Daily Discharge (Corresponding to Maximum Daily Discharge) (kg/day)	Annual Release Days (days/yr)
Graniteville Specialty Fabrics, Graniteville, SC	DMR-Direct Discharges	N/A – facility does not report DMRs	N/A – facility does not report DMRs	N/A – facility does not report DMRs	N/A – facility does not report DMRs	215
Graniteville Specialty Fabrics, Graniteville, SC	TRI-Direct Discharges	0	0	0	0	215
Graniteville Specialty Fabrics, Graniteville, SC	TRI-Transfers to POTW	598	2.7	777	3.5	215
Graniteville Specialty Fabrics, Graniteville, SC	TRI-Transfers to non-POTW	0	0	0	0	215
Milliken & Co Magnolia PLT, Cherokee, SC	DMR-Direct Discharges	2.6	1.2E−02	2.6	1.2E−02	215
Milliken & Co Magnolia PLT, Cherokee, SC	TRI-Direct Discharges	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	215
Milliken & Co Magnolia PLT, Cherokee, SC	TRI-Transfers to POTW	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	215
Milliken & Co Magnolia PLT, Cherokee, SC	TRI-Transfers to non-POTW	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	215

3.8.4 Occupational Exposure Assessment

3.8.4.1 Worker Activities

During textile finishing using DEHP-containing products, worker inhalation and dermal exposures to liquids containing DEHP may occur while transferring products to finishing and coating equipment, cleaning of transport containers, finishing and coating operations, and cleaning of process vessels (OECD, 2024). EPA did not identify information on engineering controls or worker PPE used at fabric finishing using DEHP-containing products.

ONUs include supervisors, managers, and other employees that work in the fabric finishing area but do not directly contact or apply fabric finishing products. ONUs are potentially exposed through the inhalation and dermal routes while in the finishing area.

3.8.4.2 Occupational Inhalation Exposure Results

EPA did not identify inhalation monitoring data for the textile finishing OES during systematic review. While EPA expects inhalation exposure from both DEHP vapor and particulates, based on the presence of DEHP in textile products, EPA assessed worker inhalation exposures to DEHP as an exposure to particulates of textiles generated during cutting and trimming activities. Therefore, EPA estimated worker inhalation exposures during disposal using the Generic Model for Central Tendency and High-End Inhalation Exposure to Total and Respirable Particulates Not Otherwise Regulated (PNOR) (U.S. EPA, 2021b). Model approaches and parameters are described in Appendix D.

To estimate plastic particulate concentrations in the air, EPA used a subset of the Generic Model for Central Tendency and High-End Inhalation Exposure to Total and Respirable Particulates Not Otherwise Regulated (PNOR) (U.S. EPA, 2021b) data that came from facilities with the NAICS code starting with 313 or 314 (Textile Manufacturing). This dataset was from a Danish EPA survey of chemicals in textile fabrics (Laursen et al., 2003) which reported the results of concentration testing of DEHP in 10 different textile samples comprising a total of 71 measurements, with 8.6 mg/kg (equivalent to 8.6×10^{-4} percent) being the highest value reported in duplicate samples EPA used this value, representing the highest expected concentration of DEHP in textile products, to estimate the concentration of DEHP present in particulates. The estimated exposures assume that DEHP is present in particulates of the textile at this fixed concentration throughout the working shift. Due to the lack of inhalation monitoring data, the worker central tendency exposure concentration was used to assess both the ONU high-end and central tendency exposures. It should be noted that the much higher weight fractions of DEHP (e.g., up to 21.3%) that EPA described in Section 3.8.1 are from testing of *samples of water-resistant outer wear, including jackets, mittens, and clogs, or attachments (reflectors on a zipper, labels, etc.)* (ECHA, 2010)*, which are not considered representative of textiles more broadly and would result in an overestimation of expected exposure by up to 4 orders of magnitude.*

The *Generic Model for Central Tendency and High-End Inhalation Exposure to Total and Respirable Particulates Not Otherwise Regulated (PNOR)* (U.S. EPA, 2021b) estimates an 8-hour TWA for particulate concentrations by assuming exposures outside the sample duration are zero. The model does not determine exposures during individual worker activities.

Table 3-56 summarizes the estimated 8-hour TWA concentration, AD, IADD, and ADD for worker exposures to DEHP during textile finishing operations. The high-end and central tendency exposures use 215 days per year as the exposure frequency based on the default release duration. Appendix A describes the approach for estimating AD, IADD, and ADD. The estimated exposures assume that the worker is exposed to DEHP in the form of textile particulates and does not account for other potential inhalation exposure routes, such as the inhalation of vapors. Based on the low vapor pressure of DEHP, EPA expects any contribution to inhalation exposures from vapors to be low. The *Occupational Inhalation Exposures from Textile Finishing for Diethylhexyl Phthalate (DEHP)* also contains information about model equations and parameters and contains calculation results; refer to Appendix J for a reference to this supplemental document.

Table 3-56. Summary of Estimated Worker Inhalation Exposures for Textile Finishing

Modeled Scenario	Exposure Concentration Type	Central Tendency	High-End
Average Adult Worker	8-hour TWA Exposure Concentration - Dust (mg/m^3)	3.1E−06	4.3E−05
	Acute (AD, mg/kg-day)	3.9E−07	5.4E−06
	Intermediate (IADD, mg/kg-day)	2.8E−07	3.9E−06
	Chronic, Non-Cancer (ADD, mg/kg-day)	2.3E−07	3.2E−06
Female of Reproductive Age	8-hour TWA Exposure Concentration - Dust (mg/m^3)	3.1E−06	4.3E−05
	Acute (AD, mg/kg-day)	4.3E−07	5.9E−06
	Intermediate (IADD, mg/kg-day)	3.1E−07	4.4E−06
	Chronic, Non-Cancer (ADD, mg/kg-day)	2.5E−07	3.5E−06
ONU	8-hour TWA Exposure Concentration – Dust (mg/m^3)	3.1E−06	
	Acute (AD, mg/kg-day)	3.9E−07	
	Intermediate (IADD, mg/kg-day)	2.8E−07	
	Chronic, Non-Cancer (ADD, mg/kg-day)	2.3E−07	

3.8.4.3 Occupational Dermal Exposure Results

EPA estimated dermal exposures for this OES using the methodology outlined in Appendix C. The various "Exposure Concentration Types" from Table 3-57 are explained in Appendix A. Workers may be exposed to solid or liquid DEHP-containing textile finishing products. Because both physical forms are expected, EPA assessed the absorptive flux of DEHP using dermal absorption data for liquid DEHP (see Appendix C.2.1.1 for details) as well as solid DEHP (see Appendix C.2.1.2 for details) and used the maximum value for the exposure calculation. Table 3-57 summarizes the APDR, AD, IADD, and ADD for both average adult workers and female workers of reproductive age. Because dust or mist is expected to be deposited on surfaces from this OES, EPA assessed dermal exposures to ONUs from contact with surfaces. Dermal exposure parameters are described in Appendix C. The *Occupational Dermal Exposure Modeling Results for Diethylhexyl Phthalate (DEHP)* also contains information about model equations and parameters and contains calculation results; refer to Appendix J for a reference to this supplemental document.

Table 3-57. Summary of Estimated Worker Dermal Exposures for Textile Finishing

Worker Population	Exposure Concentration Type	Central Tendency	High-End
Average Adult Worker	Dose Rate (APDR, mg/day)	0.21	0.41
	Acute (AD, mg/kg-day)	2.6E−03	5.1E−03
	Intermediate (IADD, mg/kg-day)	1.9E−03	3.8E−03
	Chronic, Non-Cancer (ADD, mg/kg-day)	1.5E−03	3.0E−03
Female of Reproductive Age	Dose Rate (APDR, mg/day)	0.17	0.34
	Acute (AD, mg/kg-day)	2.4E−03	4.7E−03

Worker Population	Exposure Concentration Type	Central Tendency	High-End
	Intermediate (IADD, mg/kg-day)	1.7E−03	3.5E−03
	Chronic, Non-Cancer (ADD, mg/kg-day)	1.4E−03	2.8E−03
ONU	Dose Rate (APDR, mg/day)	0.21	
	Acute (AD, mg/kg-day)	2.6E−03	
	Intermediate (IADD, mg/kg-day)	1.9E−03	
	Chronic, Non-Cancer (ADD, mg/kg-day)	1.5E−03	

3.8.4.4 Occupational Aggregate Exposure Results

Inhalation and dermal exposure estimates were aggregated based on the approach described in Appendix A to arrive at the aggregate worker and ONU exposure estimates in Table 3-58 below. The *Occupational Risk Calculator for Diethylhexyl Phthalate (DEHP)* (U.S. EPA, 2025e) contains the calculations of aggregate exposure; refer to Appendix J for a reference to this supplemental document.

Table 3-58. Summary of Estimated Worker Aggregate Exposures for Textile Finishing

Modeled Scenario	Exposure Concentration Type (mg/kg/day)	Central Tendency	High-End
Average Adult Worker	Acute (AD, mg/kg-day)	2.6E−03	5.1E−03
	Intermediate (IADD, mg/kg-day)	1.9E−03	3.8E−03
	Chronic, Non-Cancer (ADD, mg/kg-day)	1.5E−03	3.0E−03
Female of Reproductive Age	Acute (AD, mg/kg-day)	2.4E−03	4.7E−03
	Intermediate (IADD, mg/kg-day)	1.7E−03	3.5E−03
	Chronic, Non-Cancer (ADD, mg/kg-day)	1.4E−03	2.8E−03
ONU	Acute (AD, mg/kg-day)	2.6E−03	
	Intermediate (IADD, mg/kg-day)	1.9E−03	
	Chronic, Non-Cancer (ADD, mg/kg-day)	1.5E−03	

3.9 Fabrication of Final Products from Articles

3.9.1 Process Description

EPA anticipates that DEHP may be present in a wide array of final articles that are used both commercially and industrially. The 2020 *Final Scope of the Risk Evaluation for Di-ethylhexyl Phthalate* states that DEHP is incorporated into articles. Articles identified in DEHP-containing product SDSs include banners, fabrics, cork soundproofing, drums, electrical tape, rubber, putty, ear tags, pipe wrap, polyclay bricks, rollers, and vinyl tape (U.S. EPA, 2020e).

Use cases may include melting articles containing DEHP; drilling, cutting, grinding, or otherwise shaping articles containing DEHP. EPA was unable to identify products for the fabrication and final use of products or articles OES. Per the above discussion, EPA assumes that most products used under this OES are plastics and therefore used the estimated concentration from the plastic compounding/converting OESs to represent this scenario, with DEHP at a typical concentration ranging from 20 to 40 percent of the plastic material (Chao et al., 2015; Xu et al., 2010), but may include articles with weight fractions up to 60 percent (Gaudin et al., 2011; Gaudin et al., 2008).

3.9.2 Facility Estimates

EPA identified 16 unique sites which it assessed for the use of DEHP in fabrication of final products from articles from NEI (U.S. EPA, 2022e) and TRI (U.S. EPA, 2022f) dataset. For air, three sites reported to TRI and 13 reported to NEI. No sites reported land or water releases. Due to the lack of data on the annual PV of DEHP in fabrication of final products, EPA does not present annual or daily site throughputs. EPA assumes that each end use site utilizes a small number of finished articles containing DEHP. EPA identified operating days ranging from 131 to 350 with an average of 238 days through NEI air release data.

3.9.3 Release Assessment

3.9.3.1 Environmental Release Points

Based on TRI (U.S. EPA, 2022f) and NEI (U.S. EPA, 2022e) data, fabrication of final products from articles releases may go to stack air or fugitive air. Fugitive air and stack air releases may occur during heating/plastic welding activities and cutting, grinding, shaping, drilling, abrading, and similar activities.

3.9.3.2 Environmental Release Assessment Results

Table 3-59 presents fugitive and stack air releases per year and per day for Fabrication of final products from articles based on the 2017 to 2022 TRI (U.S. EPA, 2022f) database reporting years, along with the number of release days per year, with medians and maxima presented from across the six-year reporting range. Table 3-60 presents fugitive and stack air releases per year and per day based on the 2020 NEI (U.S. EPA, 2022e) database along with the number of release days per year. There were no land releases found in the 2017 to 2022 TRI database, nor water releases found in the 2017 to 2022 DMR (U.S. EPA, 2022c) and TRI databases. The *Environmental Releases to Wastewater for Diethylhexyl Phthalate (DEHP)*, *Environmental Releases to Air for Diethylhexyl Phthalate (DEHP)*, and *Environmental Releases to Land for Diethylhexyl Phthalate (DEHP)* contain additional information about the calculation results; refer to Appendix J for a reference to these supplemental documents.

Table 3-59. Summary of Air Releases from TRI for Fabrication of Final Products from Articles

Site Identity	Maximum Annual Fugitive Air Release (kg/yr)	Max. Annual Stack Air Release (kg/yr)	Median Annual Fugitive Air Release (kg/yr)	Median Annual Stack Air Release (kg/yr)	Max. Daily Fugitive Air Release (kg/day)	Max. Daily Stack Air Release (kg/day)	Median Daily Fugitive Air Release (kg/day)	Median Daily Stack Air Release (kg/day)	Annual Release Days (days/yr)
Anamet Electrical Inc, Mattoon, IL	0	0	0	0	0	0	0	0	238
Ford Motor Company-Kansas City Assembly Plant, Claycomo, MO	0	0	0	0	0	0	0	0	238
Aw Texas, Cibolo, TX	20	0	10	0	8.5E−02	0	4.2E−02	0	238

Table 3-60. Summary of Air Releases from NEI (2020) for Fabrication of Final Products from Articles

Site Identity	Total Fugitive Air Release (kg/yr)	Daily Fugitive Air Release (kg/day)	Total Stack Air Release (kg/yr)	Daily Stack Air Release (kg/day)	Annual Release Days (days/yr)
Bernstein Display, Shaftsbury, VT	Fugitive releases not reported	Fugitive releases not reported	Stack releases not reported	Stack releases not reported	238
Teknor Apex Co., Pawtucket, RI	292	0.61	Stack releases not reported	Stack releases not reported	238
General Electric Steam Turbine Generator Global, Schenectady, NY	0	0	Stack releases not reported	Stack releases not reported	238
Baxter Healthcare of Puerto Rico, Aibonito, PR	Fugitive releases not reported	Fugitive releases not reported	4.5	9.5E−03	238
Terumo Cardiovascular Systems Corporation, Elkton, MD	83	0.16	Stack releases not reported	Stack releases not reported	260
Safran Power USA, LLC, Sarasota, FL	0	0	0	0	208
Us Army Fort Jackson, Fort Jackson, SC	0.46	6.5E−04	Stack releases not reported	Stack releases not reported	350
Zimmer Orthopaedic Surgical Products, Dover, OH	Fugitive releases not reported	Fugitive releases not reported	2.3	4.8E−03	238
New Cie Opco LLC, Canton, IL	Fugitive releases not reported	Fugitive releases not reported	Stack releases not reported	Stack releases not reported	238

Site Identity	Total Fugitive Air Release (kg/yr)	Daily Fugitive Air Release (kg/day)	Total Stack Air Release (kg/yr)	Daily Stack Air Release (kg/day)	Annual Release Days (days/yr)
Natvar, Clayton, NC	113	0.24	Stack releases not reported	Stack releases not reported	238
Plant Factory Inc (0247090337), North Ridgeville, OH	1.5E−06	5.6E−09	1.5E−04	5.6E−07	131
Plant #47, Sheridan, OR	0.83	1.8E−03	Stack releases not reported	Stack releases not reported	238
Fenwal International Inc., San German, PR	55	0.12	Stack releases not reported	Stack releases not reported	238

3.9.4 Occupational Exposure Assessment

3.9.4.1 Worker Activities

During fabrication and final use of products or articles, worker exposures to DEHP may occur via dermal contact while handling and shaping articles containing DEHP additives. Worker exposures may also occur via particulate inhalation during activities such as cutting, grinding, shaping, drilling, and/or abrasive actions that generate particulates from the product. Additionally, DEHP vapor inhalation exposure may occur during heating or plastic welding. EPA did not identify chemical-specific information on engineering controls and worker PPE used at final product or article formulation or use sites. Based on the presence of DEHP as an additive within solid articles or products, EPA expects particulate inhalation exposures to be higher than vapor exposures for this OES.

ONUs include supervisors, managers, and other employees that may be in manufacturing or use areas but do not directly handle DEHP-containing materials or articles. ONUs are potentially exposed through the inhalation route while in the working area. Also, dermal exposures from contact with surfaces where dust has been deposited were assessed for ONUs.

3.9.4.2 Occupational Inhalation Exposure Results

The high-end and central tendency worker inhalation exposure results for this OES are based on the 95th and 50th percentile exposure values from time-weighted averages calculated from personal samples collected from the 2019 OSHA CEHD data (OSHA, 2019). The time-weighted averages were calculated based on samples that shared the same Inspection, Establishment, and Sampling number and had a sum of sampling time greater than three hours. EPA calculated eight-hour TWAs by assuming exposures outside the sampling time were zero. These data had a data quality rating of high. As all data were deemed of acceptable quality without notable deficiencies, EPA elected to integrate all the data in the final exposure assessment. Results of this analysis are presented in Table 3-61. Additional discussion on the uncertainty and limitations of these data are included in the weight of scientific evidence (Section 4.2). No data with full shift samples for ONUs was identified for this OES through systematic review. For this reason, the worker central tendency exposure concentration was used to assess both the ONU high-end and central tendency exposures. The *Occupational Inhalation Exposure Data for Diethylhexyl Phthalate (DEHP)* contains additional information about the calculation results; refer to Appendix J for a reference to this supplemental document.

Table 3-61. Summary of Estimated Worker Inhalation Exposures for Fabrication of Final Products from Articles

Modeled Scenario	Exposure Concentration Type	Central Tendency	High-End
Average Adult Worker	8-hour TWA Exposure Concentration to Dust (mg/m^3)	4.0E−02	0.11
	Acute Dose (AD) (mg/kg/day)	5.0E−03	1.4E−02
	Intermediate Average Daily Dose, Non-Cancer Exposures (IADD) (mg/m^3)	3.7E−03	1.0E−02
	Chronic Average Daily Dose, Non-Cancer Exposures (ADD) (mg/kg/day)	3.3E−03	9.0E−03
Female of Reproductive Age	8-hour TWA Exposure Concentration to Dust (mg/m^3)	4.0E−02	0.11
	Acute Dose (AD) (mg/kg/day)	5.5E−03	1.5E−02

Modeled Scenario	Exposure Concentration Type	Central Tendency	High-End
	Intermediate Average Daily Dose, Non-Cancer Exposures (IADD) (mg/m^3)	4.1E−03	1.1E−02
	Chronic Average Daily Dose, Non-Cancer Exposures (ADD) (mg/kg/day)	3.6E−03	9.9E−03
ONU	8-hour TWA Exposure Concentration to Dust (mg/m^3)	4.0E−02	
	Acute Dose (AD) (mg/kg/day)	5.0E−03	
	Intermediate Average Daily Dose, Non-Cancer Exposures (IADD) (mg/m^3)	3.7E−03	
	Chronic Average Daily Dose, Non-Cancer Exposures (ADD) (mg/kg/day)	3.3E−03	

3.9.4.3 Occupational Dermal Exposure Results

EPA estimated dermal exposures for this OES using the methodology outlined in Appendix C. The various "Exposure Concentration Types" from Table 3-62 are explained in Appendix A. Because dermal exposures to workers may occur while handling and shaping solid DEHP-containing articles, EPA assessed the absorptive flux of DEHP using the dermal absorption data for solid DEHP (see Appendix C.2.1.2 for details). Table 3-62 summarizes the APDR, AD, IADD, and ADD for both average adult workers and female workers of reproductive age. Because dust or mist is expected to be deposited on surfaces from this OES, EPA assessed dermal exposures to ONUs from contact with surfaces. Dermal exposure parameters are described in Appendix C. The *Occupational Dermal Exposure Modeling Results for Diethylhexyl Phthalate (DEHP)* also contains information about model equations and parameters and contains calculation results; refer to Appendix J for a reference to this supplemental document.

Table 3-62. Summary of Estimated Worker Dermal Exposures for Fabrication of Final Products from Articles

Worker Population	Exposure Concentration Type	Central Tendency	High-End
Average Adult Worker	Dose Rate (APDR, mg/day)	0.21	0.41
	Acute (AD, mg/kg-day)	2.6E−03	5.1E−03
	Intermediate (IADD, mg/kg-day)	1.9E−03	3.8E−03
	Chronic, Non-Cancer (ADD, mg/kg-day)	1.7E−03	3.3E−03
Female of Reproductive Age	Dose Rate (APDR, mg/day)	0.17	0.34
	Acute (AD, mg/kg-day)	2.4E−03	4.7E−03
	Intermediate (IADD, mg/kg-day)	1.7E−03	3.5E−03
	Chronic, Non-Cancer (ADD, mg/kg-day)	1.5E−03	3.1E−03
ONU	Dose Rate (APDR, mg/day)	0.21	
	Acute (AD, mg/kg-day)	2.6E−03	
	Intermediate (IADD, mg/kg-day)	1.9E−03	
	Chronic, Non-Cancer (ADD, mg/kg-day)	1.7E−03	

3.9.4.4 Occupational Aggregate Exposure Results

Inhalation and dermal exposure estimates were aggregated based on the approach described in Appendix A to arrive at the aggregate worker and ONU exposure estimates in Table 3-63 below. The *Occupational Risk Calculator for Diethylhexyl Phthalate (DEHP)* (U.S. EPA, 2025e) contains the calculations of aggregate exposure; refer to Appendix J for a reference to this supplemental document.

Table 3-63. Summary of Estimated Worker Aggregate Exposures for Fabrication of Final Products from Articles

Modeled Scenario	Exposure Concentration Type (mg/kg/day)	Central Tendency	High-End
Average Adult Worker	Acute (AD, mg/kg-day)	7.6E−03	1.9E−02
	Intermediate (IADD, mg/kg-day)	5.5E−03	1.4E−02
	Chronic, Non-Cancer (ADD, mg/kg-day)	4.9E−03	1.2E−02
Female of Reproductive Age	Acute (AD, mg/kg-day)	7.9E−03	2.0E−02
	Intermediate (IADD, mg/kg-day)	5.8E−03	1.5E−02
	Chronic, Non-Cancer (ADD, mg/kg-day)	5.1E−03	1.3E−02
ONU	Acute (AD, mg/kg-day)	7.6E−03	
	Intermediate (IADD, mg/kg-day)	5.5E−03	
	Chronic, Non-Cancer (ADD, mg/kg-day)	4.9E−03	

3.10 Use of Dyes, Pigments, and Fixing Agents

3.10.1 Process Description

DEHP was also identified in coloring agents and printing inks the Substances in Preparations in Nordic Countries (SPIN) database (SPIN, 2019), though the source doesn't provide DEHP concentrations. However, another source identified DEHP at less than 0.2 percent in a blue gel stamp saturated with ink (Identity Group, 2016a). One EPA report also identifies DEHP in dye and pigment waste as a contaminant from plastic (U.S. EPA, 1999). Though EPA was unable to find examples of products, DEHP may also be used in textile dyes (OECD, 2017).

Liquid and solid dye formulations used for textile dyeing are typically unloaded from transport containers (*e.g.*, drums) directly into the dyeing machine. Unloading is considered the main exposure point, because exposure occurs at the highest chemical concentration and because of potential inhalation of powder dyes. The receiving facility typically rinses container residuals into the dyeing process, or the empty container is landfilled or incinerated. In the United States, approximately 80 percent of textile dyeing is done in the fabric stage using beam dyeing, jig dyeing, winch or beck dyeing or jet dyeing. However, fibers or yarns may also be dyed prior to being woven or knit into textile fabrics. Textile dyeing is mainly accomplished by batch processes, which involves a textile substrate immersed in a bath of water in which dye is dispersed or dissolved. Using agitation and heat, the dye diffuses through the solution, is sorbed at the fiber surface and diffuses into the fiber. Release of spent dye bath to wastewater is expected to be the main release source, depending on the dye exhaustion rate (OECD, 2017).

Inks are comprised of colorants (*e.g.*, pigments, dyes and toners) dispersed in a formulation to form a paste, liquid or solid which can be applied to a substrate surface and dried (U.S. EPA, 2010). Industrial printing processes can be categorized as lithographic, flexographic, gravure, letterpress, screen printing or digital printing. Commercial printing may involve lithographic, flexographic, gravure and letterpress printing - all of which involve the transfer of images from printing plates to a substrate. Screen printing requires a mesh screen to transfer the ink to a substrate, whereas digital printing allows for the transfer of a digital image directly onto a substrate. Inkjet printing is the most common form of digital printing. It involves the application of small drops of ink onto a substrate, with direct contact between the ink nozzle and the substrate (U.S. EPA, 2010). The use of stamps, such as the identified product with DEHP, involves manually applying the ink to substrates. The ESD on the Application of Radiation Curable Coatings, Inks and Adhesives indicates that ink products may be received in pails and smaller containers (OECD, 2011b).

Figure 3-10 provides an illustration of the typical release and exposure points during printing operations.

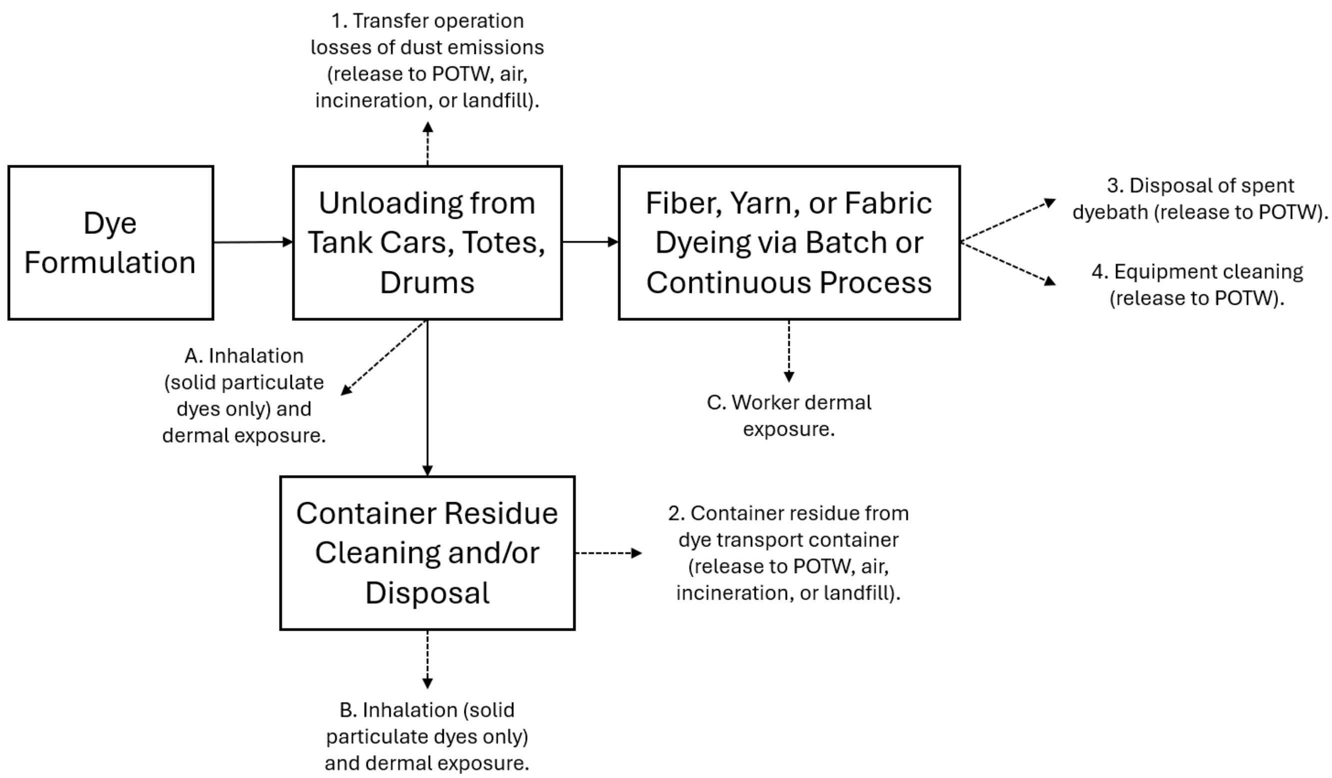


Figure 3-10: Typical Release and Exposure Points During the General Textile Dyeing Process (OECD, 2017)

3.10.2 Facility Estimates

EPA identified five unique sites which it assessed for the use of DEHP in dyes, pigments, and fixing agents through the DMR (U.S. EPA, 2022c) dataset. For water, all five sites reported to DMR. No sites reported air or land releases. No sites were identified under the 2020 CDR. Due to the lack of data on the annual PV of DEHP in use of dyes, pigments, and fixing agents, EPA does not present annual or daily site throughputs. EPA did not identify data on site-specific operating days; therefore, EPA assumes 157 days/yr of operation per the ESD on Use of Textile Dyes (OECD, 2017) as discussed in Section 2.3.2.

3.10.3 Release Assessment

3.10.3.1 Environmental Release Points

Based on the Manufacture and Use of Printing Inks Generic Scenario, potential releases may go to surface water or fugitive air. Surface water releases may occur during equipment cleaning as well as container cleaning. Fugitive air releases may occur during unloading of volatile components, volatile components remaining in ink reservoir, ink mist generated by printing press, and from volatile components during drying. Based on DMR data, use of dyes, pigments, and fixing agents' releases may go to surface water (U.S. EPA, 2022c).

3.10.3.2 Environmental Release Assessment Results

Table 3-64 presents water releases per year and per day based on the 2017 to 2022 DMR (U.S. EPA, 2022c) and TRI (U.S. EPA, 2022f) databases along with the number of release days per year, with medians and maxima presented from across the six-year reporting range. No air or land releases were reported through the TRI or NEI (U.S. EPA, 2022e) databases from 2017 to 2022.

The *Environmental Releases to Wastewater for Diethylhexyl Phthalate (DEHP)* contains additional information about the calculation results; refer to Appendix J for a reference to this supplemental document.

Table 3-64. Summary of Water Releases from DMR and TRI for Use of Dyes, Pigments, and Fixing Agents

Site Identity	Source-Discharge Type	Median Annual Discharge (kg/yr)	Daily Discharge (Corresponding to Median Annual Discharge) (kg/day)	Maximum Annual Discharge (kg/yr)	Daily Discharge (Corresponding to Maximum Daily Discharge) (kg/day)	Annual Release Days (days/yr)
Acordis Cellulosic Fibers, Inc., Mobile, AL	DMR-Direct Discharges	27	0.17	27	0.17	157
Acordis Cellulosic Fibers, Inc., Mobile, AL	TRI-Direct Discharges	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	157
Acordis Cellulosic Fibers, Inc., Mobile, AL	TRI-Transfers to POTW	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	157
Acordis Cellulosic Fibers, Inc., Mobile, AL	TRI-Transfers to non-POTW	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	157
E I Dupont De Nemours & Co - Parlin Plant, Middlesex, NJ	DMR-Direct Discharges	0.38	2.4E−03	0.38	2.4E−03	157
E I Dupont De Nemours & Co - Parlin Plant, Middlesex, NJ	TRI-Direct Discharges	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	157
E I Dupont De Nemours & Co - Parlin Plant, Middlesex, NJ	TRI-Transfers to POTW	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	157
E I Dupont De Nemours & Co - Parlin Plant, Middlesex, NJ	TRI-Transfers to non-POTW	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	157
IBM Corp, Dutchess, NY	DMR-Direct Discharges	1.1	7.3E−03	1.1	7.3E−03	157
IBM Corp, Dutchess, NY	TRI-Direct Discharges	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	157
IBM Corp, Dutchess, NY	TRI-Transfers to POTW	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	157
IBM Corp, Dutchess, NY	TRI-Transfers to non-POTW	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	157
Morristown Staves, Hamblen, TN	DMR-Direct Discharges	0.22	1.4E−03	0.22	1.4E−03	157
Morristown Staves, Hamblen, TN	TRI-Direct Discharges	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	157

Site Identity	Source-Discharge Type	Median Annual Discharge (kg/yr)	Daily Discharge (Corresponding to Median Annual Discharge) (kg/day)	Maximum Annual Discharge (kg/yr)	Daily Discharge (Corresponding to Maximum Daily Discharge) (kg/day)	Annual Release Days (days/yr)
Morristown Staves, Hamblen, TN	TRI-Transfers to POTW	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	157
Morristown Staves, Hamblen, TN	TRI-Transfers to non-POTW	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	157
Shaw Industries Group Inc Plant 8S, Richland, SC	DMR-Direct Discharges	2.8	1.8E−02	3.3	2.1E−02	157
Shaw Industries Group Inc Plant 8S, Richland, SC	TRI-Direct Discharges	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	157
Shaw Industries Group Inc Plant 8S, Richland, SC	TRI-Transfers to POTW	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	157
Shaw Industries Group Inc Plant 8S, Richland, SC	TRI-Transfers to non-POTW	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	N/A – facility does not report to TRI	157

3.10.4 Occupational Exposure Assessment

3.10.4.1 Worker Activities

Worker exposures to DEHP during the use of DEHP-containing printing inks may occur through the inhalation of mists generated during printing operations. In addition, worker mist exposures are expected from high-speed, web-fed presses (U.S. EPA, 2010). Worker exposures during the use of dyes may occur during unloading of liquid dyes, container cleaning, and machine operation (U.S. EPA, 2014e).

EPA did not find information on the extent to which printing or textile dyeing facilities that use DEHP-containing products also use engineering controls and/or worker PPE. Based on the Emission Scenario Document on the Use of Textile Dyes, workers typically wear safety glasses, goggles, aprons, respirators, and/or masks (U.S. EPA, 2014e). EPA expects the types of PPE used at each site to be based on the hazards present; therefore, the common PPE presented in the ESD may or may not apply when DEHP is being used.

ONUs include supervisors, managers, and other employees that do not directly handle the dyes, pigments, fixing agents, or associated equipment but may be present in the process areas. ONUs are potentially exposed through the inhalation route while in process areas.

3.10.4.2 Occupational Inhalation Exposure Results

No references with discrete full shift samples were identified for the use of dyes, pigments, and fixing agents through systematic review. However, the Rubber Manufacturing OES was selected as a surrogate as it represented the highest air concentration of DEHP across all non-spray scenarios with monitoring data, given that volatilization is the primary contributor to the air concentration for both OES and no inhalation monitoring data were identified specifically for the dyes, pigments, and fixing agents OES. A European Commission document provided maximum concentrations based on time-weighted average personal and area samples from a plant performing rubber calendaring (ECB, 2003). These data included the highest air concentration values for each sampling event along with the sampling duration. EPA assessed the inhalation exposures for this OES by calculating the 8-hour TWA using the sampling event with highest air concentration. Similarly, EPA assessed the central tendency exposures using the sampling event with lowest reported air concentration. The reported range for these data was 0.04 mg/m^3 to 26.7 mg/m^3. However, all of the individual measurements (concentration and duration) reflected in this data range were not presented.

These data had a data quality rating of high, meaning they are of acceptable quality. These results are presented in Table 3-64.

EPA acknowledges that rubber manufacturing (calendering) employs high temperatures (200°C) which likely result in higher air concentrations compared to other non-spray OES such as dyes, pigments, and fixing agents. Therefore, EPA compared the dose from non-spray application of application of paints, coatings, adhesives, and sealants and the use of dyes, pigments, and fixing agents for DEHP (both based on rubber calendering) to another phthalate (DBP) which had inhalation monitoring data for non-spray application of paints, coatings, adhesives, and sealants from operations at ambient temperatures. Importantly, the DEHP inhalation dose to females of reproductive age using rubber calendering data as a surrogate for non-spray applications and the use of dyes, pigments, and fixing agents (0.23 mg/kg-day at central tendency and 1.12 mg/kg-day for high-end; Table 3-65) is very similar to DBP for non-spray applications (0.21 mg/kg-day at central tendency and 1.02 mg/kg-day for high-end (U.S. EPA, 2025b), thereby increasing EPA's confidence in the use of rubber manufacturing inhalation monitoring data as a surrogate for dyes, pigments, and fixing agents. Additional discussion on the uncertainty and limitations of these data are included in the weight of scientific evidence (Section 4.2). No data with full shift samples for ONUs were identified for this OES through systematic review. For this reason, worker central tendency exposure concentrations were used to assess ONU high-end and central tendency exposures. The *Occupational Inhalation Exposure Data for Diethylhexyl Phthalate (DEHP)* contains additional information about the calculation results; refer to Appendix J for a reference to this supplemental document.

Table 3-65. Summary of Estimated Worker Inhalation Exposures for Use of Dyes, Pigments, and Fixing Agents[a]

Worker Population	Exposure Concentration Type	Central Tendency	High-End
Average Adult Worker	8-hour TWA Exposure Concentration (mg/m^3)	1.7	10
	Acute (AD, mg/kg-day)	0.21	1.02
	Intermediate (IADD, mg/kg-day)	0.15	0.75
	Chronic, Non-Cancer (ADD, mg/kg-day)	0.14	0.70
Female of Reproductive Age	8-hour TWA Exposure Concentration (mg/m^3)	1.7	8.1
	Acute (AD, mg/kg-day)	0.23 [b]	1.1 [b]
	Intermediate (IADD, mg/kg-day)	0.17	0.82
	Chronic, Non-Cancer (ADD, mg/kg-day)	0.16	0.77
ONU	8-hour TWA Exposure Concentration (mg/m^3)	1.7	
	Acute (AD, mg/kg-day)	0.21	
	Intermediate (IADD, mg/kg-day)	0.15	
	Chronic, Non-Cancer (ADD, mg/kg-day)	0.14	

[a] Monitoring data for the rubber manufacturing OES is being used as a surrogate for dyes, pigments, and fixing agents.
[b] EPA used inhalation monitoring data from rubber manufacturing as a surrogate for the dyes, pigments, and fixing agents OES, given that volatilization is the primary contributor to the air concentration for both OES and no inhalation monitoring data were identified specifically for the dyes, pigments, and fixing agents OES. EPA acknowledges that rubber manufacturing (calendering) employs high temperatures (200°C) which likely result in higher air concentrations compared to other non-spray OES such as dyes, pigments, and fixing agents. Therefore, EPA compared the dose from non-spray application of application of paints, coatings, adhesives, and sealants and the use of dyes, pigments, and fixing agents for DEHP (both based on rubber calendering) to another phthalate (DBP) which had inhalation monitoring data for non-spray application of paints, coatings, adhesives from operations that did not entail elevated temperatures. Importantly, the DEHP inhalation dose to females of reproductive age using rubber calendering data for non-spray applications and dyes, pigments, and fixing agents (0.23 mg/kg-day at central tendency and 1.12 mg/kg-day for high-end) is very similar to DBP for non-spray applications (0.21 mg/kg-day at central tendency and 1.02 mg/kg-day for high-end), thereby increasing EPA's confidence in the use of rubber manufacturing inhalation monitoring data as a surrogate for dyes, pigments, and fixing agents.

3.10.4.3 Occupational Dermal Exposure Results

EPA estimated dermal exposures for this OES using the methodology outlined in Appendix C. The various "Exposure Concentration Types" from Table 3-66 are explained in Appendix A. Because workers may be exposed to liquid DEHP-containing dyes, pigments, and fixing agents, EPA assessed the absorptive flux of DEHP using dermal absorption data for liquid DEHP (see Appendix C.2.1.1 for details). Table 3-66 summarizes the APDR, AD, IADD, and ADD for both average adult workers and female workers of reproductive age. Because no dust or mist is expected to be deposited on surfaces from this OES, EPA did not assess dermal exposures to ONUs from contact with surfaces. Dermal exposure parameters are described in Appendix C. The *Occupational Dermal Exposure Modeling Results for Diethylhexyl Phthalate (DEHP)* also contains information about model equations and parameters and contains calculation results; refer to Appendix J for a reference to this supplemental document.

Table 3-66. Summary of Estimated Worker Dermal Exposures for Use of Dyes, Pigments, and Fixing Agents

Worker Population	Exposure Concentration Type	Central Tendency	High-End
Average Adult Worker	Dose Rate (APDR, mg/day)	0.11	0.21
	Acute (AD, mg/kg-day)	1.3E−03	2.7E−03
	Intermediate (IADD, mg/kg-day)	9.8E−04	2.0E−03
	Chronic, Non-Cancer (ADD, mg/kg-day)	9.2E−04	1.8E−03
Female of Reproductive Age	Dose Rate (APDR, mg/day)	9.0E−02	0.18
	Acute (AD, mg/kg-day)	1.2E−03	2.5E−03
	Intermediate (IADD, mg/kg-day)	9.0E−04	1.8E−03
	Chronic, Non-Cancer (ADD, mg/kg-day)	8.4E−04	1.7E−03

3.10.4.4 Occupational Aggregate Exposure Results

Inhalation and dermal exposure estimates were aggregated based on the approach described in Appendix A to arrive at the aggregate worker and ONU exposure estimates in Table 3-67 below. The *Occupational Risk Calculator for Diethylhexyl Phthalate (DEHP)* (U.S. EPA, 2025e) contains the calculations of aggregate exposure; refer to Appendix J for a reference to this supplemental document.

Table 3-67. Summary of Estimated Worker Aggregate Exposures for Use of Dyes, Pigments, and Fixing Agents

Worker Population	Exposure Concentration Type	Central Tendency	High-End
Average Adult Worker	Acute (AD, mg/kg-day)	0.21	1.02
	Intermediate (IADD, mg/kg-day)	0.15	0.75
	Chronic, Non-Cancer (ADD, mg/kg-day)	0.14	0.70
Female of Reproductive Age	Acute (AD, mg/kg-day)	0.23	1.1
	Intermediate (IADD, mg/kg-day)	0.17	0.82
	Chronic, Non-Cancer (ADD, mg/kg-day)	0.16	0.77
ONU	Acute (AD, mg/kg-day)	0.21	
	Intermediate (IADD, mg/kg-day)	0.15	
	Chronic, Non-Cancer (ADD, mg/kg-day)	0.14	

3.11 Formulations for Diffusion Bonding

3.11.1 Process Description

DEHP was identified in one diffusion bonding product for the manufacture of aero engine fan blades (Morgan Advanced Materials, 2016a, b). Diffusion bonding is the solid state joining of two surfaces using intimate contact under high temperature and pressure. This results in an undetectable bond line. Formulations for diffusion bonding are applied to metal surfaces to protect against the equipment and extreme temperatures of diffusion bonding equipment (U.S. EPA, 2020c). The identified product is from a line that the supplier indicates can be applied by syringe, brushing, spraying, or dipping

The identified product is a liquid with a DEHP concentration listed as less than 10 percent (Morgan Advanced Materials, 2016a, b). The volume of DEHP used in this application is unknown. EPA assumed the product is supplied in small containers based on the similarity to soldering and welding. As such, EPA expects that the application site transfers the formulation for diffusion bonding from the shipping container to the application equipment, such as a caulk gun, brush, or syringe, and applies the formulation for diffusion bonding to the metal or metals undergoing diffusion bonding (OECD, 2015a). Application may occur repeatedly over the course of one or two eight-hour workdays, accounting for drying or curing times and application of additional coats, if necessary. Therefore, EPA assumes 250 days/yr of operation, which is based on operation over 5 days/week for 50 weeks/yr.

3.11.2 Facility Estimates

EPA identified 14 unique sites which it assessed for the use of DEHP in formulations for diffusion bonding that reported to NEI (U.S. EPA, 2022e) and DMR (U.S. EPA, 2022c). For air, 13 sites reported to NEI. For water, one site reported to DMR. No sites reported land releases. No sites were identified under the 2020 CDR. Due to the lack of data on the annual PV of DEHP in formulations for diffusion bonding, EPA does not present annual or daily site throughputs. EPA identified operating days ranging from 250 to 365 days/year with an average of 348 days based on NEI data. For sites without operating data from NEI, EPA assumed 250 days/yr as discussed in Section 2.3.2.

3.11.3 Release Assessment

3.11.3.1 Environmental Release Points

Based on the SDS product application, Diffusion bonding releases may go to fugitive air, stack air, surface water, and landfill. Fugitive air and stack air releases may occur during unloading of containers, sampling, container cleaning, equipment cleaning, and drying and curing times. Surface water or landfill releases may occur from small container residue, container/equipment cleaning waste, and coating application process waste. Releases to surface water may occur from sampling and loading/unloading transport containers. Additional fugitive air releases may occur during leakage of pipes, flanges, and accessories used for transport.

3.11.3.2 Environmental Release Assessment Results

Table 3-68 presents fugitive and stack air releases per year and per day based on the 2020 NEI (U.S. EPA, 2022e) database along with the number of release days per year. Table 3-69 presents water releases per year and per day based on the 2017 to 2022 DMR (U.S. EPA, 2022c) database reporting years along with the number of release days per year, with medians and maxima presented from across the six-year reporting range. No air, land, or water releases were reported from the TRI (U.S. EPA, 2022f) database between 2017 to 2022. The *Environmental Releases to Wastewater for Diethylhexyl Phthalate (DEHP)*, *Environmental Releases to Air for Diethylhexyl Phthalate (DEHP)*, and *Environmental Releases to Land for Diethylhexyl Phthalate (DEHP)* contain additional information about the calculation results; refer to Appendix J for a reference to these supplemental documents.

Table 3-68. Summary of Air Releases from NEI (2020) for Formulations for Diffusion Bonding

Site Identity	Total Fugitive Air Release (kg/yr)	Daily Fugitive Air Release (kg/day)	Total Stack Air Release (kg/yr)	Daily Stack Air Release (kg/day)	Annual Release Days (days/yr)
West Virginia Alloys, Inc., Alloy, WV	4.2E−02	5.8E−05	7.3	9.9E−03	365
Sanders Lead Co, Troy, AL	Fugitive releases not reported	Fugitive releases not reported	666	0.91	365
Mississippi Silicon LLC, Burnsville, MS	Fugitive releases not reported	Fugitive releases not reported	17	2.4E−02	365
Wieland Copper Products, LLC, Pine Hall, NC	0	0	Stack releases not reported	Stack releases not reported	365
Federal Cartridge Co - Medium Caliber Lab, Anoka, MN	Fugitive releases not reported	Fugitive releases not reported	3.1E−03	4.3E−06	365
Hensley Industries, Dallas, TX	4.8	6.6E−03	4.8	6.6E−03	365
Meridian Manufacturing Group, Storm Lake, IA	Fugitive releases not reported	Fugitive releases not reported	Stack releases not reported	Stack releases not reported	260
Arconic Inc - Davenport Works (Formerly Alcoa), Riverdale, IA	38	5.2E−02	72	9.8E−02	364
Exide Technologies Canon Hollow, Forest City, MO	Fugitive releases not reported	Fugitive releases not reported	11	1.5E−02	365
Pratt & Whitney Div UTC, East Hartford, CT	Fugitive releases not reported	Fugitive releases not reported	5.3E−02	7.3E−05	365
Aerocraft Heat Treating Co Inc, Paramount, CA	0	0	Stack releases not reported	Stack releases not reported	250
ATI Millersburg, Albany, Or	Fugitive releases not reported	Fugitive releases not reported	4.3E−03	5.9E−06	364
Gopher Resource, Eagan, MN	Fugitive releases not reported	Fugitive releases not reported	12	1.6E−02	365

Table 3-69. Summary of Water Releases from DMR for Formulations for Diffusion Bonding

Site Identity	Source-Discharge Type	Median Annual Discharge (kg/yr)	Daily Discharge (Corresponding to Median Annual Discharge) (kg/day)	Maximum Annual Discharge (kg/yr)	Daily Discharge (Corresponding to Maximum Daily Discharge) (kg/day)	Annual Release Days (days/yr)
United Technologies Corporation, Pratt and Whitney Division, Hartford County, CT	DMR-Direct Discharges	9.2E−02	3.7E−04	9.2E−02	3.7E−04	250

3.11.4 Occupational Exposure Assessment

3.11.4.1 Worker Activities

The application of diffusion bonding formulations is expected to be comparable to that of adhesives and sealants. Worker exposures to DEHP may occur through the inhalation of vapors or dermal contact with liquid diffusion bonding formulations while unloading and transferring the formulations to the application equipment, such as a caulk gun, brush, or syringe, container and application equipment cleaning, and applying the diffusion bonding product to the metal or metals undergoing diffusion bonding. Worker inhalation exposures may occur during the diffusion bonding process and during the curing/drying of the diffusion bonding formulation (OECD, 2015a).

EPA did not find information on the extent to which facilities performing diffusion bonding that use DEHP-containing formulations also use engineering controls and/or worker PPE.

ONUs include supervisors, managers, and other employees that do not directly handle the diffusion bonding formulations or equipment but may be present in the process area. ONUs are potentially exposed through the inhalation route while in the process area.

3.11.4.2 Occupational Inhalation Exposure Results

EPA did not identify inhalation monitoring data specific to DEHP for the Formulations for diffusion bonding OES during systematic review of literature sources. Because spray application is one of several methods relevant to application for bonding, EPA assessed exposures from spray application using the *Automotive Refinishing Spray Coating Mist Inhalation Model* which estimates worker inhalation exposure based on the concentration of the chemical of interest in the nonvolatile portion of the sprayed product and the concentration of over sprayed mist/particles (OECD, 2011a). The model is based on PBZ monitoring data for mists during automotive refinishing. EPA used the 50th and 95th percentile mist concentrations along with the maximum and central tendency concentration of DEHP identified in diffusion bonding formulations to estimate the central tendency and high-end inhalation exposures, respectively. Equations and parameters used to calculate inhalation exposures using the *Automotive Refinishing Spray Coating Mist Inhalation Model* are included in Appendix D.6.

Table 3-70 summarizes the estimated 8-hour TWA concentration, AD, IADD, and ADD for worker exposures to DEHP during the Use of formulations for diffusion bonding. The high-end and central tendency exposures use 250 days per year as the exposure frequency since the default number of operating days in the release assessment exceeded 250 days per year, which is the expected maximum number of working days. Appendix A describes the approach for estimating AD, IADD, and ADD. The *Occupational Exposures from Formulations for Diffusion Bonding for Diethylhexyl Phthalate (DEHP)* also contains information about model equations and parameters and contains calculation results; refer to Appendix J for a reference to this supplemental document.

Table 3-70. Summary of Estimated Worker Inhalation Exposures During Formulations for Diffusion Bonding

Worker Population	Exposure Concentration Type	Central Tendency	High-End
Average Adult Worker	8-hour TWA Exposure Concentration (mg/m^3)	0.34	8.0
	Acute (AD, mg/kg-day)	4.3E−02	1.0
	Intermediate (IADD, mg/kg-day)	3.1E−02	0.73
	Chronic, Non-Cancer (ADD, mg/kg-day)	2.9E−02	0.68
Female of Reproductive Age	8-hour TWA Exposure Concentration (mg/m^3)	0.34	8.0
	Acute (AD, mg/kg-day)	4.7E−02	1.1
	Intermediate (IADD, mg/kg-day)	3.4E−02	0.81
	Chronic, Non-Cancer (ADD, mg/kg-day)	3.2E−02	0.75
ONU	8-hour TWA Exposure Concentration (mg/m^3)	0.34	
	Acute (AD, mg/kg-day)	4.3E−02	
	Intermediate (IADD, mg/kg-day)	3.1E−02	
	Chronic, Non-Cancer (ADD, mg/kg-day)	2.9E−02	

3.11.4.3 Occupational Dermal Exposure Results

EPA estimated dermal exposures for this OES using the methodology outlined in Appendix C. The various "Exposure Concentration Types" from Table 3-71 are explained in Appendix A. Because dermal exposures to workers may occur in the liquid form during the use of diffusion bonding formulations containing DEHP, EPA assessed the absorptive flux of DEHP using dermal absorption data for liquid DEHP (see Appendix C.2.1.1 for details). Table 3-71 summarizes the APDR, AD, IADD, and ADD for both average adult workers and female workers of reproductive age. Because no dust or mist is expected to be deposited on surfaces from this OES, EPA did not assess dermal exposures to ONUs from contact with surfaces. Dermal exposure parameters are described in Appendix C. The *Occupational Dermal Exposure Modeling Results for Diethylhexyl Phthalate (DEHP)* also contains information about model equations and parameters and contains calculation results; refer to Appendix J for a reference to this supplemental document.

Table 3-71. Summary of Estimated Worker Dermal Exposures During Formulations for Diffusion Bonding

Worker Population	Exposure Concentration Type	Central Tendency	High-End
Average Adult Worker	Dose Rate (APDR, mg/day)	0.11	0.21
	Acute (AD, mg/kg-day)	1.3E−03	2.7E−03
	Intermediate (IADD, mg/kg-day)	9.8E−04	2.0E−03
	Chronic, Non-Cancer (ADD, mg/kg-day)	9.2E−04	1.8E−03
Female of Reproductive Age	Dose Rate (APDR, mg/day)	0.09	0.18
	Acute (AD, mg/kg-day)	1.2E−03	2.5E−03
	Intermediate (IADD, mg/kg-day)	9.0E−04	1.8E−03
	Chronic, Non-Cancer (ADD, mg/kg-day)	8.4E−04	1.7E−03

3.11.4.4 Occupational Aggregate Exposure Results

Inhalation and dermal exposure estimates were aggregated based on the approach described in Appendix A to arrive at the aggregate worker and ONU exposure estimates in Table 3-72 below. The *Occupational Risk Calculator for Diethylhexyl Phthalate (DEHP)* (U.S. EPA, 2025e) contains the calculations of aggregate exposure; refer to Appendix J for a reference to this supplemental document.

Table 3-72. Summary of Estimated Worker Aggregate Exposures During Formulations for Diffusion Bonding

Worker Population	Exposure Concentration Type	Central Tendency	High-End
Average Adult Worker	Acute (AD, mg/kg-day)	4.4E−02	1.0
	Intermediate (IADD, mg/kg-day)	3.2E−02	0.73
	Chronic, Non-Cancer (ADD, mg/kg-day)	3.0E−02	0.68
Female of Reproductive Age	Acute (AD, mg/kg-day)	4.8E−02	1.1
	Intermediate (IADD, mg/kg-day)	3.5E−02	0.81
	Chronic, Non-Cancer (ADD, mg/kg-day)	3.3E−02	0.75
ONU	Acute (AD, mg/kg-day)	4.3E−02	
	Intermediate (IADD, mg/kg-day)	3.1E−02	
	Chronic, Non-Cancer (ADD, mg/kg-day)	2.9E−02	

3.12 Use of Laboratory Chemicals

3.12.1 Process Description

DEHP was identified as a reference material and/or laboratory reagent in two products (Restek, 2023a; UltraScientific, 2014). One product is supplied in ampules as a liquid with 0.2 percent DEHP (Restek, 2023a). The other product is also a liquid with 0.15 to 0.2 percent DEHP (UltraScientific, 2014). Additionally, a public comment submitted by the National Aeronautics and Space Administration (NASA) identifies the use of DEHP in laboratories, including such applications as analytical standards, research, equipment calibration, and sample preparation (NASA, 2020). Figure 3-11. Use of Laboratory Chemicals Flow Diagram (U.S. EPA, 2023b) shows a flow diagram for the use of DEHP in laboratory chemicals. EPA expects that DEHP is used in these laboratory procedures and then disposed of with other laboratory wastes. NASA did not indicate the physical form or concentration of DEHP used. EPA expects DEHP may be supplied in various small container sizes per the Use of Laboratory Chemicals Generic Scenario document, which recommends assuming liquid transportation containers are bottles, which have a size of 3.79 L (1 gal). For solids, EPA recommends assuming default container sized of 1 kg, based on a 1 L container and a density of 1 kg/L (U.S. EPA, 2023b).

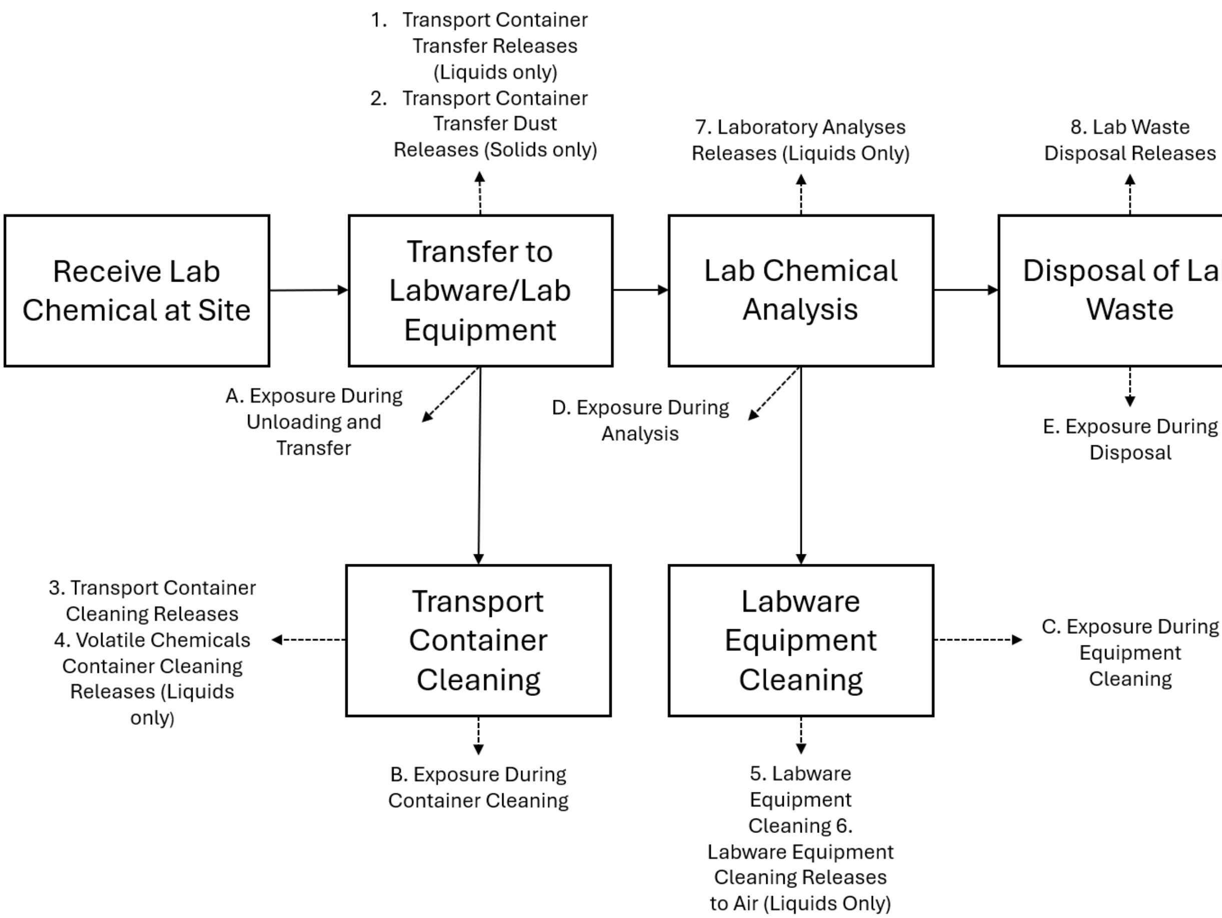


Figure 3-11. Use of Laboratory Chemicals Flow Diagram (U.S. EPA, 2023b)

3.12.2 Facility Estimates

EPA identified six unique sites that it assessed for the use of DEHP in laboratory chemicals that reported in NEI (U.S. EPA, 2022e) and DMR (U.S. EPA, 2022c). For air, four sites reported to NEI. For water, two sites reported to DMR. No sites reported land releases. No sites reported the use of DEHP-containing laboratory chemicals in the 2020 CDR (U.S. EPA, 2020a). Therefore, EPA estimated the total PV of DEHP in laboratory chemicals using the CDR reporting threshold limits of either 25,000 pounds (11,340 kg) or 5 percent of a site's reported PV, whichever value was smaller. EPA assumed that sites that claimed their production volume as CBI used 25,000 pounds of DEHP-containing laboratory chemicals annually. The total 2019 PV for this OES was 130,455 kg/year (287,604 lbs/yr) as shown in Table 3-73.

Table 3-73. Site PV Estimate for Laboratory Chemicals

Site Name	2019 PV	2018 PV	2017 PV	2016 PV	Site PV Estimate (lbs/yr)
Alac International Inc.	112,875	157,115	326,229	590,833	5,644
Allchem Industries Industrial Chemicals Group, Inc	35,280	0	0	0	1,764
Brenntag Mid-South Inc	172,096	129,030	129,240	0	8,605
Chemspec, Ltd.	131,456	134,184	88,184	94,150	6,573
Eastman Chemical Co. B-280 OFF	CBI	CBI	CBI	CBI	25,000

Site Name	2019 PV	2018 PV	2017 PV	2016 PV	Site PV Estimate (lbs/yr)
Formosa Global Solutions, Inc.	480,453	437,485	964,480	0	24,023
GJ Chemical Co Inc	573,312	681,712	951,690	1,035,760	25,000
Geon Performance Solutions Llc	0	0	44,100	87,200	0
Harwick Standard Distribution Corp	105,623	176,338	43,736	0	5,281
Industrial Chemicals Inc	257,484	37,699	346,343	220,469	12,874
LG Chem America, Inc.	CBI	CBI	CBI	CBI	25,000
M.A.Global Resources Inc	89,825	44,092	88,000	132,000	4,491
Alphagary Corp	214,378	1,559,242	9,026,933	8,033,157	10,719
Alphagary Corp	3,230,008	3,350,606	5,103,068	6,219,949	25,000
Momentive Performance Materials - Waterford	2,985	2,483	3,936	3,100	149
Elyria Distribution Ctr.	–	25,794	49,604	51,588	0
R.E. Carroll, Inc.	308,844	173,305	281,264	32,408	15,442
Shrieve Chemical Company, Llc	CBI	CBI	CBI	0	25,000
The Chemical Company	CBI	CBI	CBI	CBI	25,000
Tribute Energy, Inc.	4,276,967	5,396,915	6,481,589	6,225,853	25,000
Tricon International, Ltd		0	0	CBI	0
Univar Solutions Usa The Woodlands	305,516	0	0	0	15,276
Connell Bros. Co. Llc	35,274	0	35,274	70,547	1,764
Total Calculated PV	–	–	–	–	287,604

EPA did not identify site- or chemical-specific operating data for laboratory use of DEHP (*i.e.*, facility throughput, operating days, number of sites). For solid products, the 2023 Generic Scenario on The Use of Laboratory Chemicals provides an estimated throughput of 0.255 kg/site-day for solid laboratory chemicals (U.S. EPA, 2023b). Based on the mass fraction of DEHP in the laboratory chemical of 0.003 kg/kg, EPA estimated a daily facility solid DEHP use rate using Monte Carlo modeling, resulting in a 50th to 95th percentile range of 0.015 to 0.018 kg/site-day. For liquid products, the 2023 Generic Scenario on The Use of Laboratory Chemicals provided an estimated throughput of 0.50 to 4,000 mL/site-day for liquid laboratory chemicals. Based on the concentration of DEHP in liquid laboratory chemicals of 0.1 to 20 percent, and the DEHP product density of 1.3256 kg/L, EPA estimated a daily facility use rate of liquid laboratory chemicals using Monte Carlo modeling, resulting in a 50th to 95th percentile range of 0.113 to 0.415 kg/site-day. Additionally, the GS estimated the number of operating days as 174 to 260 days/year, with 8 to 12 hour/day operations (U.S. EPA, 2023b). Due to reporting thresholds of NEI and DMR, EPA does not expect the six identified sites to be the only sites using DEHP as a laboratory chemical. Therefore, EPA estimated the total number of sites that use DEHP-containing laboratory chemicals using a Monte Carlo model. The 50th to 95th percentile range of the number of sites was 4,996 to 36,873.

3.12.3 Release Assessment

3.12.3.1 Environmental Release Points

EPA assessed release points based on the 2023 Generic Scenario on the Use of Laboratory Chemicals (U.S. EPA, 2023b). Laboratory sites may use a combination of solid and liquid laboratory chemicals, but for the release estimate EPA assumed each site used either the liquid or the solid form of the DEHP-containing laboratory chemical. Based on the 2023 Generic Scenario on the Use of Laboratory Chemicals, fugitive or stack air releases may occur from unloading containers, container cleaning, labware cleaning, and laboratory analysis. In the solid laboratory chemical use case, release dust may occur from unloading to stack air, incineration, or landfill. In both use cases, surface water, POTW, incineration, or landfill releases may occur from container cleaning wastes, labware equipment cleaning wastes, and laboratory wastes (U.S. EPA, 2023b).

3.12.3.2 Environmental Release Assessment Results

Table 3-74 summarizes the number of release days and the annual and daily release estimates that were modeled for each release media and scenario assessed for Use of Laboratory Chemicals. See Appendix 0 for additional details on model equations and parameters used. The *Environmental Releases from Use of Laboratory Chemicals for Diethylhexyl Phthalate (DEHP)* also contains information about model equations and parameters and contains calculation results; refer to Appendix J for a reference to this supplemental document.

Table 3-74. Summary of Modeled Environmental Releases for Use of Laboratory Chemicals

<table>
<tr><th rowspan="2">Modeled Scenario</th><th rowspan="2">Environmental Media</th><th colspan="3">Annual Release (kg/site-yr)</th><th colspan="2">Number of Release Days (days/yr)</th><th colspan="2">Daily Release (kg/site-day)</th></tr>
<tr><th colspan="2">Central Tendency</th><th>High-End</th><th>Central Tendency</th><th>High-End</th><th>Central Tendency</th><th>High-End</th></tr>
<tr><td rowspan="2">Liquid, Laboratory Chemicals</td><td>Fugitive or Stack Air</td><td colspan="2">6.3E−09</td><td>2.1E−08</td><td rowspan="2">235</td><td rowspan="2">258</td><td>2.8E−11</td><td>9.1E−11</td></tr>
<tr><td>Wastewater, Incineration, or Landfill</td><td colspan="2">26</td><td>96</td><td>1.1E−01</td><td>4.1E−01</td></tr>
<tr><td rowspan="4">Solid Laboratory Chemicals</td><td>Water, Incineration, or Landfill</td><td>3.5</td><td>3.5</td><td rowspan="2">235</td><td rowspan="4">258</td><td colspan="2">1.5E−02</td><td>1.8E−02</td></tr>
<tr><td>Air, Water, Incineration, or Landfill</td><td>1.8E−02</td><td>1.8E−02</td><td colspan="2">6.8E−05</td><td>8.8E−05</td></tr>
<tr><td>Stack Air</td><td colspan="2">1.7E−02</td><td>1.8E−02</td><td colspan="2">6.8E−05</td><td>8.8E−05</td></tr>
<tr><td>Incineration or Landfill</td><td colspan="2">1.7E−02</td><td>1.8E−02</td><td colspan="2">6.8E−05</td><td>8.8E−05</td></tr>
</table>

3.12.4 Occupational Exposure Assessment

3.12.4.1 Worker Activities

Worker exposures to DEHP may occur through the inhalation of solid powders while unloading and transferring laboratory chemicals and during laboratory analysis. Inhalation exposures to DEHP vapor and dermal exposure to liquid and solid chemicals may occur during laboratory chemical unloading, container cleaning, labware and labware equipment cleaning, chemical use during laboratory analysis, and disposal of laboratory wastes (U.S. EPA, 2023b).

EPA did not find information on the extent to which laboratories that use DEHP-containing chemicals also use engineering controls and/or worker PPE. Based on the Generic Scenario for Use of Laboratory Chemicals, basic PPE at laboratories includes long sleeve lab coats, long pants, closed-toe shoes, safety glasses or goggles, and gloves. In addition to PPE, laboratories often use engineering controls, including fume hoods and local exhaust ventilation, to protect employees from exposures (U.S. EPA, 2023b). EPA expects the types of PPE and controls used at each site to be based on the hazards present; therefore, the common PPE/controls presented in the GS/ESD may or may not apply when DEHP is being used.

ONUs include supervisors, managers, and other employees that do not directly handle the laboratory chemical or laboratory equipment but may be present in the laboratory or analysis area. ONUs are potentially exposed through the inhalation route while in the laboratory area. Also, dermal exposures from contact with surfaces where mist or dust has been deposited were assessed for ONUs.

3.12.4.2 Occupational Inhalation Exposure Results

No references with discrete full shift samples were identified for this OES through systematic review; however, the European Union Risk Assessment for DEHP provided a minimum and maximum based on their collected full shift area samples from a laboratory used during DEHP production (ECB, 2008). A report from Modigh et al. provided full shift, personal sampling data statistics for two non-detected samples for laboratory staff at a plant producing DEHP (Modigh et al., 2002). EPA assessed the high-end worker inhalation exposure result for this OES using the maximum from the European Union Risk Assessment for DEHP and central tendency worker inhalation exposure result for this OES using the non-detected concentration result from the Modigh et al. study (ECJRC, 2008; Modigh et al., 2002). These data had data quality ratings ranging from medium to high, meaning they are of acceptable quality. These results are presented in Table 3-75. Additional discussion on the uncertainty and limitations of these data are included in the weight of scientific evidence (Section 4.2). No data with full shift samples for ONUs was identified for this OES through systematic review. For this reason, the worker central tendency exposure concentration was used to assess both the ONU high-end and central tendency exposures. The *Occupational Inhalation Exposure Data for Diethylhexyl Phthalate (DEHP)* contains additional information about the calculation results; refer to Appendix J for a reference to this supplemental document.

Table 3-75. Summary of Estimated Worker Inhalation Exposures for Use of Laboratory Chemicals

Worker Population	Exposure Concentration Type	Central Tendency	High-End
Average Adult Worker	8-hour TWA Exposure Concentration (mg/m^3)	1.0E−02	0.10
	Acute (AD, mg/kg-day)	1.3E−03	1.3E−02
	Intermediate (IADD, mg/kg-day)	9.2E−04	9.2E−03
	Chronic, Non-Cancer (ADD, mg/kg-day)	8.0E−04	8.6E−03
Female of Reproductive Age	8-hour TWA Exposure Concentration (mg/m^3)	1.0E−02	0.10
	Acute (AD, mg/kg-day)	1.4E−03	1.4E−02
	Intermediate (IADD, mg/kg-day)	1.0E−03	1.0E−02
	Chronic, Non-Cancer (ADD, mg/kg-day)	8.9E−04	9.5E−03
ONU	8-hour TWA Exposure Concentration (mg/m^3)	1.0E−02	1.0E−02
	Acute (AD, mg/kg-day)	1.3E−03	1.3E−02
	Intermediate (IADD, mg/kg-day)	9.2E−04	9.2E−03
	Chronic, Non-Cancer (ADD, mg/kg-day)	8.0E−04	8.6E−04

3.12.4.3 Occupational Dermal Exposure Results

EPA estimated dermal exposures for this OES using the methodology outlined in Appendix C. The various "Exposure Concentration Types" from Table 3-76 are explained in Appendix A. Because workers may be exposed to liquid or solid DEHP-containing lab chemicals, EPA assessed the absorptive flux of DEHP using the dermal absorption data for liquid DEHP (see Appendix C.2.1.1 for details) as well as solid DEHP (see Appendix C.2.1.2 for details) and used the maximum value for the exposure calculation. The *Occupational Dermal Exposure Modeling Results for Diethylhexyl Phthalate (DEHP)* also contains information about model equations and parameters and contains calculation results; refer to Appendix J for a reference to this supplemental document.

Table 3-76. Summary of Estimated Worker Dermal Exposures During Use of Laboratory Chemicals

Worker Population	Exposure Concentration Type	Central Tendency	High-End
Average Adult Worker	Dose Rate (APDR, mg/day)	0.21	0.41
	Acute (AD, mg/kg-day)	2.6E−03	5.1E−03
	Intermediate (IADD, mg/kg-day)	1.9E−03	3.8E−03
	Chronic, Non-Cancer (ADD, mg/kg-day)	1.7E−03	3.5E−03
Female of Reproductive Age	Dose Rate (APDR, mg/day)	0.17	0.34
	Acute (AD, mg/kg-day)	2.4E−03	4.7E−03
	Intermediate (IADD, mg/kg-day)	1.7E−03	3.5E−03
	Chronic, Non-Cancer (ADD, mg/kg-day)	1.5E−03	3.2E−03
ONU	Dose Rate (APDR, mg/day)	0.21	
	Acute (AD, mg/kg-day)	2.6E−03	
	Intermediate (IADD, mg/kg-day)	1.9E−03	
	Chronic, Non-Cancer (ADD, mg/kg-day)	1.7E−03	

Table 3-76 summarizes the APDR, AD, IADD, and ADD for both average adult workers and female workers of reproductive age. Because dust or mist is expected to be deposited on surfaces from this OES, EPA assessed dermal exposures to ONUs from contact with surfaces. Dermal exposure parameters are described in Appendix C.

3.12.4.4 Occupational Aggregate Exposure Results

Inhalation and dermal exposure estimates were aggregated based on the approach described in Appendix A to arrive at the aggregate worker and ONU exposure estimates in Table 3-77 below. The *Occupational Risk Calculator for Diethylhexyl Phthalate (DEHP) (*U.S. EPA, 2025e*)* contains the calculations of aggregate exposure; refer to Appendix J for a reference to this supplemental document.

Table 3-77. Summary of Estimated Worker Aggregate Exposures for Use of Laboratory Chemicals

Worker Population	Exposure Concentration Type	Central Tendency	High-End
Average Adult Worker	Acute (AD, mg/kg-day)	3.8E−03	1.8E−02
	Intermediate (IADD, mg/kg-day)	2.8E−03	1.3E−02
	Chronic, Non-Cancer (ADD, mg/kg-day)	2.5E−03	1.2E−02
Female of Reproductive Age	Acute (AD, mg/kg-day)	3.7E−03	1.9E−02
	Intermediate (IADD, mg/kg-day)	2.7E−03	1.4E−02
	Chronic, Non-Cancer (ADD, mg/kg-day)	2.4E−03	1.3E−02
ONU	Acute (AD, mg/kg-day)	3.8E−03	
	Intermediate (IADD, mg/kg-day)	2.8E−03	
	Chronic, Non-Cancer (ADD, mg/kg-day)	2.5E−03	2.6E−03

3.13 Use of Automotive Care Products

3.13.1 Process Description

DEHP is listed as a plasticizer on the global automotive declarable substance list, which includes substances that are expected to be present in a material or part of a vehicle (ACC, 2019). The Danish EPA Survey and Health Assessment of Products for Interior Car Care identified the presence of DEHP in glass cleaner (0.00026 to 0.025% DEHP), vinyl care products (0.0032 to 0.025% DEHP), and a fabric water proofing product (0.017 percent DEHP) (Danish EPA, 2010). Additionally, DEHP was identified in one rust converter product, which is a liquid that is brushed onto cars to chemically react and remove rust (1 to 5% DEHP) (3M, 2017).

Based on the types of products identified, the application methods for these products likely include brushing, spraying, and wiping with cloths, rags, or other materials. EPA expects that some of these products are then wiped off, such as the glass cleaning product and rust converter, and the wipes are disposed. Other products, such as the vinyl care and fabric water proofing product may remain on the surfaces after the excess is wiped off (U.S. EPA, 2022b).

All of the identified products are liquids and are generally received at detailing shops in small containers, ranging in size from 4 ounces to 15 gallons, with 16-ounce containers being the most common.(U.S. EPA, 2022b). For example, the rust converter is available in 1-quart bottles (3M, 2017). These products are expected to be used by workers in commercial settings, which includes automotive maintenance shops.

3.13.2 Facility Estimates

The number of sites that use automotive care products is unknown. EPA identified only one site, 7-Eleven Store #32509 in Westerly, RI, in DMR (U.S. EPA, 2022c) that reported an industrial sector (5541 – Gasoline Service Stations) that would be associated with DEHP in the use of automotive care products. No sites reported air or land releases. No sites reported the use of DEHP-containing automotive care products in the 2020 CDR (U.S. EPA, 2020a); therefore, EPA estimated the total PV of DEHP in automotive care products using the CDR reporting threshold limits of either 25,000 pounds (11,340 kg) or 5 percent of a site's reported PV, whichever value was smaller. EPA assumed that sites that claimed their PV as CBI used 25,000 pounds of DEHP-containing automotive care products annually. The total PV for this OES was 130,455 kg/year.

EPA did not identify site- or chemical-specific operating data for automotive care product use of DEHP (*i.e.*, facility throughput, operating days, number of sites). For use of automotive care products, the 2022 Methodology Review Document (MRD) on Use of Automotive Detailing Products provided an estimated use rate of 1 to 16 oz/car and estimated 1,610 to 3,212 cars/site-yr (U.S. EPA, 2022b). Based on the concentration of DEHP in automotive care products of 1.1×10^{-3} kg/kg, EPA estimated a daily facility use rate of automotive care products using Monte Carlo modeling, resulting in a 50th and 95th percentile range of 0.022 to 0.099 kg/site-day. Additionally, the MRD estimated the number of operating days as 235 to 258 days/yr (U.S. EPA, 2022b). While programmatic data provided one site, EPA did not identify industry-specific estimates of the number of sites that use automotive care products containing DEHP. Therefore, EPA estimated the total number of sites that use DEHP-containing automotive care products using a Monte Carlo model. The 50th to 95th percentile range of the number of sites was 25,170 to 147,152.

3.13.3 Release Assessment

3.13.3.1 Environmental Release Points

EPA assessed release points based on the 2022 MRD on Use of Automotive Detailing Products (U.S. EPA, 2022b). Based on the identified products for this OES, DEHP was expected to be present in paste and liquid form of the automotive detailing products. Therefore, EPA did not expect any releases from dust which typically occur during the unloading of solid products. Based on the 2022 Automotive Detailing Products – Generic Scenario Methodology Review Draft fugitive air releases may occur from unloading containers and cleaning containers. POTW or landfill releases may occur from container residue losses and product application (U.S. EPA, 2022b).

3.13.3.2 Environmental Release Assessment Results

Table 3-78 summarizes the number of release days and the annual and daily release estimates that were modeled for each release media and scenario assessed for Use of automotive care products. See 0 for additional information on equations and parameters used. The *Environmental Releases from Use of Automotive Care Products for Diethylhexyl Phthalate (DEHP)* also contains information about model equations and parameters and contains calculation results; refer to Appendix J for a reference to this supplemental document.

Table 3-78. Summary of Modeled Environmental Releases for Use of Automotive Care Products

Modeled Scenario	Environmental Media	Annual Release (kg/site-yr)		Daily Release (kg/site-day)		Number of Release Days	
		Central Tendency	High-End	Central Tendency	High-End	Central Tendency	High-End
130,455.21 kg/yr production volume	Fugitive Air	4.6E−11	3.4E−10	2.0E−13	1.5E−12	235	258
	POTW or Landfill	5.2	23	2.3E−02	0.10		

3.13.4 Occupational Exposure Assessment

3.13.4.1 Worker Activities

Worker exposures to DEHP may occur through the inhalation of vapors or mists or dermal contact with liquid DEHP-containing automotive care products during unloading transport containers and during the application and use of the automotive care products. (U.S. EPA, 2022b).

EPA did not find information on the extent to which facilities that use DEHP-containing automotive care products also use engineering controls and/or worker PPE.

Based on the Generic Scenario for Commercial Use of Automotive Detailing Products, PPE available for purchase for automotive detailing facilities includes particle respirators, ear plugs, safety glasses, aprons, knee pads, nitrile gloves, cooling towels, and face masks. The GS also states that based on an industry website, eyewear, face masks, and ear plugs are recommended during automotive detailing (U.S. EPA, 2022b). EPA expects the types of PPE used at each site to be based on the hazards present; therefore, the common PPE GS may or may not apply when DEHP is being used.

ONUs include supervisors, managers, and other employees that do not directly handle the automotive care products or application equipment but may be present in the application area. ONUs are potentially exposed through the inhalation route while in the application area.

3.13.4.2 Occupational Inhalation Exposure Results

No references with discrete worker full shift samples were identified for this OES through systematic review; however, the European Union Risk Assessment on DEHP provided a minimum (below LOD) concentration and maximum concentration based on their collected full shift samples during the application of car sealings and under-coatings (ECJRC, 2008). EPA assessed the high-end worker inhalation exposure result for this OES using the maximum concentration and central tendency worker inhalation exposure result for this OES using the midpoint between zero and the maximum concentration from the European Union Risk Assessment on DEHP as the minimum given in the sample was below the LOD (ECJRC, 2008). These data had a data quality rating of high, meaning they are of acceptable quality. In addition to the European Union Risk Assessment for DEHP, the 2019 OSHA CEHD data included two discrete full shift area samples for ONUs relevant to automotive care products (OSHA, 2019). EPA assessed the high-end ONU inhalation exposure result for this OES using the higher concentration sample and the central tendency ONU inhalation exposure result for this OES using the average of the two sample concentrations from the OSHA CEHD dataset (OSHA, 2019). These results are presented in Table 3-79. Additional discussion on the uncertainty and limitations of these data are included in the weight of scientific evidence (Section 4.2). The *Occupational Inhalation Exposure Data for Diethylhexyl Phthalate (DEHP)* contains additional information about the calculation results; refer to Appendix J for a reference to this supplemental document.

Table 3-79. Summary of Estimated Worker Inhalation Exposures for Use of Automotive Care Products

Modeled Scenario	Exposure Concentration Type	Central Tendency	High-End
Average Adult Worker	8-hour TWA Exposure Concentration (mg/m^3)	5.5E−02	0.11
	Acute Dose (AD) (mg/kg/day)	6.9E−03	1.4E−02
	Intermediate Average Daily Dose, Non-Cancer Exposures (IADD) (mg/m^3)	5.0E−03	1.0E−02
	Chronic Average Daily Dose, Non-Cancer Exposures (ADD) (mg/kg/day)	4.4E−03	9.4E−03
Female of Reproductive Age	8-hour TWA Exposure Concentration (mg/m^3)	5.5E−02	0.11
	Acute Dose (AD) (mg/kg/day)	7.6E−03	1.5E−02
	Intermediate Average Daily Dose, Non-Cancer Exposures (IADD) (mg/m^3)	5.6E−03	1.1E−02
	Chronic Average Daily Dose, Non-Cancer Exposures (ADD) (mg/kg/day)	4.9E−03	1.0E−02
ONU	8-hour TWA Exposure Concentration (mg/m^3) [a]	5.0E−02	6.0E−02
	Acute Dose (AD) (mg/kg/day)	6.3E−03	7.5E−03
	Intermediate Average Daily Dose, Non-Cancer Exposures (IADD) (mg/m^3)	4.6E−03	5.5E−03
	Chronic Average Daily Dose, Non-Cancer Exposures (ADD) (mg/kg/day)	4.0E−03	5.1E−03

[a] OSHA area sample data used for central tendency and high-end exposure estimates.

3.13.4.3 Occupational Dermal Exposure Results

EPA estimated dermal exposures for this OES using the methodology outlined in Appendix C. The various "Exposure Concentration Types" from Table 3-80 are explained in Appendix A. Because dermal exposures to workers may occur in the liquid form during the use of automotive care products containing DEHP, EPA assessed the absorptive flux of DEHP according to the dermal absorption data of liquid DEHP (see Appendix C.2.1.1 for details). Table 3-80 summarizes the APDR, the AD, the IADD, and the ADD for both average adult workers and female workers of reproductive age. Because there is no dust or mist expected to be deposited on surfaces from this OES, dermal exposures to ONUs from contact with surfaces were not assessed. Dermal exposure parameters are described in Appendix C. The *Occupational Dermal Exposure Modeling Results for Diethylhexyl Phthalate (DEHP)* also contains information about model equations and parameters and contains calculation results; refer to Appendix J for a reference to this supplemental document.

Table 3-80. Summary of Estimated Worker Dermal Exposures for Use of Automotive Care Products

Worker Population	Exposure Concentration Type	Central Tendency	High-End
Average Adult Worker	Dose Rate (APDR, mg/day)	0.11	0.21
	Acute (AD, mg/kg-day)	1.3E−03	2.7E−03
	Intermediate (IADD, mg/kg-day)	9.8E−04	2.0E−03
	Chronic, Non-Cancer (ADD, mg/kg-day)	8.6E−04	1.8E−03
Female of Reproductive Age	Dose Rate (APDR, mg/day)	9.0E−02	0.18
	Acute (AD, mg/kg-day)	1.2E−03	2.5E−03
	Intermediate (IADD, mg/kg-day)	9.0E−04	1.8E−03
	Chronic, Non-Cancer (ADD, mg/kg-day)	7.9E−04	1.7E−03

3.13.4.4 Occupational Aggregate Exposure Results

Inhalation and dermal exposure estimates were aggregated based on the approach described in Appendix A to arrive at the aggregate worker and ONU exposure estimates in Table 3-81 below. The *Occupational Risk Calculator for Diethylhexyl Phthalate (DEHP)* (U.S. EPA, 2025e) contains the calculations of aggregate exposure; refer to Appendix J for a reference to this supplemental document.

Table 3-81. Summary of Estimated Worker Aggregate Exposures for Use of Automotive Care Products

Modeled Scenario	Exposure Concentration Type (mg/kg/day)	Central Tendency	High-End
Average Adult Worker	Acute (AD, mg/kg-day)	8.2E−03	1.6E−02
	Intermediate (IADD, mg/kg-day)	6.0E−03	1.2E−02
	Chronic, Non-Cancer (ADD, mg/kg-day)	5.3E−03	1.1E−02
Female of Reproductive Age	Acute (AD, mg/kg-day)	8.8E−03	1.8E−02
	Intermediate (IADD, mg/kg-day)	6.5E−03	1.3E−02
	Chronic, Non-Cancer (ADD, mg/kg-day)	5.7E−03	1.2E−02
ONU	Acute (AD, mg/kg-day)	6.3E−03	7.5E−03
	Intermediate (IADD, mg/kg-day)	4.6E−03	5.5E−03
	Chronic, Non-Cancer (ADD, mg/kg-day)	4.0E−03	5.1E−03

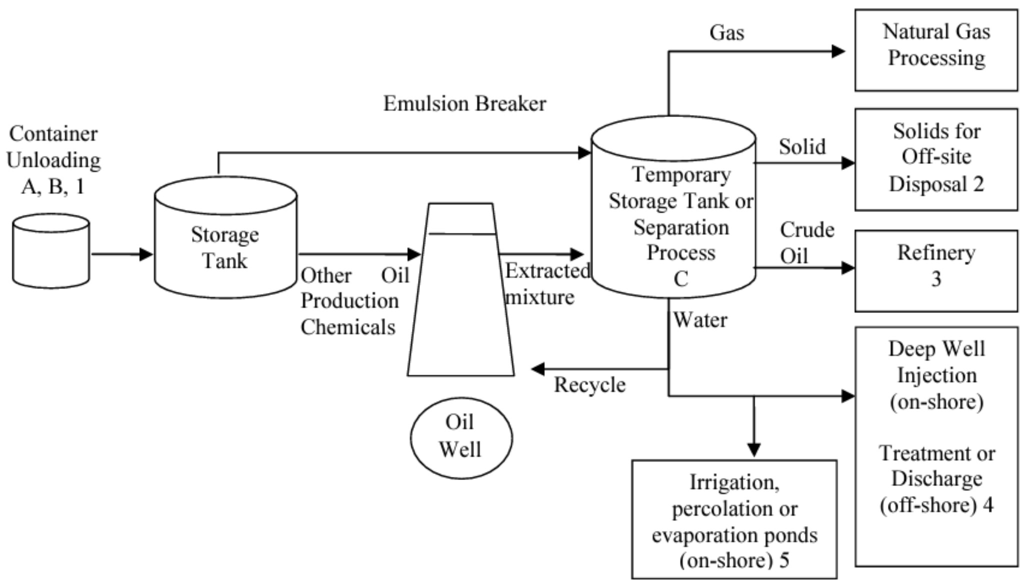
3.14 Use in Hydraulic Fracturing

3.14.1 Process Description

DEHP was identified as a chemical used in hydraulic fracturing fluids in a U.S. House of Representatives report (U. S. House of Representatives, 2011). DEHP was also identified in flowback water from hydraulic fracturing operations in Pennsylvania and West Virginia according to a New York State Department of Environmental Conservation report (NYSDEC, 2011). These sources do not list the function of DEHP in hydraulic fracturing fluids.

Per the ESD on Chemicals Used in Oil Well Production, hydraulic fracturing involves the stimulation of oil wells by injecting pressurized water containing chemical additives into the well (OECD, 2012). Chemicals are received at oil well sites where they are unloaded into storage tanks or directly into mix tanks where they are blended with other additives and water to create the hydraulic fracturing fluid. For hydraulic fracturing operations, the surface facilities and layout typically involve several pieces of mobile equipment including hydraulic fracturing fluid storage tanks, sand storage units, chemical trucks, blending equipment and pumping equipment. All facets of the hydraulic fracturing job, from the blending and pumping of the hydraulic fracturing fluids and proppants, to the way the rock formation responds to the fracturing, are managed from a single truck often referred to as the Data Monitoring Van (U.S. EPA, 2022d). The hydraulic fracturing fluid is then injected into the well and fluid comprised of oil, gas, water, sand, and chemical additives used in the hydraulic fracturing fluid is extracted from the well. The extracted mixture is then processed on site to separate the mixture by phase (*e.g.*, sand, water, water/oil emulsion, and oil). Oil is sent to refineries for further processing and wastewater is further treated, reused, and/or disposed (OECD, 2012).

EPA found information on the concentration of DEHP in hydraulic fracturing fluids using Frac Focus, which showed a maximum of 5 percent in the DEHP-containing products added to the fluid. The resulting fracturing fluids contained a maximum of 0.03 percent DEHP (FracFocus, 2022). Figure 3-12 presents a typical process flow diagram for on-shore and off-shore operations.



Environmental Release:
1. Container residue from raw material released to uncertain media (water, incineration or land)
2. Chemical in solids/sand to off-site disposal (water or land)
3. Chemical in oil to refinery (incineration)
4. Chemical in produced water recycled, deep well injected or discharged (water)
5. Chemical in produced water to irrigation, evaporation and percolation ponds (land)

Occupational Exposure:
A. Dermal exposure to liquid raw material during container unloading
B. Dermal exposure to liquid raw material during container cleaning
C. Dermal exposure to liquid product during equipment and storage tank cleaning

Figure 3-12. Typical Process Flow Diagram for On-Shore and Off-Shore Operations (OECD, 2012)

3.14.2 Facility Estimates

No sites reported to programmatic databases or CDR for DEHP use in hydraulic fracturing (U.S. EPA, 2020a). EPA estimated the total PV of DEHP in hydraulic fracturing fluids using a discrete distribution of FracFocus data. Based on a reported data from FracFocus, the mass fraction of DEHP in hydraulic fracturing fluid ranged from 6.9121×10^{-16} to 1.61 kg/kg (FracFocus, 2022). The annual use rate of fracturing fluids containing DEHP reported in FracFocus ranged from 15,250 to 1,212,136 gal/site-yr and the number of sites reporting use of DEHP is 44 (FracFocus, 2022). Using the data reported in FracFocus, EPA estimated a maximum daily use rate of 61,600 kg/site-day. Additionally, FracFocus reported the number of operating days ranging between 1 to 3 days/yr resulting in a maximum production volume of 184,800 kg/site-yr (FracFocus, 2022).

3.14.3 Release Assessment

3.14.3.1 Environmental Release Points

EPA assessed release points based on the 2022 *Emission Scenario Document on Chemicals Used in Hydraulic Fracturing* (U.S. EPA, 2022d). Based on the 2022 *Emission Scenario Document on Chemicals Used in Hydraulic Fracturing*, fugitive air releases may occur from unloading volatile chemicals during containers, container cleaning, and equipment and storage tank cleaning. Releases to surface water, incineration, or landfill may occur from container residuals and container cleaning. Releases to surface water, soil, landfill, or incineration may occur from spills. Releases to deep well injection may occur from the portion of fracturing fluid that remains underground after hydraulic fracturing and does not return in flowback or produced water. Releases to recycling, deep well injection, surface water, or soil may occur from flowback and produced wastewater release (U.S. EPA, 2022d).

3.14.3.2 Environmental Release Assessment Results

Table 3-82 summarizes the number of release days and the annual and daily release estimates that were modeled for each release media and scenario assessed for Use in hydraulic fracturing. See Appendix 0 for additional details on model equations and parameters use. The *Environmental Releases from Use of Hydraulic Fracturing for Diethylhexyl Phthalate (DEHP)* also contains information about model equations and parameters and contains calculation results; refer to Appendix J for a reference to this supplemental document.

Table 3-82. Summary of Modeled Environmental Releases for Use in Hydraulic Fracturing

Modeled Scenario	Environmental Media	Annual Release (kg/site-yr)		Daily Release (kg/site-day)		Number of Release Days	
		Central Tendency	High-End	Central Tendency	High-End	Central Tendency	High-End
Default number of sites set to 44	Fugitive Air	1.7E−11	1.8E−10	1.1E−11	1.3E−10	1	3
	Water, Incineration, or Landfill	9.7E−02	2	0.12	1.4		
	Surface Water	0.37	6.5	1.2E−02	0.22		
	Soil	0.12	2.1	4.0E−03	7.0E−02		
	Incineration or Landfill	0	6.6E−04	0	4.2E−04		
	Deep Well Injection	2.9	45	0.87	19		
	Recycle	9.6E−02	1.7	0.32	5.7E−02		
	Total	3.6	56	1.0	21		

3.14.4 Occupational Exposure Assessment

3.14.4.1 Worker Activities

Worker exposures to DEHP may occur through the inhalation of vapors or dermal contact with DEHP-containing hydraulic fracturing fluids during unloading transport containers, transport container cleaning, and during equipment/storage tank cleaning.

EPA did not find information on the extent to which facilities that use DEHP-containing fracturing fluids also use engineering controls and/or worker PPE.

Based on the Emission Scenario Document on Chemicals Used in Oil Well Production, PPE used during oil well production may include impervious gloves, clothing, safety glasses, masks, or respirators. In cases where the material SDS identifies specific hazards, full chemical suits with a breathing apparatus may be used (OECD, 2012). EPA expects the types of PPE used at each site to be based on the hazards present; therefore, the common PPE GS may or may not apply when DEHP is being used.

ONUs include supervisors, managers, and other employees that do not directly handle the hydraulic fracturing fluids or process equipment but may be present in the process area. ONUs are potentially exposed through the inhalation route while in the process area.

3.14.4.2 Occupational Inhalation Exposure Results

No references with full shift samples were identified for this OES through systematic review; however, data were available for a similar OES (Manufacturing). Manufacturing was selected as a surrogate OES for monitoring data since it is both expected to be a conservative estimate. Specifically, by using the Manufacturing OES as a surrogate, EPA is not making assertions as to the similarities of the processes and applications covered under this OES. Instead, EPA selected the Manufacturing OES exposure concentrations as a basis for presenting a value which no exposure from the use in hydraulic fracturing is expected to exceed. These OES are expected to have similar exposure potential based on the similarity of chemical physical form in each OES. Therefore, EPA assessed worker and ONU exposures using monitoring data for the Manufacturing OES as a surrogate for this OES. These data had data quality ratings ranging from medium to high, meaning they are of acceptable quality. These results are presented in Table 3-83. There is some uncertainty in how well these surrogate data approximate exposures for this OES such as the throughputs, chemical concentrations, process conditions (temperatures, pressures, feed rates), and engineering controls used; EPA is uncertain as to the degree which these differences may significantly impact exposure results. Additional discussion on the uncertainty and limitations of these data are included in the weight of scientific evidence (Section 4.2). The *Occupational Inhalation Exposure Data for Diethylhexyl Phthalate (DEHP)* contains additional information about the calculation results; refer to Appendix J for a reference to this supplemental document.

Table 3-83. Summary of Estimated Worker Inhalation Exposures for Use in Hydraulic Fracturing

Modeled Scenario	Exposure Concentration Type	Central Tendency	High-End
Average Adult Worker	8-hour TWA Exposure Concentration (mg/m^3)	1.2E−02	2.2E−02
	Acute Dose (AD) (mg/kg/day)	1.5E−03	2.8E−03
	Intermediate Average Daily Dose, Non-Cancer Exposures (IADD) (mg/m^3)	5.0E−05	2.8E−04
	Chronic Average Daily Dose, Non-Cancer Exposures (ADD) (mg/kg/day)	4.1E−06	2.3E−05
Female of Reproductive Age	8-hour TWA Exposure Concentration (mg/m^3)	1.2E−02	2.2E−02
	Acute Dose (AD) (mg/kg/day)	1.7E−03	3.0E−03
	Intermediate Average Daily Dose, Non-Cancer Exposures (IADD) (mg/m^3)	5.5E−05	3.0E−04
	Chronic Average Daily Dose, Non-Cancer Exposures (ADD) (mg/kg/day)	4.5E−06	2.5E−05
ONU	8-hour TWA Exposure Concentration (mg/m^3)	1.2E−02	
	Acute Dose (AD) (mg/kg/day)	1.5E−03	
	Intermediate Average Daily Dose, Non-Cancer Exposures (IADD) (mg/m^3)	5.0E−05	1.5E−04
	Chronic Average Daily Dose, Non-Cancer Exposures (ADD) (mg/kg/day)	4.1E−06	1.2E−05

3.14.4.3 Occupational Dermal Exposure Results

EPA estimated dermal exposures for this OES using the methodology outlined in Appendix C. The various "Exposure Concentration Types" from Table 3-84 are explained in Appendix A. Because workers may be exposed to liquid DEHP-containing-contain hydraulic fracturing fluid, EPA assessed the absorptive flux of DEHP using dermal absorption data for liquid DEHP (see Appendix C.2.1.1 for details). Table 3-84 summarizes the APDR, AD, IADD, and ADD for both average adult workers and female workers of reproductive age. Because no dust or mist is expected to be deposited on surfaces from this OES, EPA did not assess dermal exposures to ONUs from contact with surfaces. Dermal exposure parameters are described in Appendix C. The *Occupational Dermal Exposure Modeling Results for Diethylhexyl Phthalate (DEHP)* also contains information about model equations and parameters and contains calculation results; refer to Appendix J for a reference to this supplemental document.

Table 3-84. Summary of Estimated Worker Dermal Exposures for Use in Hydraulic Fracturing

Worker Population	Exposure Concentration Type	Central Tendency	High-End
Average Adult Worker	Dose Rate (APDR, mg/day)	0.11	0.21
	Acute (AD, mg/kg-day)	1.3E−03	2.7E−03
	Intermediate (IADD, mg/kg-day)	4.5E−05	2.7E−04
	Chronic, Non-Cancer (ADD, mg/kg-day)	3.7E−06	2.2E−05
Female of Reproductive Age	Dose Rate (APDR, mg/day)	9.0E−02	0.18
	Acute (AD, mg/kg-day)	1.2E−03	2.5E−03
	Intermediate (IADD, mg/kg-day)	4.1E−05	2.5E−04
	Chronic, Non-Cancer (ADD, mg/kg-day)	3.4E−06	2.0E−05

3.14.4.4 Occupational Aggregate Exposure Results (waiting)

Inhalation and dermal exposure estimates were aggregated based on the approach described in Appendix A to arrive at the aggregate worker and ONU exposure estimates in Table 3-85 below. The *Occupational Risk Calculator for Diethylhexyl Phthalate (DEHP)* (U.S. EPA, 2025e) contains the calculations of aggregate exposure; refer to Appendix J for a reference to this supplemental document.

Table 3-85. Summary of Estimated Worker Aggregate Exposures for Use in Hydraulic Fracturing

Modeled Scenario	Exposure Concentration Type (mg/kg/day)	Central Tendency	High-End
Average Adult Worker	Acute (AD, mg/kg-day)	2.8E−03	5.4E−03
	Intermediate (IADD, mg/kg-day)	9.5E−05	5.4E−04
	Chronic, Non-Cancer (ADD, mg/kg-day)	7.8E−06	4.5E−05
Female of Reproductive Age	Acute (AD, mg/kg-day)	2.9E−03	5.5E−03
	Intermediate (IADD, mg/kg-day)	9.6E−05	5.5E−04
	Chronic, Non-Cancer (ADD, mg/kg-day)	7.9E−06	4.5E−05
ONU	Acute (AD, mg/kg-day)	1.5E−03	
	Intermediate (IADD, mg/kg-day)	5.0E−05	1.5E−04
	Chronic, Non-Cancer (ADD, mg/kg-day)	4.1E−06	1.2E−05

3.15 Recycling

3.15.1 Process Description

EPA did not identify information specific to DEHP recycling; however, multiple companies reported to CDR that DEHP is recycled (U.S. EPA, 2020a). Materials containing DEHP, such as plastic and rubber products, may be recycled through mechanical, chemical, or thermal processing (Muchangos et al., 2019). Recovered plastics from waste streams are generally sent to plastic production sites for recycling into new plastic products (Muchangos et al., 2019).

The Association of Plastic Recyclers reported recycled PVC arrives at a typical recycling site tightly baled as crushed finished articles ranging from 240 to 453 kg (APR, 2023). The bales are unloaded into process vessels, where the PVC is grinded and separated from non-PVC fractions using electrostatic separation, washing/floatation, or air/jet separation. Following cooling of grinded PVC, that the site transfers the product to feedstock storage for use in the plastics compounding or converting line or loaded into containers for shipment to downstream use sites. Table 3-13 provides an illustration of the

PVC recycling process. While EPA did not identify information specific to the exposure activities and release points for other recycling operations, DEHP exposures and releases are also expected for the recycling of non-PVC materials.

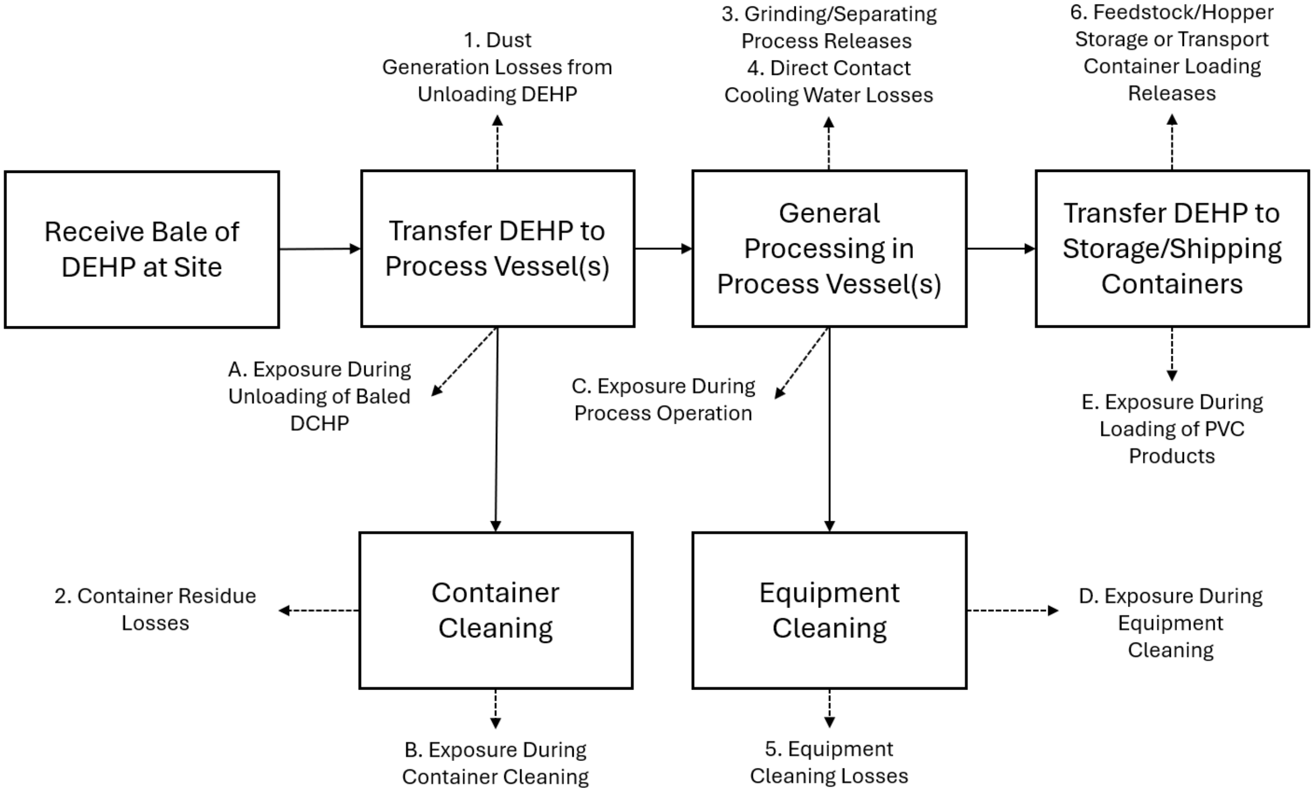


Figure 3-13. DEHP-Containing PVC Recycling Flow Diagram (U.S. EPA, 2021d)

3.15.2 Facility Estimates

EPA identified one site – Demenno/Kerdoon dba World Oil Recycling in Compton, CA - that it assessed for the use of DEHP in recycling through the TRI (U.S. EPA, 2022f) dataset. TRI does not report operating days, therefore EPA assumed 246 release days per year per the *Revised Plastic Compounding GS* as discussed in Section 2.3.2 (U.S. EPA, 2021d). No sites were identified under the 2020 CDR or DMR (U.S. EPA, 2022c)/NEI (U.S. EPA, 2022e) datasets.

3.15.3 Release Assessment

3.15.3.1 Environmental Release Points

Based on TRI (U.S. EPA, 2022f) data, recycling releases may go to fugitive air, stack air, surface water, incineration, or landfill. Fugitive air, surface water, incineration or landfill releases may occur from storage or loading of recycled plastic and general recycling processing. Water, incineration, or landfill releases may occur from container residue losses and equipment cleaning. Surface water releases may occur from direct contact cooling water. Stack air releases may occur from loading recycled plastics into storage and transport containers. Additional fugitive air releases may occur during leakage of pipes, flanges, and accessories used for transport. Due to lack of process information at recycling sites, EPA assumes that these sites do not utilize air pollution capture and control technologies.

3.15.3.2 Environmental Release Assessment Results

Table 3-86 presents fugitive and stack air releases per year and per day for Recycling based on 2017 to 2022 TRI (U.S. EPA, 2022f) database reporting years along with the number of release days per year, with medians and maxima presented from across the six-year reporting range. No land or water releases were reported through 2017 to 2022 TRI data, and no releases were reported through 2020 NEI (U.S. EPA, 2022e) data nor 2017 to 2022 DMR (U.S. EPA, 2022c) data. The *Environmental Releases to Wastewater for Diethylhexyl Phthalate (DEHP)*, *Environmental Releases to Air for Diethylhexyl Phthalate (DEHP)*, and *Environmental Releases to Land for Diethylhexyl Phthalate (DEHP)* contain additional information about the calculation results; refer to Appendix J for a reference to these supplemental documents.

Table 3-86. Summary of Air Releases from TRI for Recycling

Site Identity	Maximum Annual Fugitive Air Release (kg/yr)	Max. Annual Stack Air Release (kg/yr)	Median Annual Fugitive Air Release (kg/yr)	Median Annual Stack Air Release (kg/yr)	Max. Daily Fugitive Air Release (kg/day)	Max. Daily Stack Air Release (kg/day)	Median Daily Fugitive Air Release (kg/day)	Median Daily Stack Air Release (kg/day)	Annual Release Days (days/yr)
Demennokerdoon Dba World Oil Recycling, Compton, CA	3.3E−02	1.2E−02	3.3E−02	1.2E−02	1.3E−04	4.7E−05	1.3E−04	4.7E−05	248

3.15.4 Occupational Exposure Assessment

3.15.4.1 Worker Activities

At plastic or rubber recycling sites, worker exposures from dermal contact with solids and inhalation may occur during the unloading of baled plastics or rubber, loading of processed DEHP-containing plastics or rubber onto compounding or converting lines or into transport containers, processing of recycled plastics or rubber, and equipment cleaning (U.S. EPA, 2021d).

EPA did not identify information on engineering controls or worker PPE used at recycling sites. Based on the Generic Scenario for Plastic Compounding, suitable PPE in the plastics industry includes gloves, hearing protection in high noise levels, eye protection, and respiratory protection in areas where ventilation is not used. The generic scenario also states that most plants use forced ventilation techniques to reduce worker exposures to vapors and local exhaust ventilation in areas where particulates or vapor may be formed (U.S. EPA, 2021d). EPA expects that recycling sites utilize similar PPE/controls as compounding sites, but the types of PPE and controls used at each site to be based on the hazards present; therefore, the common PPE/controls presented in the GS/ESD may or may not apply when DEHP is being used.

ONUs include supervisors, managers, and other employees that work in the processing area but do not directly handle DEHP-containing plastic or the recycled compounded product. ONUs are potentially exposed through the inhalation route while in the working area. Also, dermal exposures from contact with surfaces where dust has been deposited were assessed for ONUs.

3.15.4.2 Occupational Inhalation Exposure Results

EPA did not identify inhalation monitoring data for the recycling OES during systematic review. Based on plastic recyclers relying heavily on the plastic converting processes, EPA used Plastic converting inhalation monitoring data as surrogate data (see Section 3.4.4.2). The high-end worker inhalation exposure results for this OES are based on the 95th percentile exposure values from full shift samples collected from (OSHA, 2019). These data had a data quality rating of High. The central tendency worker inhalation exposure results for this OES are based on a weighted average of mean values from full shift samples collected from (Modigh et al., 2002) and a mean sample calculated from the discrete samples given in (OSHA, 2019). These data had a data quality rating of high. As all data were deemed of acceptable quality without notable deficiencies, EPA elected to integrate all the data in the final exposure assessment. Results of this analysis are presented in Table 3-87. In addition to these data, the following reference was not included in the analysis as it did not provide discrete sample data: Dirven et al. (1993). The estimated high-end generally aligns with data from Dirven et al. with EPA's estimated high-end being within an order of magnitude of the maximum presented in Dirven et al. (1993). The estimated central tendency also generally aligns with Dirven et al. with EPA's estimated central tendency being within an order of magnitude of the median presented by Dirven et al. (1993). Additional discussion on the uncertainty and limitations of these data are included in the weight of scientific evidence (Section 4.2). No data with full shift samples for ONUs was identified for this OES through systematic review; for this reason, worker central tendency exposures were used as both the ONU high-end and central tendency exposures.

Table 3-87 summarizes the estimated 8-hour TWA concentration, AD, IADD, and ADD for worker exposures to DEHP during recycling operations. Both the high-end and central tendency exposures use 250 days per year as the exposure frequency. Appendix A describes the approach for estimating AD, IADD, and ADD. The *Occupational Inhalation Exposure Data for Diethylhexyl Phthalate (DEHP)* contains additional information about the calculation results; refer to Appendix J for a reference to this supplemental document.

Table 3-87. Summary of Estimated Worker Inhalation Exposures for Recycling

Modeled Scenario	Exposure Concentration Type	Central Tendency	High-End
Average Adult Worker	8-hour TWA Exposure Concentration (mg/m^3)	5.1E−02 [a]	
	Acute Dose (AD, mg/kg/day)	6.4E−03	6.6E−02
	Intermediate (IADD, mg/kg-day)	4.7E−03	4.7E−03
	Chronic, Non-Cancer (ADD, mg/kg-day)	4.4E−03	4.4E−03
Female of Reproductive Age	8-hour TWA Exposure Concentration (mg/m^3)	5.1E−02 [a]	
	Acute Dose (AD, mg/kg/day)	7.0E−03	7.0E−03
	Intermediate, non-Cancer (IADD, mg/kg-day)	5.2E−03	5.2E−03
	Chronic, non-Cancer (ADD, mg/kg-day)	4.8E−03	4.8E−03
ONU	8-hour TWA Exposure Concentration (mg/m^3)	5.1E−02 [a]	
	Acute Dose (AD) (mg/kg/day)	6.4E−03	
	Intermediate, Non-Cancer (IADD, mg/kg-day)	4.7E−03	
	Chronic, Non-Cancer (ADD, mg/kg-day)	4.4E−03	

[a] A single value representing the highest 8-hour TWA provided for plastic compounding was used as both the central tendency and high-end exposure value (Vinyl Institute, 2025) for all populations. The underlying data was not provided in the public comment, therefore the highest value measured was used as a screening value.

3.15.4.3 Occupational Dermal Exposure Results

EPA estimated dermal exposures for this OES using the methodology outlined in Appendix C. The various "Exposure Concentration Types" from Table 3-88 are explained in Appendix A. Because workers may be exposed to solid DEHP-containing products during recycling, EPA assessed the absorptive flux of DEHP using dermal absorption data for solid DEHP (see Appendix C.2.1.2 for details). Table 3-88 summarizes the APDR, AD, IADD, and ADD for both average adult workers and female workers of reproductive age. Because dust or mist is expected to be deposited on surfaces from this OES, EPA assessed dermal exposures to ONUs from contact with surfaces. Dermal exposure parameters are described in Appendix C. The *Occupational Dermal Exposure Modeling Results for Diethylhexyl Phthalate (DEHP)* also contains information about model equations and parameters and contains calculation results; refer to Appendix J for a reference to this supplemental document.

Table 3-88. Summary of Estimated Worker Dermal Exposures for Recycling

Worker Population	Exposure Concentration Type	Central Tendency	High-End
Average Adult Worker	Dose Rate (APDR, mg/day)	0.21	0.41
	Acute (AD, mg/kg-day)	2.6E−03	5.1E−03
	Intermediate (IADD, mg/kg-day)	1.9E−03	3.8E−03
	Chronic, Non-Cancer (ADD, mg/kg-day)	1.8E−03	3.5E−03
Female of Reproductive Age	Dose Rate (APDR, mg/day)	0.17	0.34
	Acute (AD, mg/kg-day)	2.4E−03	4.7E−03
	Intermediate (IADD, mg/kg-day)	1.7E−03	3.5E−03
	Chronic, Non-Cancer (ADD, mg/kg-day)	1.6E−03	3.2E−03
ONU	Dose Rate (APDR, mg/day)	0.21	
	Acute (AD, mg/kg-day)	2.6E−03	

Worker Population	Exposure Concentration Type	Central Tendency	High-End
	Intermediate (IADD, mg/kg-day)	1.9E−03	
	Chronic, Non-Cancer (ADD, mg/kg-day)	1.8E−03	

3.15.4.4 Occupational Aggregate Exposure Results

Inhalation and dermal exposure estimates were aggregated based on the approach described in Appendix A to arrive at the aggregate worker and ONU exposure estimates in Table 3-89 below. The *Occupational Risk Calculator for Diethylhexyl Phthalate (DEHP)* (U.S. EPA, 2025e) contains the calculations of aggregate exposure; refer to Appendix J for a reference to this supplemental document.

Table 3-89. Summary of Estimated Worker Aggregate Exposures for Recycling

Modeled Scenario	Exposure Concentration Type (mg/kg/day)	Central Tendency	High-End
Average Adult Worker	Acute (AD, mg/kg-day)	1.0E−02	1.0E−02
	Intermediate (IADD, mg/kg-day)	1.0E−02	1.0E−02
	Chronic, Non-Cancer (ADD, mg/kg-day)	1.0E−02	1.0E−02
Female of Reproductive Age	Acute (AD, mg/kg-day)	1.0E−02	1.0E−02
	Intermediate (IADD, mg/kg-day)	1.0E−02	1.0E−02
	Chronic, Non-Cancer (ADD, mg/kg-day)	1.0E−02	1.0E−02
ONU	Acute (AD, mg/kg-day)	1.0E−02	
	Intermediate (IADD, mg/kg-day)	1.0E−02	
	Chronic, Non-Cancer (ADD, mg/kg-day)	1.0E−02	

3.16 Waste Handling, Disposal, and Treatment

3.16.1 Process Description

Each of the COUs of DEHP may generate waste streams of the chemical that are collected and transported to third-party sites for disposal or treatment. Industrial sites that treat or dispose onsite wastes that they themselves generate are assessed in each COU assessment. Similarly, releases of DEHP to surface water, air, or land are assessed in each COU assessment. Wastes of DEHP that are generated during a COU and sent to a third-party site for treatment, disposal, or may include the following:

- Wastewater: DEHP may be contained in wastewater discharged to POTW or other, non-public treatment works for treatment. Industrial wastewater containing DEHP discharged to a POTW may be subject to EPA or authorized NPDES state pretreatment programs. The assessment of wastewater discharges to POTWs and non-public treatment works of DEHP is included in each of the COU assessments.
- Solid Wastes: Solid wastes are defined under RCRA as any material that is discarded by being: abandoned; inherently waste-like; a discarded military munition; or recycled in certain ways (certain instances of the generation and legitimate reclamation of secondary materials are exempted as solid wastes under RCRA). Solid wastes may subsequently meet RCRA's definition of hazardous waste by either being listed as a waste at 40 CFR sections 261.30 to 261.35 or by meeting waste-like characteristics as defined at 40 CFR sections 261.20 to 261.24. Solid wastes that are hazardous wastes are regulated under the more stringent requirements of Subtitle C of

RCRA, whereas non-hazardous solid wastes are regulated under the less stringent requirements of Subtitle D of RCRA.

DEHP is a U-listed hazardous waste under code U028 under RCRA; therefore, discarded, unused pure and commercial grades of DEHP are regulated as a hazardous waste under RCRA (40 CFR section 261.33(f)).

- Wastes Exempted as Solid Wastes under RCRA: Certain COUs of DEHP may generate wastes of DEHP that are exempted as solid wastes under 40 CFR section 261.4(a). For example, the generation and legitimate reclamation of hazardous secondary materials of DEHP may be exempt as a solid waste.

2019 TRI (U.S. EPA, 2021c) data lists off-site transfers of DEHP to land disposal, wastewater treatment, incineration, and recycling facilities. About 85.4 percent of off-site transfers were recycled, 8.2 percent sent for energy recovery, 3.5 percent sent for land disposal, 2.9 percent sent for incineration, and 0.03 percent sent to wastewater treatment (U.S. EPA, 2021c); see Figure 3-14.

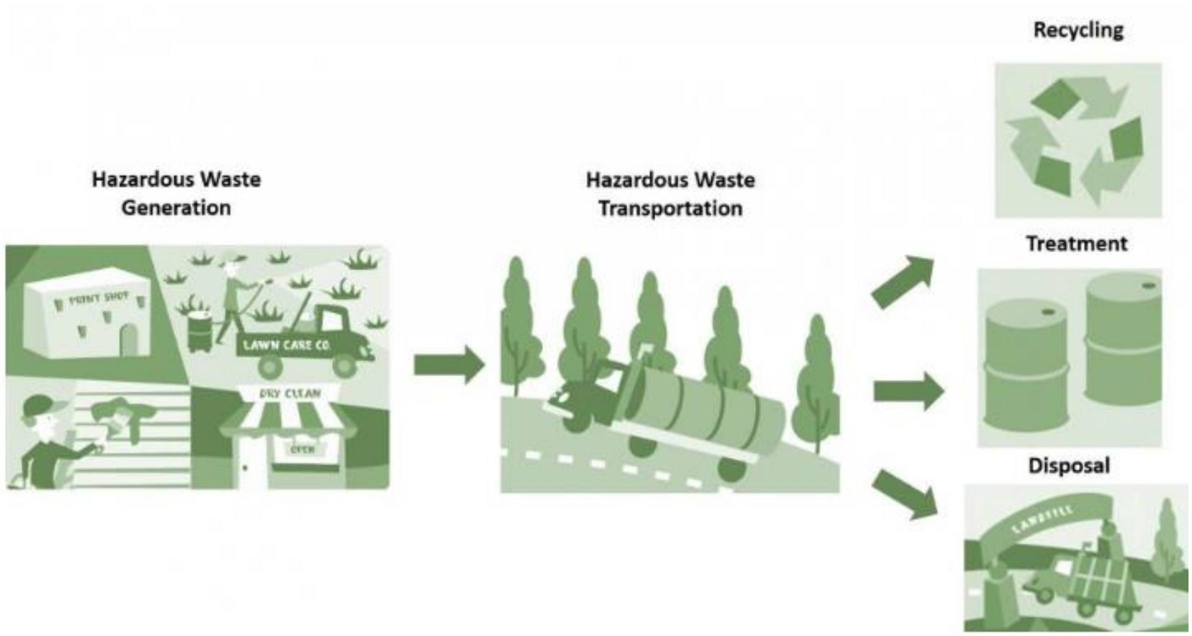


Figure 3-14. Typical Waste Disposal Process (U.S. EPA, 2017)

Municipal Waste Incineration

Municipal waste combustors (MWCs) that recover energy are generally located at large facilities and comprised of an enclosed tipping floor and a deep waste storage pit. Typical large MWCs may range in capacity from 250 to over 1,000 tons per day. At facilities of this scale, waste materials are not generally handled directly by workers. Trucks may dump the waste directly into the pit, or waste may be tipped to the floor and later pushed into the pit by a worker operating a front-end loader. A large grapple from an overhead crane is used to grab waste from the pit and drop it into a hopper, where hydraulic rams feed the material continuously into the combustion unit at a controlled rate. The crane operator also uses the grapple to mix the waste within the pit, in order to provide a fuel consistent in composition and heating value, and to pick out hazardous or problematic waste.

Facilities burning refuse-derived fuel (RDF) conduct on-site sorting, shredding, and inspection of the waste prior to incineration to recover recyclables and remove hazardous waste or other unwanted materials. Sorting is usually an automated process that uses mechanical separation methods, such as trommel screens, disk screens, and magnetic separators. Once processed, the waste material may be transferred to a storage pit, or it may be conveyed directly to the hopper for combustion.

Tipping floor operations may generate dust. Air from the enclosed tipping floor, however, is continuously drawn into the combustion unit via one or more forced air fans to serve as the primary combustion air and minimize odors. Dust and lint present in the air is typically captured in filters or other cleaning devices in order to prevent the clogging of steam coils, which are used to heat the combustion air and help dry higher-moisture inputs (Kitto and Stultz, 1992).

Municipal Waste Landfill

Municipal solid waste landfills are discrete areas of land or excavated sites that receive household wastes and other types of non-hazardous wastes (*e.g.*, industrial and commercial solid wastes). Standards and requirements for municipal waste landfills include location restrictions, composite liner requirements, leachate collection and removal system, operating practices, groundwater monitoring requirements, corrective action provisions, and closure-and post-closure care requirements that include financial assurance. Non-hazardous solid wastes are regulated under RCRA Subtitle D, but states may impose more stringent requirements.

Municipal solid wastes may be first unloaded at waste transfer stations for temporary storage, prior to being transported to the landfill or other treatment or disposal facilities.

Hazardous Waste Landfill

Hazardous waste landfills are excavated or engineered sites specifically designed for the final disposal of non-liquid hazardous wastes. Design standards for these landfills require double liner, double leachate collection and removal systems, leak detection systems, runoff and wind dispersal controls, and construction quality assurance program (U.S. EPA, 2018). There are also requirements for closure and post-closure, such as the addition of a final cover over the landfill and continued monitoring and maintenance. These standards and requirements prevent potential contamination of groundwater and nearby surface water resources. Hazardous waste landfills are regulated under 40 CFR parts 264 and 265, Subpart N.

3.16.2 Facility Estimates

In the NEI (U.S. EPA, 2022e), DMR (U.S. EPA, 2022c), and TRI (U.S. EPA, 2022f) data, EPA identified 221 unique sites which it assessed for the use of DEHP in waste handling, treatment and disposal, 260 DMR sites reported under waste handling, treatment and disposal –POTW (water; publicly owned treatment works), and 315 NEI sites reporting under waste handling, treatment and disposal - combustion. For air, 21 sites reported to TRI and 514 to NEI. For water, 261 sites reported to DMR. For land, seven sites reported to TRI. The total number of sites reporting air, water, and land releases can be larger than the number of unique sites due to the overlap of facilities between reporting databases. No sites were identified under the 2020 CDR. Due to the lack of data on the annual PV of DEHP in waste handling, treatment, and disposal, EPA does not present annual or daily site throughputs. EPA identified operating days ranging from 15 to 365 with an average of 350 days through NEI air release data. TRI/DMR did not report operating days, therefore, EPA assumes 365 days/yr of operation for sites reporting in these datasets, as discussed in Section 2.3.1.

3.16.3 Release Assessment

3.16.3.1 Environmental Release Points

Potential releases to the environment from Waste handling, treatment, and disposal may go to fugitive air, stack air, surface water, POTW, landfill, and additional releases may occur from transfers of wastes from off-site treatment facilities. Fugitive air releases may occur during sampling, equipment cleaning, container loading/unloading, and connecting/disconnecting transfer lines. Stack air releases may occur from vented losses during treatment operations. Releases to surface water, POTW, or landfill may occur from equipment cleaning, treatment wastes, and sampling wastes. Surface water releases may occur from container cleaning.

3.16.3.2 Environmental Release Assessment Results

Table 3-90 presents fugitive and stack air releases per year and per day for Waste handling, disposal, and treatment based on the 2017 to 2022 TRI (U.S. EPA, 2022f) database reporting years along with the number of release days per year, with medians and maxima presented from across the six-year reporting range. Table 3-91 presents fugitive and stack air releases per year and per day based on the 2020 NEI (U.S. EPA, 2022e) database along with the number of release days per year. Table 3-92 presents land releases per year based on the 2017 to 2022 TRI database along with the number of release days per year. Table 3-93 presents water releases per year and per day based on the 2017 to 2022 DMR (U.S. EPA, 2022c) database along with the number of release days per year, with medians and maxima presented from across the six-year reporting range. The *Environmental Releases to Wastewater for Diethylhexyl Phthalate (DEHP)*, *Environmental Releases to Air for Diethylhexyl Phthalate (DEHP)*, and *Environmental Releases to Land for Diethylhexyl Phthalate (DEHP)* contain additional information about the calculation results; refer to Appendix J for a reference to this supplemental document.

Table 3-90. Summary of Air Releases from TRI for Waste Handling, Disposal, and Treatment

Site Identity	Maximum Annual Fugitive Air Release (kg/yr)	Max. Annual Stack Air Release (kg/yr)	Median Annual Fugitive Air Release (kg/yr)	Median Annual Stack Air Release (kg/yr)	Max. Daily Fugitive Air Release (kg/day)	Max. Daily Stack Air Release (kg/day)	Median Daily Fugitive Air Release (kg/day)	Median Daily Stack Air Release (kg/day)	Annual Release Days (days/yr)
J Ryan Corp, Plantsville, CT	222	0	222	0	0.61	0	0.61	0	365
Norlite LLC, Cohoes, NY	4.5E−03	0	4.5E−03	0	1.2E−05	0	1.2E−05	0	365
Keystone Cement Co, Bath, PA	0.14	113	0.14	113	3.7E−04	0.31	3.7E−04	0.31	365
Pine Hall Brick Co Inc, Madison, NC	0	219	0	199	0	0.6	0	0.54	365
Giant Cement Co, Harleyville, SC	0.9	0.47	9.1E−02	0.45	2.5E−03	1.3E−03	2.5E−04	1.2E−03	365
Heritage Thermal Services, East Liverpool, OH	1.2	1.4E−02	1.1E−05	4.5E−03	3.3E−03	3.7E−05	3.1E−08	1.2E−05	365
Ross Incineration Services Inc, Grafton, OH	2.1E−02	4.5E−04	4.1E−03	4.5E−04	5.8E−05	1.2E−06	1.1E−05	1.2E−06	365
Heidelberg Materials Us Cement LLC, Logansport, IN	0.45	0.45	0.23	0.23	1.2E−03	1.2E−03	6.2E−04	6.2E−04	365
Wayne Disposal Inc, Belleville, MI	9.1E−03	0.13	4.5E−03	6.4E−02	2.5E−05	3.5E−04	1.2E−05	1.7E−04	365
Veolia N.A. Inc., Sauget, IL	0	0	0	0	0	0	0	0	365
Continental Cement Co LLC, Hannibal, MO	0.64	7.3	0.64	7.3	1.8E−03	2.0E−02	1.8E−03	2.0E−02	365
Buzzi Unicem USA-Cape Girardeau, Cape Girardeau, MO	4.1	0.91	2.7	0.45	1.1E−02	2.5E−03	7.5E−03	1.2E−03	365

Site Identity	Maximum Annual Fugitive Air Release (kg/yr)	Max. Annual Stack Air Release (kg/yr)	Median Annual Fugitive Air Release (kg/yr)	Median Annual Stack Air Release (kg/yr)	Max. Daily Fugitive Air Release (kg/day)	Max. Daily Stack Air Release (kg/day)	Median Daily Fugitive Air Release (kg/day)	Median Daily Stack Air Release (kg/day)	Annual Release Days (days/yr)
Ash Grove Cement Co, Chanute, KS	0	4.5E−03	0	4.5E−03	0	1.2E−05	0	1.2E−05	365
Clean Harbors Environmental Services Inc, Kimball, Ne	4.5E−02	18	4.5E−02	18	1.2E−04	5.0E−02	1.2E−04	5.0E−02	365
Clean Harbors El Dorado LLC, El Dorado, AR	4.5E−02	5.4E−02	4.5E−02	4.5E−02	1.2E−04	1.5E−04	1.2E−04	1.2E−04	365
Superior Materials 38, Ann Arbor, MI	227	227	227	227	0.62	0.62	0.62	0.62	365
Ash Grove Cement, Foreman, AR	0	2.5E−02	0	2.5E−02	0	7.0E−05	0	7.0E−05	365
Clean Harbors Deer Park LLC, La Porte, TX	4.5E−02	4.5E−02	4.5E−02	4.5E−02	1.2E−04	1.2E−04	1.2E−04	1.2E−04	365
Veolia ES Technical Solutions LLC Port Arthur Facility, Beaumont, TX	5	0	5	0	1.4E−02	0	1.4E−02	0	365
Clean Harbors Aragonite LLC, Grantsville, UT	0	9.1E−03	0	9.1E−03	0	2.5E−05	0	2.5E−05	365
Chemical Waste Management of the Northwest Inc., Arlington, OR	0	0	0	0	0	0	0	0	365

Table 3-91. Summary of Air Releases from NEI (2020) for Waste Handling, Disposal, and Treatment

Site Identity[a]	Total Fugitive Air Release (kg/yr)	Daily Fugitive Air Release (kg/day)	Total Stack Air Release (kg/yr)	Daily Stack Air Release (kg/day)	Annual Release Days (days/yr)
M D C /Hartford WPCF, Hartford, CT	Fugitive releases not reported	Fugitive releases not reported	2.1	2.9E−03	365
Mattabassett District, Cromwell, CT	Fugitive releases not reported	Fugitive releases not reported	Stack releases not reported	Stack releases not reported	365
Greater New Haven WPCA, New Haven, CT	Fugitive releases not reported	Fugitive releases not reported	13	1.8E−02	365
RJF - Morin Brick LLC - Auburn, Auburn, ME	Fugitive releases not reported	Fugitive releases not reported	13	1.8E−02	365
ECSD No 3 Southtowns Advanced Wastewater Treatment Plant, Hamburg, NY	Fugitive releases not reported	Fugitive releases not reported	123	0.17	365
NYC-Dep Newtown Creek WPCP, Brooklyn, NY	Fugitive releases not reported	Fugitive releases not reported	0.17	2.4E−04	365
NYC-Dep Coney Island WPCP, Brooklyn, NY	3.1E−02	4.3E−05	2.2E−02	3.0E−05	365
Albany County Sewer District - South Plant, Albany, NY	Fugitive releases not reported	Fugitive releases not reported	0.82	1.1E−03	365
Albany County Sewer District - North Plant, Menands, NY	Fugitive releases not reported	Fugitive releases not reported	1.8	2.4E−03	365
Lehigh Cement Company - Union Bridge, Union Bridge, MD	0	0	9.6	1.8E−02	260
NYC-Dep Tallman Island WPCP, College Point, NY	0	0	Stack releases not reported	Stack releases not reported	365
Finch Paper LLC, Glens Falls, NY	Fugitive releases not reported	Fugitive releases not reported	0.95	1.3E−03	365
Redland Brick, Williamsport, MD	0	0	0	0	260
Erie Sewer Authority/Erie WWTP, Erie, PA	Fugitive releases not reported	Fugitive releases not reported	7.3	1.8E−02	198
BNZ Materials Inc/Zelienople, Zelienople, PA	Fugitive releases not reported	Fugitive releases not reported	12	2.0E−02	301
Lehigh Cement Company LLC/Nazareth, Nazareth, PA	24	4.8E−02	16	3.2E−02	249

Site Identity[a]	Total Fugitive Air Release (kg/yr)	Daily Fugitive Air Release (kg/day)	Total Stack Air Release (kg/yr)	Daily Stack Air Release (kg/day)	Annual Release Days (days/yr)
Glen Gery Corp/Hanley Plant, Summerville, PA	Fugitive releases not reported	Fugitive releases not reported	80	0.11	365
Watsontown Brick Co/Watsontown PLT, Watsontown, PA	Fugitive releases not reported	Fugitive releases not reported	54	7.4E−02	365
Hatfield Twp Muni Auth/Colmar, Colmar, PA	15	2.0E−02	1	1.4E−03	365
Glen Gery Corp/Bigler Div, Bigler, PA	Fugitive releases not reported	Fugitive releases not reported	0.82	2.7E−02	15
Glen Gery Corp/Mid Atlantic PLT, Shoemakersville, PA	Fugitive releases not reported	Fugitive releases not reported	131	0.18	364
General Shale Products Inc, Blue Ridge, VA	Fugitive releases not reported	Fugitive releases not reported	70	9.6E−02	365
Glen-Gery Corp/York Division, York, PA	Fugitive releases not reported	Fugitive releases not reported	41	9.8E−02	209
HRSD Williamsburg Sewage Treatment Plant, Williamsburg, VA	3.8E−02	5.1E−05	1.6	2.3E−03	365
HRSD Army Base Sewage Treatment Plant, Norfolk, VA	3.9E−02	5.3E−05	0.93	1.3E−03	365
Greer Industries, Inc. Dba Greer Lime Company - Riverton Facility, Riverton, WV	Fugitive releases not reported	Fugitive releases not reported	1.7	2.4E−03	365
HRSD Chesapeake-Elizabeth Sewage Treatment Plant, Virginia Beach, VA	6.3E−02	8.7E−05	Stack releases not reported	Stack releases not reported	365
HRSD Virginia Initiative Plant, Norfolk, VA	Fugitive releases not reported	Fugitive releases not reported	19	2.6E−02	365
Argos USA - Martinsburg, Martinsburg, WV	Fugitive releases not reported	Fugitive releases not reported	50	1.0E−01	246
Harbison Walker (Fairfield), Fairfield, AL	0	0	Stack releases not reported	Stack releases not reported	365
Meridian Brick, LLC Bessemer Plant No. 6, Bessemer, AL	Fugitive releases not reported	Fugitive releases not reported	126	0.17	365
Meridian Brick LLC, Phenix City, AL	Fugitive releases not reported	Fugitive releases not reported	0	0	365

Site Identity[a]	Total Fugitive Air Release (kg/yr)	Daily Fugitive Air Release (kg/day)	Total Stack Air Release (kg/yr)	Daily Stack Air Release (kg/day)	Annual Release Days (days/yr)
Lhoist North America of Alabama, LLC, Calera, AL	Fugitive releases not reported	Fugitive releases not reported	4.8	6.6E−03	365
Lhoist North America of Alabama, LLC, Calera, AL	Fugitive releases not reported	Fugitive releases not reported	2.7	3.7E−03	365
Henry Brick Company, Inc., Selma, AL	Fugitive releases not reported	Fugitive releases not reported	134	0.18	365
Acme Brick Company, Montgomery, AL	Fugitive releases not reported	Fugitive releases not reported	45	6.1E−02	365
Florida Brick & Clay Co, Plant City, FL	Fugitive releases not reported	Fugitive releases not reported	Stack releases not reported	Stack releases not reported	365
Continental Brick - Martinsburg Facility, Martinsburg, WV	25	5.6E−02	Stack releases not reported	Stack releases not reported	220
Cheney Lime & Cement Company, Alabaster, AL	Fugitive releases not reported	Fugitive releases not reported	1.8	2.4E−03	365
Meridian Brick LLC, Phenix City, AL	Fugitive releases not reported	Fugitive releases not reported	0	0	365
Acme Brick Company, Leeds, AL	Fugitive releases not reported	Fugitive releases not reported	1,101	1.5	365
3M Company, Guin, AL	Fugitive releases not reported	Fugitive releases not reported	0	0	365
General Shale Brick, Inc. - Plant 40, Coosa, GA	Fugitive releases not reported	Fugitive releases not reported	183	0.25	365
Owensboro Brick LLC, Owensboro, KY	Fugitive releases not reported	Fugitive releases not reported	22	3.1E−02	365
North American Refractories, South Shore, KY	Fugitive releases not reported	Fugitive releases not reported	3.3	4.5E−03	365
U. S. Refractories, Hitchins, KY	Fugitive releases not reported	Fugitive releases not reported	0	0	365
Columbus Brick Company Inc, Columbus, MS	Fugitive releases not reported	Fugitive releases not reported	175	0.24	365
Meridian Brick LLC - Stanton Plant, Stanton, KY	Fugitive releases not reported	Fugitive releases not reported	36	4.9E−02	365

Site Identity[a]	Total Fugitive Air Release (kg/yr)	Daily Fugitive Air Release (kg/day)	Total Stack Air Release (kg/yr)	Daily Stack Air Release (kg/day)	Annual Release Days (days/yr)
Polyone Corporation/Goodrich Corporation, Calvert City, KY	Fugitive releases not reported	Fugitive releases not reported	6.5E−03	9.0E−06	365
Resco Products, Inc., Greensboro, NC	Fugitive releases not reported	Fugitive releases not reported	Stack releases not reported	Stack releases not reported	365
City of Greensboro - T.Z. Osborne Water Reclamation Facility, McLeansville, NC	Fugitive releases not reported	Fugitive releases not reported	636	0.87	364
Triangle Brick Company - Wadesboro Brick Manufacturing Plant, Wadesboro, NC	Fugitive releases not reported	Fugitive releases not reported	173	0.24	364
Metropolitan Sewerage District of Buncombe County, Asheville, NC	Fugitive releases not reported	Fugitive releases not reported	196	0.27	365
Statesville Brick Company, Statesville, NC	Fugitive releases not reported	Fugitive releases not reported	5	6.8E−03	364
Lee Brick and Tile Company, Inc., Sanford, NC	Fugitive releases not reported	Fugitive releases not reported	47	6.4E−02	364
Triangle Brick Company-Merry Oaks Brick Manufacturing Plant, Moncure, NC	Fugitive releases not reported	Fugitive releases not reported	144	0.2	364
General Shale Brick, Inc. - Kings Mountain Facility, Grover, NC	Fugitive releases not reported	Fugitive releases not reported	17	3.3E−02	260
General Shale Brick, Inc. - Moncure Facility, Moncure, NC	Fugitive releases not reported	Fugitive releases not reported	95	0.18	260
Meridian Brick LLC - Salisbury Facility, East Spencer, NC	Fugitive releases not reported	Fugitive releases not reported	104	0.14	364
Pine Hall Brick Co., Inc., Madison, NC	Fugitive releases not reported	Fugitive releases not reported	176	0.24	364
Taylor Clay Products, Inc., Salisbury, NC	Fugitive releases not reported	Fugitive releases not reported	Stack releases not reported	Stack releases not reported	365
AGY Aiken LLC, Aiken, SC	223	0.31	Stack releases not reported	Stack releases not reported	365
Forterra Brick East, LLC - Monroe Facility, Monroe, NC	Fugitive releases not reported	Fugitive releases not reported	Stack releases not reported	Stack releases not reported	365
Meridian Brick LLC Columbia Facility, Columbia, SC	Fugitive releases not reported	Fugitive releases not reported	66	9.0E−02	364

Site Identity[a]	Total Fugitive Air Release (kg/yr)	Daily Fugitive Air Release (kg/day)	Total Stack Air Release (kg/yr)	Daily Stack Air Release (kg/day)	Annual Release Days (days/yr)
Palmetto Brick, Wallace, SC	Fugitive releases not reported	Fugitive releases not reported	152	0.21	365
Forterra Brick, LLC - Roseboro Facility, Roseboro, NC	Fugitive releases not reported	Fugitive releases not reported	Stack releases not reported	Stack releases not reported	365
General Shale Brick - Plant #42, Spring City, TN	Fugitive releases not reported	Fugitive releases not reported	4.7	6.4E−03	365
Meridian Brick LLC - Gleason Plant, Gleason, TN	Fugitive releases not reported	Fugitive releases not reported	47	6.4E−02	365
NYC-Dep North River WPCP, New York, NY	9.1E−05	1.2E−07	2.6E−02	3.5E−05	365
Sand Draw Landfill, Fremont, WY	Fugitive releases not reported	Fugitive releases not reported	0	0	259
Wood Island Waste Management, Wetmore, MI	Fugitive releases not reported	Fugitive releases not reported	1.9E−05	6.8E−08	137
Chaffee Landfill, Chaffee, NY	Fugitive releases not reported	Fugitive releases not reported	2.0E−03	2.7E−06	365
Crow Wing County Portable Air Curtain Incinerator, Crow Wind County, MN	Fugitive releases not reported	Fugitive releases not reported	4.3E−05	5.9E−08	365
Rock Oil Refining Inc, Stratford, WI	Fugitive releases not reported	Fugitive releases not reported	4.3E−02	5.9E−05	365
Glen-Gery Corp, Marseilles, IL	Fugitive releases not reported	Fugitive releases not reported	215	0.34	320
Illinois Cement Co, La Salle, IL	Fugitive releases not reported	Fugitive releases not reported	Stack releases not reported	Stack releases not reported	365
Richards Brick Co, Edwardsville, IL	Fugitive releases not reported	Fugitive releases not reported	Stack releases not reported	Stack releases not reported	365
Holcim US Inc, Grand Chain, IL	Fugitive releases not reported	Fugitive releases not reported	Stack releases not reported	Stack releases not reported	365
Veolia ES Technical Solutions LLC, Sauget, IL	0	0	Stack releases not reported	Stack releases not reported	365
Lehigh Cement Company LLC, Logansport, In	0.45	6.2E−04	0.45	6.2E−04	365

Site Identity[a]	Total Fugitive Air Release (kg/yr)	Daily Fugitive Air Release (kg/day)	Total Stack Air Release (kg/yr)	Daily Stack Air Release (kg/day)	Annual Release Days (days/yr)
St. Marys Cement Inc, Dixon, IL	Fugitive releases not reported	Fugitive releases not reported	Stack releases not reported	Stack releases not reported	365
Warren Waste Water Treatment Plant, Warren, MI	Fugitive releases not reported	Fugitive releases not reported	Stack releases not reported	Stack releases not reported	365
Brampton Brick, Farmersburg, In	Fugitive releases not reported	Fugitive releases not reported	77	0.11	365
Wayne Disposal Inc, Belleville, MI	0	0	Stack releases not reported	Stack releases not reported	365
Met Council - Seneca WWTP, Eagan, MN	Fugitive releases not reported	Fugitive releases not reported	8.6E−04	1.2E−06	365
Met Council - Empire WWTP, Farmington, MN	510	0.7	Stack releases not reported	Stack releases not reported	365
Meridian Brick, Corunna, MI	Fugitive releases not reported	Fugitive releases not reported	66	9.1E−02	365
Met Council Metropolitan WWTP, Saint Paul, MN	0	0	Stack releases not reported	Stack releases not reported	365
Western Lake Superior Sanitary District Administrative Office, Duluth, MN	0	0	Stack releases not reported	Stack releases not reported	365
3M - Cottage Grove - Corporate Incinerator, Cottage Grove, MN	3.9E−02	5.4E−05	8.3E−04	1.1E−06	365
Bowerston Shale Company (0145000010), Newark, OH	Fugitive releases not reported	Fugitive releases not reported	27	3.7E−02	365
Buffalo WWTP, Buffalo, MN	Fugitive releases not reported	Fugitive releases not reported	2.2E−03	3.0E−06	365
HarbisonWalker International, Inc. (1667090000), Windham, OH	Fugitive releases not reported	Fugitive releases not reported	13	1.7E−02	364
Summitville Tiles, Inc. - Minerva Plant (0210000047), Minerva, OH	Fugitive releases not reported	Fugitive releases not reported	8.1	1.1E−02	365
Bowerston Shale Company (0634000012), Bowerston, OH	Fugitive releases not reported	Fugitive releases not reported	30	4.1E−02	365
Westerly Wastewater Treatment Plant (1318002480), Cleveland, OH	Fugitive releases not reported	Fugitive releases not reported	1.2	4.0E−03	150

Site Identity[a]	Total Fugitive Air Release (kg/yr)	Daily Fugitive Air Release (kg/day)	Total Stack Air Release (kg/yr)	Daily Stack Air Release (kg/day)	Annual Release Days (days/yr)
Whitacre-Greer (0250000005), Alliance, OH	Fugitive releases not reported	Fugitive releases not reported	35	4.7E−02	365
Glen Gery Corporation (0351000005), Caledonia, OH	Fugitive releases not reported	Fugitive releases not reported	32	5.8E−02	277
Koch Knight, LLC (1576001851), East Canton, OH	Fugitive releases not reported	Fugitive releases not reported	5	6.9E−03	365
Resco Products Inc (1576000771), East Canton, OH	Fugitive releases not reported	Fugitive releases not reported	3.4	4.7E−03	365
Ironrock Capital, Inc. (1576051149), Canton, OH	Fugitive releases not reported	Fugitive releases not reported	34	4.6E−02	365
The Belden Brick Company (0679000118), Sugarcreek, OH	Fugitive releases not reported	Fugitive releases not reported	206	0.28	365
Heritage Thermal Services (0215020233), East Liverpool, OH	0	0	4.5E−03	6.2E−06	365
Acme Brick Co -- Perla Plant, Malvern, AR	Fugitive releases not reported	Fugitive releases not reported	83	0.11	364
Elgin Facility, Elgin, TX	Fugitive releases not reported	Fugitive releases not reported	99	0.13	365
Elgin Plant, Elgin, TX	Fugitive releases not reported	Fugitive releases not reported	21	2.9E−02	365
Denton Plant, Denton, TX	Fugitive releases not reported	Fugitive releases not reported	236	0.32	365
Muskogee PLT, Muskogee, OK	Fugitive releases not reported	Fugitive releases not reported	111	0.21	260
Triangle Brick Clay County Plant, Henrietta, TX	Fugitive releases not reported	Fugitive releases not reported	159	0.22	365
Vopak Deer Park Facility, Deer Park, TX	0	0	Stack releases not reported	Stack releases not reported	365
San Felipe, Sealy, TX	Fugitive releases not reported	Fugitive releases not reported	66	9.0E−02	365
Wewoka PLT, Wewoka, OK	Fugitive releases not reported	Fugitive releases not reported	250	0.34	365

Site Identity[a]	Total Fugitive Air Release (kg/yr)	Daily Fugitive Air Release (kg/day)	Total Stack Air Release (kg/yr)	Daily Stack Air Release (kg/day)	Annual Release Days (days/yr)
Crosby Facility, Crosby, TX	Fugitive releases not reported	Fugitive releases not reported	Stack releases not reported	Stack releases not reported	365
Texas Clay, Malakoff, TX	Fugitive releases not reported	Fugitive releases not reported	171	0.23	365
Hazardous Waste Disposal, Port Arthur, TX	Fugitive releases not reported	Fugitive releases not reported	9.1E−02	1.2E−04	365
Athens Facility, Athens, TX	Fugitive releases not reported	Fugitive releases not reported	63	8.7E−02	365
Mineral Wells Facility, Mineral Wells, TX	Fugitive releases not reported	Fugitive releases not reported	128	0.17	365
40 Acre Facility, Texas City, TX	0	0	Stack releases not reported	Stack releases not reported	365
Mineral Wells East Facility, Mineral Wells, TX	Fugitive releases not reported	Fugitive releases not reported	41	5.6E−02	365
Acme Brick Bennett Plant, Millsap, TX	Fugitive releases not reported	Fugitive releases not reported	578	0.79	365
LNVA - North Plant Regional Treatment Plant, Beaumont, TX	1.2	1.6E−03	Stack releases not reported	Stack releases not reported	365
Henderson Plant 1, Henderson, TX	Fugitive releases not reported	Fugitive releases not reported	20	3.3E−02	307
Glen-Gery Corporation, Redfield, IA	Fugitive releases not reported	Fugitive releases not reported	Stack releases not reported	Stack releases not reported	365
Cedar Rapids WPCF, Cedar Rapids, IA	Fugitive releases not reported	Fugitive releases not reported	2.7	3.7E−03	364
Cloud Ceramics, Concordia, KS	Fugitive releases not reported	Fugitive releases not reported	47	6.4E−02	364
River Cement Co. Dba Buzzi Unicem USA Selma Plant, Festus, MO	Fugitive releases not reported	Fugitive releases not reported	98	0.13	365
Harbison-Walker International, Inc. Vandalia Plant, Vandalia, MO	Fugitive releases not reported	Fugitive releases not reported	26	3.5E−02	365
HarbisonWalker International, Inc Fulton Brick Plant, Fulton, MO	Fugitive releases not reported	Fugitive releases not reported	28	3.9E−02	365

Site Identity[a]	Total Fugitive Air Release (kg/yr)	Daily Fugitive Air Release (kg/day)	Total Stack Air Release (kg/yr)	Daily Stack Air Release (kg/day)	Annual Release Days (days/yr)
Sioux City Brick & Tile Company, Sergeant Bluff, IA	Fugitive releases not reported	Fugitive releases not reported	Stack releases not reported	Stack releases not reported	365
City of Longmont WWTP - 1st Ave Plant, Longmont, Co	0	0	518	0.71	365
Acme Brick - Kanopolis, Kanopolis, KS	Fugitive releases not reported	Fugitive releases not reported	Stack releases not reported	Stack releases not reported	365
Endicott Clay Products Co, Endicott, NE	Fugitive releases not reported	Fugitive releases not reported	151	0.21	365
Cintas Corporation No. 2, Denver, CO	Fugitive releases not reported	Fugitive releases not reported	Stack releases not reported	Stack releases not reported	365
Ash Grove Cement - Chanute, Chanute, KS	0	0	Stack releases not reported	Stack releases not reported	365
Kansas Brick & Tile, Hoisington, KS	Fugitive releases not reported	Fugitive releases not reported	32	4.3E−02	364
Colorado Springs Utilities Las Vegas WWT, Colorado Springs, CO	Fugitive releases not reported	Fugitive releases not reported	463	0.63	365
Colorado Springs Util- Jd Phillips Rec F, Colorado Springs, CO	Fugitive releases not reported	Fugitive releases not reported	119	0.16	365
Acme Brick Company, Castle Rock, CO	Fugitive releases not reported	Fugitive releases not reported	Stack releases not reported	Stack releases not reported	365
Buzzi Unicem USA Cape Girardeau, Cape Girardeau, MO	0	0	Stack releases not reported	Stack releases not reported	365
Interstate Brick Company: Brick Manufacturing Plant, West Jordan, UT	Fugitive releases not reported	Fugitive releases not reported	97	0.13	365
Metropolitan St. Louis Sewer District Lemay WWTP, St. Louis, MO	Fugitive releases not reported	Fugitive releases not reported	4.7	6.4E−03	365
Ash Grove Cement Co, Louisville, NE	Fugitive releases not reported	Fugitive releases not reported	33	4.5E−02	365
FOL Tape LLC Fenton, Fenton, MO	Fugitive releases not reported	Fugitive releases not reported	899	1.2	365
Metropolitan St. Louis Sewer District Bissell Point WWTP, St. Louis, MO	115	0.16	12	1.6E−02	365

Site Identity[a]	Total Fugitive Air Release (kg/yr)	Daily Fugitive Air Release (kg/day)	Total Stack Air Release (kg/yr)	Daily Stack Air Release (kg/day)	Annual Release Days (days/yr)
South Adams Cnty Water & Sanitn - WWTP, Henderson, CO	232	0.32	Stack releases not reported	Stack releases not reported	365
Dugway Proving Ground - U.S. Army - Dugway Proving Ground, Dugway, UT	11	1.5E−02	Stack releases not reported	Stack releases not reported	365
Summit Pressed Brick - Brick Mfg PLT, Pueblo, CO	Fugitive releases not reported	Fugitive releases not reported	84	0.11	365
Lakewood Brick & Tile Co, Lakewood, CO	Fugitive releases not reported	Fugitive releases not reported	68	9.3E−02	365
Hebron Brick Company - Hebron Brick Plant, Hebron, ND	Fugitive releases not reported	Fugitive releases not reported	52	7.1E−02	365
Pabco Building Productsdf#4070, Sacramento, CA	19	2.6E−02	Stack releases not reported	Stack releases not reported	364
City of Vancouver - Westside Wastewater Treatment Plant, Vancouver, WA	Fugitive releases not reported	Fugitive releases not reported	8.3	1.1E−02	365
Mutual Materials, Mica, WA	Fugitive releases not reported	Fugitive releases not reported	40	5.5E−02	364
NYC-Dep Owls Head WPCP, Brooklyn, NY	8.2E−02	1.1E−04	2.7E−02	3.7E−05	365
Cranston WPCF, Cranston, RI	0.56	7.7E−04	Stack releases not reported	Stack releases not reported	365
Woonsocket Regional Wastewater Commission, Woonsocket, RI	2.6	3.6E−03	Stack releases not reported	Stack releases not reported	365
Wilmington Wastewater Treatment Plant, Wilmington, DE	4.8E−02	6.6E−05	Stack releases not reported	Stack releases not reported	365
McAvoy Vitrified Brick Co/Phoenixville, Phoenixville, PA	Fugitive releases not reported	Fugitive releases not reported	21	4.9E−02	215
Redland Brick, Rocky Ridge, MD	Fugitive releases not reported	Fugitive releases not reported	0	0	260
Redland Brick Inc/Harmar PLT, Cheswick, PA	Fugitive releases not reported	Fugitive releases not reported	31	6.7E−02	230
HRSD Boat Harbor Sewage Treatment Plant, Newport News, VA	7.0E−02	9.6E−05	0.78	1.1E−03	365

Site Identity[a]	Total Fugitive Air Release (kg/yr)	Daily Fugitive Air Release (kg/day)	Total Stack Air Release (kg/yr)	Daily Stack Air Release (kg/day)	Annual Release Days (days/yr)
Glen-Gery Corporation - Manassas Quarry, Manassas, VA	Fugitive releases not reported	Fugitive releases not reported	Stack releases not reported	Stack releases not reported	365
Boral Bricks - Augusta Plants 3, 4, & 5, Augusta, GA	Fugitive releases not reported	Fugitive releases not reported	1.4	1.9E−03	365
Waste Management of Mississippi Inc, Pec, Pass Christian, MS	0	0	Stack releases not reported	Stack releases not reported	365
Wsacc - Rocky River Regional WWTP, Concord, NC	Fugitive releases not reported	Fugitive releases not reported	3.3	4.6E−03	357
Belden Brick Plant 3 (0679005018), Sugarcreek, OH	Fugitive releases not reported	Fugitive releases not reported	64	9.0E−02	357
Glen-Gery Corp. Iberia Plant (0351000051), Iberia, OH	Fugitive releases not reported	Fugitive releases not reported	54	9.6E−02	282
Ash Grove Cement Company Foreman Cement Plant, Foreman, AR	Fugitive releases not reported	Fugitive releases not reported	0	0	364
River Birch LLC - River Birch Landfill, Avondale, LA	8.5	1.2E−02	Stack releases not reported	Stack releases not reported	364
Bayport Facility, Pasadena, TX	0	0	Stack releases not reported	Stack releases not reported	365
Washburn Tunnel Facility, Pasadena, TX	0	0	Stack releases not reported	Stack releases not reported	365
Fort Worth Village Creek Wastewater, Fort Worth, TX	0	0	Stack releases not reported	Stack releases not reported	365
City of Greeley Water Pollut Control Fac, Greeley, Co	269	0.37	Stack releases not reported	Stack releases not reported	365
Continental Cement Company LLC Ilasco Plant, Hannibal, MO	Fugitive releases not reported	Fugitive releases not reported	Stack releases not reported	Stack releases not reported	365
General Shale - Denver Brick Plant #60, Denver, Co	Fugitive releases not reported	Fugitive releases not reported	91	0.13	365
JS&H, Durkee, Or	Fugitive releases not reported	Fugitive releases not reported	42	5.7E−02	365
Mutual Materials Company, Gresham, Or	19	2.6E−02	Stack releases not reported	Stack releases not reported	365

Site Identity[a]	Total Fugitive Air Release (kg/yr)	Daily Fugitive Air Release (kg/day)	Total Stack Air Release (kg/yr)	Daily Stack Air Release (kg/day)	Annual Release Days (days/yr)
Demenno-Kerdoon Dba World Oil Recycling, Compton, CA	4.3E−03	5.8E−06	Stack releases not reported	Stack releases not reported	364
Dba RB Recycling, Inc., PORTLAND, OR	Fugitive releases not reported	Fugitive releases not reported	174	0.24	365
Simi Vly Cnty Sanitation, Simi Valley, CA	7.0E−03	9.6E−06	2.6E−05	3.5E−08	365
Ventura Wastewater Plant, Ventura, CA	1.5E−02	2.0E−05	1.3E−02	1.8E−05	364
Chemical Waste Management of The Northwest, Inc., ARLINGTON, OR	0	0	0	0	365
Carson City Block Plant, Carson City, NV	Fugitive releases not reported	Fugitive releases not reported	6.5	9.9E−03	325
Musco Olive Products, Tracy, CA	0.47	6.5E−04	Stack releases not reported	Stack releases not reported	364
Clean Harbors Aragonite LLC: Hazardous Waste Storage Incineration, Aragonite, UT	Fugitive releases not reported	Fugitive releases not reported	2.8E−03	4.7E−06	302
Edwards AFB, Edwards AFB, CA	11	1.5E−02	Stack releases not reported	Stack releases not reported	365
Clean Harbors Deer Park, La Porte, TX	4.5E−02	6.2E−05	4.5E−02	6.2E−05	365
Clean Harbors El Dorado, LLC, El Dorado, AR	4.5E−02	6.2E−05	4.5E−02	6.2E−05	365
Auburn Sanitary Landfill No 2, Auburn, NY	Fugitive releases not reported	Fugitive releases not reported	9.8	1.3E−02	365
Lafarge Building Materials Inc, Ravena, NY	Fugitive releases not reported	Fugitive releases not reported	44	6.0E−02	365
Seneca Meadows SWMF, Waterloo, NY	Fugitive releases not reported	Fugitive releases not reported	3.0E−02	4.2E−05	365
Lhoist North America of Alabama, LLC, Alabaster, AL	Fugitive releases not reported	Fugitive releases not reported	1.8	2.5E−03	365
Giant Cement Co, Harleyville, SC	Fugitive releases not reported	Fugitive releases not reported	0.45	6.2E−04	365
Ross Incineration Services, Inc. (0247050278), Grafton, OH	3.6E−03	5.0E−06	4.5E−04	6.2E−07	365

Site Identity[a]	Total Fugitive Air Release (kg/yr)	Daily Fugitive Air Release (kg/day)	Total Stack Air Release (kg/yr)	Daily Stack Air Release (kg/day)	Annual Release Days (days/yr)
Norlite Corp, Cohoes, NY	4.5E−03	6.2E−06	Stack releases not reported	Stack releases not reported	365
Clean Harbors Env Services Inc, Kimball, Ne	1	1.4E−03	0.91	1.2E−03	365
City of High Point - Eastside Wastewater Treatment Plant, Jamestown, NC	Fugitive releases not reported	Fugitive releases not reported	0.11	1.5E−04	364
Valley Minerals, LLC Bonne Terre, Bonne Terre, MO	Fugitive releases not reported	Fugitive releases not reported	1	1.4E−03	365
Lone Star Industries Inc, Greencastle, In	Fugitive releases not reported	Fugitive releases not reported	30	4.1E−02	365
Chemical Lime Nelson Plant, Peach Springs, AZ	0.97	1.3E−03	Stack releases not reported	Stack releases not reported	365
[a] Note: There are 315 additional sites with combustion activities that have air releases ranging from 0–1,205 kg/site-yr.					

Table 3-92. Summary of Land Releases from TRI for Waste Handling, Disposal, and Treatment

Site Identity	Median Total Release (kg/yr)	Maximum Total Release (kg/yr)	Annual Release Days (days/yr)
Chemical Waste Management of the Northwest Inc., Arlington, OR	5,930	8,930	365
Clean Harbors El Dorado LLC, El Dorado, AR	2.3	2.3	365
Giant Cement Co, Harleyville, SC	2.5	13	365
Keystone Cement Co, Bath, PA	4.5E−02	4.5E−02	365
Ross Incineration Services Inc, Grafton, OH	2.2E−02	2.5E−02	365
Veolia N.A. Inc., Sauget, IL	1.4	1.4	365
Wayne Disposal Inc, Belleville, MI	457	768	365

Table 3-93. Summary of Water Releases from DMR for Waste Handling, Disposal, and Treatment

Site Identity	Source-Discharge Type[a]	Median Annual Discharge (kg/yr)	Daily Discharge (Corresponding to Median Annual Discharge) (kg/day)	Maximum Annual Discharge (kg/yr)	Daily Discharge (Corresponding to Maximum Daily Discharge) (kg/day)	Annual Release Days (days/yr)
Eco Services Martinez Plant, Contra Costa, CA	DMR-Direct Discharges	5.4	2.1E−02	5.4	2.1E−02	250
23rd Avenue Wastewater Treatment Plant, Maricopa, AZ	DMR-Direct Discharges	34	0.14	34	0.14	250
Agana Sewage Treatment PLT, Guam, Gu	DMR-Direct Discharges	31	0.13	31	0.13	250
Agua Nueva WRF, Pima, AZ	DMR-Direct Discharges	21	8.3E−02	21	8.3E−02	250
Aliso Creek Ocean Outfall, Orange, CA	DMR-Direct Discharges	203	0.81	328	1.3	250
American Gulch Wastewater Treatment Plant, Gila, AZ	DMR-Direct Discharges	2.6	1.0E−02	2.6	1.0E−02	250
Ashford WWTP, Houston, AL	DMR-Direct Discharges	0.38	1.5E−03	1.3	5.1E−03	250
Auburn WWTP, Placer, CA	DMR-Direct Discharges	0.28	1.1E−03	0.54	2.2E−03	250
City of Auburnna, Placer, CA	DMR-Direct Discharges	0.58	2.3E−03	0.58	2.3E−03	250
Avalon WWTP, Los Angeles, CA	DMR-Direct Discharges	1.4	5.4E−03	6.4	2.5E−02	250
Barberton WPCF, Summit, OH	DMR-Direct Discharges	35	0.14	35	0.14	250
Barbourville STP, Knox, KY	DMR-Direct Discharges	18	7.1E−02	18	7.1E−02	250
Beaumont WWTF, Riverside, CA	DMR-Direct Discharges	6.2	2.5E−02	6.2	2.5E−02	250
Beavercreek WRRF, Greene, OH	DMR-Direct Discharges	40	0.16	40	0.16	250

Site Identity	Source-Discharge Type[a]	Median Annual Discharge (kg/yr)	Daily Discharge (Corresponding to Median Annual Discharge) (kg/day)	Maximum Annual Discharge (kg/yr)	Daily Discharge (Corresponding to Maximum Daily Discharge) (kg/day)	Annual Release Days (days/yr)
Bell-Carter Olive Co. WWTP, Tehama, CA	DMR-Direct Discharges	1.3	5.0E−03	1.3	5.0E−03	250
Beverly Sewerage Authority, Burlington, NJ	DMR-Direct Discharges	92	0.37	292	1.2	250
Biddeford Wastewater Treatment Facility, York, ME	DMR-Direct Discharges	6.2	2.5E−02	8.2	3.3E−02	250
Big Sewickley WWTP, Beaver, PA	DMR-Direct Discharges	0.43	1.7E−03	0.46	1.8E−03	250
Boardman WWTP, Mahoning, OH	DMR-Direct Discharges	1.7	6.6E−03	1.7	6.6E−03	250
Bonifay, City of - Bonifay WWTF, Holmes, FL	DMR-Direct Discharges	0.42	1.7E−03	0.56	2.2E−03	250
Bowling Green, Wood, OH	DMR-Direct Discharges	41	0.16	71	0.28	250
Brawley Wastewater Treatment Plant, Imperial, CA	DMR-Direct Discharges	1.7	6.6E−03	1.7	6.7E−03	250
Bristol Borough WPC Plant, Bucks, PA	DMR-Direct Discharges	3.9	1.6E−02	4.9	1.9E−02	250
Brunswick-Glynn County Joint Water & Sewer Commission (Exit 29 WPCP), Glynn, GA	DMR-Direct Discharges	170	0.68	338	1.4	250
Buena Borough Mua Cs-Septics, Atlantic, NJ	DMR-Direct Discharges	2.2	8.6E−03	3	1.2E−02	250
Buford, City of (Westside WPCP), Gwinnett, GA	DMR-Direct Discharges	0.67	2.7E−03	0.67	2.7E−03	250
Burlingame WWTP, San Mateo, CA	DMR-Direct Discharges	16	6.4E−02	44	0.18	250
Cadillac WWTP, Wexford, MI	DMR-Direct Discharges	1.0E−01	4.1E−04	1.0E−01	4.1E−04	250
Calhoun Falls Town Of, Abbeville, SC	DMR-Direct Discharges	3,038	12	3,038	12	250

Site Identity	Source-Discharge Type[a]	Median Annual Discharge (kg/yr)	Daily Discharge (Corresponding to Median Annual Discharge) (kg/day)	Maximum Annual Discharge (kg/yr)	Daily Discharge (Corresponding to Maximum Daily Discharge) (kg/day)	Annual Release Days (days/yr)
Calipatria WWTP, Imperial, CA	DMR-Direct Discharges	0.67	2.7E−03	1.3	5.0E−03	250
Calleguas Mwd Lake Bard Water Plant, Ventura, CA	DMR-Direct Discharges	0.52	2.1E−03	0.52	2.1E−03	250
Camarillo Sanitary Dist Water Reclamation Plant, Ventura, CA	DMR-Direct Discharges	23	9.1E−02	61	0.24	250
Cambridge WWTP, Isanti, MN	DMR-Direct Discharges	7.7	3.1E−02	9	3.6E−02	250
Campbell WWTP, Mahoning, OH	DMR-Direct Discharges	16	6.6E−02	16	6.6E−02	250
Carmel Area WWTP, Monterey, CA	DMR-Direct Discharges	0.83	3.3E−03	0.83	3.3E−03	250
Carpinteria Sanitary District, Santa Barbara, CA	DMR-Direct Discharges	1.5	5.9E−03	1.5	5.9E−03	250
Casa Grande WRF, Pinal, AZ	DMR-Direct Discharges	50	0.2	50	0.2	250
Catalina Utilities Center, Los Angeles, CA	DMR-Direct Discharges	0.33	1.3E−03	0.5	2.0E−03	250
Cayucos Sanitary District WRRF, San Luis Obispo, CA	DMR-Direct Discharges	0.14	5.5E−04	0.14	5.5E−04	250
Cedar Grove Twp Mua STP, Essex, NJ	DMR-Direct Discharges	1.4	5.5E−03	5.1	2.0E−02	250
Chatsworth, City of (Judson Vick WPCP), Murray, GA	DMR-Direct Discharges	14	5.7E−02	18	7.1E−02	250
Chrin Brothers Inc, Northampton, PA	DMR-Direct Discharges	0.12	4.9E−04	0.12	4.9E−04	250
City of Alturas Wastewater Treatment Plant, Modoc, CA	DMR-Direct Discharges	0.73	2.9E−03	1.3	5.4E−03	250
City of Beacon Wastewater Treatment Facility, Dutchess, NY	DMR-Direct Discharges	46	0.18	55	0.22	250

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City of Bishopville Wastewater Treatment Facility, Lee County, SC	DMR-Direct Discharges	41	0.16	65	0.26	250
City of Bozeman WWTP, Gallatin, Mt	DMR-Direct Discharges	13	5.4E−02	25	9.8E−02	250
City of Dayton Water Reclamation Facility (0857100983), Montgomery, OH	DMR-Direct Discharges	600	2.4	600	2.4	250
City of Dubois Sewage Treatment Plant, Clearfield, PA	DMR-Direct Discharges	38	0.15	56	0.22	250
City of Great Falls WWTP, Cascade, MT	DMR-Direct Discharges	13	5.2E−02	20	7.9E−02	250
City of Griffin (Cabin Cr), Spalding County, GA	DMR-Direct Discharges	3.4E04	135	3.4E04	135	250
City of Las Vegas Water Pollution Control Facility, Clark, NV	DMR-Direct Discharges	1,026	4.1	4,144	17	250
City of Lincoln WWTP, Placer, CA	DMR-Direct Discharges	0.72	2.9E−03	0.72	2.9E−03	250
City of North Las Vegas Water Reclamation Facility, Clark County, NV	DMR-Direct Discharges	5.7	2.3E−02	5.7	2.3E−02	250
City of Paso Robles Wastewater Treatment Facility, San Luis Obispo, CA	DMR-Direct Discharges	1.8	7.0E−03	2.6	1.1E−02	250
City of Port Huron Wastewater Treatment Plant, Saint Clair, MI	DMR-Direct Discharges	0.75	3.0E−03	0.75	3.0E−03	250
City of Red Bluff Wastewater Reclamation Plant, Tehama, CA	DMR-Direct Discharges	0.49	1.9E−03	0.8	3.2E−03	250
City of Safford - Gila Resources WRP, Graham, AZ	DMR-Direct Discharges	1.9	7.7E−03	3.9	1.6E−02	250
City of Somerton - WWTP, Yuma, AZ	DMR-Direct Discharges	3.4	1.4E−02	3.9	1.6E−02	250
City of Thomasville, Georgia WWTF Renovations, Thomas, GA	DMR-Direct Discharges	2.1	8.5E−03	2.1	8.5E−03	250

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Claude 'Bud' Lewis Carlsbad Desalination Plant, San Diego, CA	DMR-Direct Discharges	62	0.25	1,451	5.8	250
Clean Harbors Baton Rouge LLC, East Baton Rouge, LA	DMR-Direct Discharges	3.3	1.3E−02	3.3	1.3E−02	250
Clean Harbors Storage & Treatment Facility, Norfolk, MA	DMR-Direct Discharges	5.6	2.2E−02	5.6	2.2E−02	250
Clean Harbors White Castle, LLC- White Castle Landfarm, Iberville, LA	DMR-Direct Discharges	8.5	3.4E−02	8.5	3.4E−02	250
Cleveland POTW, Bolivar, MS	DMR-Direct Discharges	0.46	1.8E−03	0.6	2.4E−03	250
Clovis Sewage Treatment and Water Reuse Facility, Fresno, CA	DMR-Direct Discharges	0.27	1.1E−03	0.27	1.1E−03	250
Coachella Sd WWTP, Riverside, CA	DMR-Direct Discharges	5.1	2.0E−02	6.4	2.5E−02	250
Colfax Wastewater Treatment Plant, Placer, CA	DMR-Direct Discharges	0.4	1.6E−03	0.4	1.6E−03	250
Colusa WWTP, Colusa, CA	DMR-Direct Discharges	0.96	3.9E−03	0.96	3.9E−03	250
Conneaut WWTP, Ashtabula, OH	DMR-Direct Discharges	19	7.7E−02	19	7.7E−02	250
Corning Wastewater Treatment Plant, Tehama, CA	DMR-Direct Discharges	7.3E−02	2.9E−04	7.3E−02	2.9E−04	250
Corona WWTP 1, Riverside County, CA	DMR-Direct Discharges	82	0.33	82	0.33	250
Corry City STP, Erie, PA	DMR-Direct Discharges	13	5.2E−02	861	3.4	250
Crescent City WWTF, Del Norte, CA	DMR-Direct Discharges	8.5	3.4E−02	14	5.7E−02	250
Cresson Boro WWTP, Cambria, PA	DMR-Direct Discharges	0.59	2.4E−03	1.2E04	46	250

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Dale Mabry Advanced Wastewater Treatment Plant, Hills, FL	DMR-Direct Discharges	1.3	5.3E−03	1.3	5.3E−03	250
Deer Creek WWTP, El Dorado, CA	DMR-Direct Discharges	1.3	5.0E−03	1.9	7.5E−03	250
Deer Park Terminal, Harris County, TX	DMR-Direct Discharges	0.48	1.9E−03	0.94	3.8E−03	250
Donner Summit WWTF, Nevada, CA	DMR-Direct Discharges	0.34	1.4E−03	0.34	1.4E−03	250
Dothan Omussee Creek WWTP, Houston, AL	DMR-Direct Discharges	11	4.4E−02	38	0.15	250
Durant City Utilities Auth, Bryan, OK	DMR-Direct Discharges	29	0.12	34	0.14	250
E.R.R. LLC, Orleans, LA	DMR-Direct Discharges	2,323	9.3	3,617	14	250
East Greenbush (T) WWTP, Rensselaer, NY	DMR-Direct Discharges	2	8.2E−03	2	8.2E−03	250
Edward C. Little WRP, Los Angeles, CA	DMR-Direct Discharges	19	7.6E−02	19	7.6E−02	250
Effingham STP, Effingham, IL	DMR-Direct Discharges	6.8	2.7E−02	19	7.5E−02	250
El Dorado Hills WWTP, El Dorado, CA	DMR-Direct Discharges	0.35	1.4E−03	0.35	1.4E−03	250
Encina Water Pollution Control Facility, San Diego, CA	DMR-Direct Discharges	123	0.49	187	0.75	250
Ephrata Reg 2 STP, Lancaster, PA	DMR-Direct Discharges	2.4	9.8E−03	2.9	1.2E−02	250
Ephrata STP, Lancaster, PA	DMR-Direct Discharges	3.2	1.3E−02	3.3	1.3E−02	250
Eureka Wastewater Treatment Plant, Humboldt, CA	DMR-Direct Discharges	11	4.4E−02	11	4.4E−02	250

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Excelsior Springs Waste Water Treatment Facility, Clay, MO	DMR-Direct Discharges	14	5.7E−02	22	9.0E−02	250
Fairfield WWTP, Butler, OH	DMR-Direct Discharges	25	9.9E−02	25	9.9E−02	250
Fallbrook PUD WWTP No.1, San Diego, CA	DMR-Direct Discharges	20	8.1E−02	28	0.11	250
Fallon Wastewater Treatment Plant, Churchill, NV	DMR-Direct Discharges	1.1	4.3E−03	1.1	4.3E−03	250
Farmington T STP, Ontario, NY	DMR-Direct Discharges	20	7.8E−02	31	0.12	250
Floyds Fork WQTC MSD, Jefferson, KY	DMR-Direct Discharges	73	0.29	73	0.29	250
Ford/Kingsford Site GWCU, Dickinson, MI	DMR-Direct Discharges	4.2	1.7E−02	7	2.8E−02	250
Fort Bragg WWTF, Mendocino, CA	DMR-Direct Discharges	0.27	1.1E−03	0.27	1.1E−03	250
Franklin Area Wastewater Treatment Plant, Warren, OH	DMR-Direct Discharges	22	8.6E−02	22	8.6E−02	250
Freeland Boro Mun Auth, Luzerne, PA	DMR-Direct Discharges	2.5	9.9E−03	2.5	9.9E−03	250
Fresh Kills Landfill, Richmond, NY	DMR-Direct Discharges	2.2	8.7E−03	2.4	9.6E−03	250
Gallup, City Of, McKinley, NM	DMR-Direct Discharges	1.7	6.9E−03	2.2	8.9E−03	250
Galt Sd WWTF, Sacramento, CA	DMR-Direct Discharges	12	4.8E−02	12	4.8E−02	250
Galt WWTP, Sacramento, CA	DMR-Direct Discharges	1.4	5.4E−03	1.4	5.4E−03	250
Girard WWTP, Trumbull, OH	DMR-Direct Discharges	13	5.1E−02	13	5.1E−02	250

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Glencoe WWTP, McLeod, MN	DMR-Direct Discharges	0.94	3.8E−03	0.94	3.8E−03	250
Gloucester Cnty Util Auth STP, Gloucester, NJ	DMR-Direct Discharges	13	5.4E−02	17	6.7E−02	250
Grand Canyon South Rim WWTP, Coconino, AZ	DMR-Direct Discharges	1.3	5.4E−03	1.3	5.4E−03	250
Greenville WWTP, Darke, OH	DMR-Direct Discharges	12	4.9E−02	12	4.9E−02	250
Greenwich Twp STP, Gloucester, NJ	DMR-Direct Discharges	0.95	3.8E−03	2.9	1.1E−02	250
Guymon City Of, Texas, OK	DMR-Direct Discharges	16	6.5E−02	20	8.0E−02	250
Hampton, City of (Bear Creek WPCP), Henry, GA	DMR-Direct Discharges	5.1	2.1E−02	5.1	2.1E−02	250
Hangtown Creek WWTP, El Dorado, CA	DMR-Direct Discharges	2.6	1.0E−02	2.6	1.0E−02	250
Harrison Township Treatment Pl, Gloucester, NJ	DMR-Direct Discharges	0.36	1.4E−03	0.36	1.4E−03	250
Hawaii County Hilo WWTP, Hawaii, HI	DMR-Direct Discharges	44	0.18	44	0.18	250
Heath WWTP, Licking, OH	DMR-Direct Discharges	2.5	1.0E−02	2.5	1.0E−02	250
Heber PUD WWTP, Imperial, CA	DMR-Direct Discharges	0.33	1.3E−03	7.2	2.9E−02	250
Henry County Water Authority - Indian Creek WRF, Henry, GA	DMR-Direct Discharges	9	3.6E−02	9	3.6E−02	250
Henry N. Wochholz Wastewater Treatment Facility, San Bernardino, CA	DMR-Direct Discharges	2.6	1.1E−02	652	2.6	250
Herkimer County WWTP, Herkimer, NY	DMR-Direct Discharges	27	0.11	36	0.14	250

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Hillsboro WWTP, Highland, OH	DMR-Direct Discharges	4.7	1.9E−02	4.7	1.9E−02	250
Hillsborough County Water Department, Hills, FL	DMR-Direct Discharges	6.4	2.6E−02	7.1	2.8E−02	250
Holtville City WWTP, Imperial, CA	DMR-Direct Discharges	1.2	4.6E−03	1.3	5.1E−03	250
Hugo Municipal Authority, Choctaw, OK	DMR-Direct Discharges	6.8	2.7E−02	6.8	2.7E−02	250
Imperial WWTP, Imperial, CA	DMR-Direct Discharges	26	0.11	26	0.11	250
Ishpeming Area WWTP, Marquette, MI	DMR-Direct Discharges	2.5	1.0E−02	3.4	1.4E−02	250
City of Jennings, WWTP, Jefferson Davis, LA	DMR-Direct Discharges	24	9.5E−02	24	9.5E−02	250
Joint Water Pollution Control Plant, Los Angeles, CA	DMR-Direct Discharges	1.3E04	52	1.3E04	52	250
Juanita Millender-McDonald Carson Regional WRP, Los Angeles, CA	DMR-Direct Discharges	1.3	5.2E−03	1.8	7.0E−03	250
Kc Fishing River WWTP, Clay, MO	DMR-Direct Discharges	3.8	1.5E−02	4.6	1.8E−02	250
Kelly Twp Muni Auth, Union, PA	DMR-Direct Discharges	46	0.18	46	0.18	250
Kemron Environmental Services, Inc. (Former Agri-Cycle Pond Closure Project Perm, Jackson County, GA	DMR-Direct Discharges	0.25	1.0E−03	0.25	1.0E−03	250
Kennett Square Boro WWTP, Chester, PA	DMR-Direct Discharges	5.2	2.1E−02	5.2	2.1E−02	250
Kurt R. Segler Water Reclamation Facility, Clark County, NV	DMR-Direct Discharges	55	0.22	58	0.23	250

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Lake of The Pines WWTP, Nevada, CA	DMR-Direct Discharges	1.3	5.1E−03	1.3	5.1E−03	250
Las Cruces, City of - East Mesa Water Reclamation Facility, Dona Ana, NM	DMR-Direct Discharges	3.8	1.5E−02	3.8	1.5E−02	250
Las Gallinas Valley Sanitary District, Marin, CA	DMR-Direct Discharges	28	0.11	28	0.11	250
Lawrenceburg STP, Anderson, KY	DMR-Direct Discharges	15	6.1E−02	15	6.1E−02	250
Lebanon WWTP, Laclede, MO	DMR-Direct Discharges	3.3	1.3E−02	18	7.0E−02	250
Lima WWTP, Allen, OH	DMR-Direct Discharges	193	0.77	193	0.77	250
Limestone Water & Sewer District, Aroostook, ME	DMR-Direct Discharges	0.37	1.5E−03	0.45	1.8E−03	250
Lincolnton WWTP, Lincoln, NC	DMR-Direct Discharges	37	0.15	37	0.15	250
Linda County WWTP, Yuba, CA	DMR-Direct Discharges	0.35	1.4E−03	0.47	1.9E−03	250
Litchfield WWTP, Meeker, MN	DMR-Direct Discharges	5.8	2.3E−02	7.1	2.8E−02	250
Lompoc Wastewater Plant, Santa Barbara, CA	DMR-Direct Discharges	14	5.6E−02	14	5.6E−02	250
LRBSA - Throop Plant, Lackawanna, PA	DMR-Direct Discharges	10	4.2E−02	13	5.1E−02	250
Madisonville STP West Side, Hopkins, KY	DMR-Direct Discharges	258	1	314	1.3	250
Malden Public Service District, Kanawha, WV	DMR-Direct Discharges	19	7.5E−02	32	0.13	250
Manchester STP, Clay, KY	DMR-Direct Discharges	10	4.0E−02	10	4.0E−02	250

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Manteca WWQCF, San Joaquin, CA	DMR-Direct Discharges	0.7	2.8E−03	0.7	2.8E−03	250
Marshall WWTP, Lyon, MN	DMR-Direct Discharges	9	3.6E−02	13	5.3E−02	250
McKinleyville CSD - Wastewater Treatment Plant, Humboldt, CA	DMR-Direct Discharges	0.76	3.0E−03	0.76	3.0E−03	250
Metropolitan Syracuse WWTP, Onondaga, NY	DMR-Direct Discharges	186	0.74	186	0.74	250
Middlesex County Utilities Authority, Middlesex, NJ	DMR-Direct Discharges	115	0.46	129	0.52	250
Montecito Sd WWTP, Santa Barbara, CA	DMR-Direct Discharges	1.7	6.7E−03	1.7	6.7E−03	250
Monterey Regional WWTP, Monterey, CA	DMR-Direct Discharges	1	4.1E−03	1.5	5.9E−03	250
Montgomery Twp Mua Cherry Valley STP, Somerset, NJ	DMR-Direct Discharges	0.14	5.5E−04	0.14	5.5E−04	250
Mt Carmel Muni Sew Coll Sys & STP, Northumberland, PA	DMR-Direct Discharges	1.7	6.6E−03	6.7	2.7E−02	250
Mt. Shasta WWTP, Siskiyou, CA	DMR-Direct Discharges	0.49	2.0E−03	2	7.8E−03	250
Nas Fallon, Churchill, NV	DMR-Direct Discharges	0.18	7.0E−04	0.23	9.4E−04	250
Naval Aux. Landing Field - San Clemente Island, San Diego, CA	DMR-Direct Discharges	0.42	1.7E−03	0.65	2.6E−03	250
Nevada City Wastewater Treatment Plant, Nevada, CA	DMR-Direct Discharges	0.48	1.9E−03	0.48	1.9E−03	250
New Stanton WPCP, Westmoreland, PA	DMR-Direct Discharges	28	0.11	28	0.11	250
New WindsorSTP, Orange, NY	DMR-Direct Discharges	44	0.17	55	0.22	250

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Newark WWTP, Licking, OH	DMR-Direct Discharges	48	0.19	85	0.34	250
Niles WWTP, Trumbull, OH	DMR-Direct Discharges	30	0.12	30	0.12	250
North Berwick SD WWTF, York, ME	DMR-Direct Discharges	0.65	2.6E−03	0.65	2.6E−03	250
North Regional Treatment Plant, Jefferson, TX	DMR-Direct Discharges	248	0.99	248	0.99	250
North Regional Wastewater Treatment Plan (0857143037), Montgomery, OH	DMR-Direct Discharges	17	6.9E−02	17	6.9E−02	250
Northern Edge Casino, San Juan, NM	DMR-Direct Discharges	0.28	1.1E−03	0.28	1.1E−03	250
Northern Madison County Sanitation District, Madison, KY	DMR-Direct Discharges	1.4	5.5E−03	1.4	5.5E−03	250
Ok City Wtr Util Trst-Chisholm, Oklahoma County, OK	DMR-Direct Discharges	103	0.41	195	0.78	250
Olentangy Environmental Control Center, Delaware, OH	DMR-Direct Discharges	13	5.1E−02	13	5.1E−02	250
Orange County Sanitation District Plant 1, Orange, CA	DMR-Direct Discharges	59	0.24	100	0.4	250
Oxnard Wastewater Treatment Plant (OWTP), Ventura County, CA	DMR-Direct Discharges	66	0.26	84	0.34	250
Petroleum Wastewater Treatment Facility, Terrebonne, LA	DMR-Direct Discharges	0.54	2.2E−03	0.54	2.2E−03	250
Phila Water Dept - SE STP, Philadelphia, PA	DMR-Direct Discharges	667	2.7	1.3E04	52	250
Pickerington WWTP, Fairfield, OH	DMR-Direct Discharges	49	0.19	67	0.27	250
Pigeon Forge STP, Sevier, TN	DMR-Direct Discharges	7.8	3.1E−02	7.8	3.1E−02	250

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Pima County - Ina Road WWTP, Pima, AZ	DMR-Direct Discharges	92	0.37	92	0.37	250
Pismo Beach WWTF, San Luis Obispo, CA	DMR-Direct Discharges	88	0.35	88	0.35	250
Pittsfield Wastewater Treatment Facility, Berkshire, MA	DMR-Direct Discharges	2.7	1.1E−02	2.7	1.1E−02	250
Plattsburgh (C) WPCP, Clinton, NY	DMR-Direct Discharges	8	3.2E−02	17	6.7E−02	250
Rahway Valley Sewerage Authority, Union, NJ	DMR-Direct Discharges	11	4.3E−02	465	1.9	250
Raritan Twp Mua Flemington, Hunterdon, NJ	DMR-Direct Discharges	0.53	2.1E−03	0.54	2.2E−03	250
Ravenswood, Jackson, WV	DMR-Direct Discharges	1.8	7.2E−03	1.8	7.2E−03	250
Red River WWTP, Powell, KY	DMR-Direct Discharges	21	8.3E−02	21	8.3E−02	250
Redding Stillwater Wastewater Treatment Plant, Shasta, CA	DMR-Direct Discharges	0.13	5.0E−04	0.13	5.0E−04	250
Regionwide Water Recycling System - Temescal Creek Discharge, Riverside, CA	DMR-Direct Discharges	17	6.6E−02	22	9.0E−02	250
Rialto Wastewater Treatment Plant, San Bernardino, CA	DMR-Direct Discharges	12	4.7E−02	12	4.7E−02	250
Richmond Otter Creek STP, Madison, KY	DMR-Direct Discharges	69	0.28	69	0.28	250
Richmond Silver Creek STP, Madison, KY	DMR-Direct Discharges	6.4	2.6E−02	52	0.21	250
Rio Vista WWTF, Solano, CA	DMR-Direct Discharges	0.45	1.8E−03	0.45	1.8E−03	250
Riverside Sewerage Authority, Burlington, NJ	DMR-Direct Discharges	0.31	1.2E−03	0.31	1.2E−03	250

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Rock Island – South West STP, Rock Island, IL	DMR-Direct Discharges	0.64	2.5E−03	0.64	2.5E−03	250
Rodeo Sanitary District, Contra Costa, CA	DMR-Direct Discharges	0.23	9.2E−04	0.23	9.2E−04	250
Rotterdam (T) Sd #2 STP, Schenectady, NY	DMR-Direct Discharges	13	5.4E−02	20	8.1E−02	250
Russian River POTW, Sonoma, CA	DMR-Direct Discharges	9.5E−02	3.8E−04	9.5E−02	3.8E−04	250
Saint Michael WWTP, Wright, MN	DMR-Direct Discharges	6.1	2.4E−02	8.2	3.3E−02	250
Salt Rock Sewer PSD, Cabell, WV	DMR-Direct Discharges	4,444	18	2.1E05	835	250
San Elijo WPCF, San Diego, CA	DMR-Direct Discharges	32	0.13	32	0.13	250
San Simeon Acres WWTF, San Luis Obispo, CA	DMR-Direct Discharges	0.72	2.9E−03	0.72	2.9E−03	250
Santa Cruz Wastewater Treatment Plant, Santa Cruz, CA	DMR-Direct Discharges	21	8.4E−02	39	0.16	250
Sausalito-Marin City Sanitary District, Marin, CA	DMR-Direct Discharges	4.3	1.7E−02	4.3	1.7E−02	250
Savannah Crossroads WPCP, Chatham, GA	DMR-Direct Discharges	4.4	1.8E−02	5.2	2.1E−02	250
Schenectady (C) STP, Schenectady, NY	DMR-Direct Discharges	37	0.15	41	0.17	250
SD City Pt Loma Wastewater Treatment, San Diego, CA	DMR-Direct Discharges	834	3.3	1,127	4.5	250
SD No. 5 of Marin County WWTP, Marin, CA	DMR-Direct Discharges	2.1	8.6E−03	2.1	8.6E−03	250
Shasta Lake WWTF, Shasta, CA	DMR-Direct Discharges	129	0.51	129	0.51	250

Site Identity	Source-Discharge Type[a]	Median Annual Discharge (kg/yr)	Daily Discharge (Corresponding to Median Annual Discharge) (kg/day)	Maximum Annual Discharge (kg/yr)	Daily Discharge (Corresponding to Maximum Daily Discharge) (kg/day)	Annual Release Days (days/yr)
Shepherdsville STP, Bullitt, KY	DMR-Direct Discharges	20	8.0E−02	20	8.0E−02	250
Sikeston WWTP, Scott, MO	DMR-Direct Discharges	15	5.8E−02	20	7.9E−02	250
Simi Vly Cnty Sanitation, Ventura, CA	DMR-Direct Discharges	8.1	3.2E−02	12	5.0E−02	250
Smithfield Wastewater Treatment Plant, Providence, RI	DMR-Direct Discharges	8	3.2E−02	15	6.0E−02	250
South Bay International WWTP, San Diego, CA	DMR-Direct Discharges	28	0.11	171	0.68	250
South San Luis Obispo Sd WWTP, San Luis Obispo, CA	DMR-Direct Discharges	5.1	2.1E−02	5.1	2.1E−02	250
South Suburban Sanitary District STP, Klamath, Or	DMR-Direct Discharges	0.67	2.7E−03	1	4.2E−03	250
St Clair PWS, Franklin, MO	DMR-Direct Discharges	9.2	3.7E−02	13	5.2E−02	250
City of Sterling, Logan, CO	DMR-Direct Discharges	1.6	6.2E−03	1.9	7.5E−03	250
Stewartville WWTP, Olmsted, MN	DMR-Direct Discharges	1.8	7.0E−03	1.8	7.0E−03	250
Stockton RWCF, San Joaquin, CA	DMR-Direct Discharges	3.9	1.6E−02	3.9	1.6E−02	250
Sugarcreek WRF, Greene, OH	DMR-Direct Discharges	3,847	15	3,847	15	250
Summerland SD WWTP, Santa Barbara, CA	DMR-Direct Discharges	0.38	1.5E−03	0.68	2.7E−03	250
Susanville SD WWTP, Lassen, CA	DMR-Direct Discharges	0.73	2.9E−03	1	4.1E−03	250
Sylvania WPCP, Screven, GA	DMR-Direct Discharges	11	4.3E−02	32	0.13	250

Site Identity	Source-Discharge Type[a]	Median Annual Discharge (kg/yr)	Daily Discharge (Corresponding to Median Annual Discharge) (kg/day)	Maximum Annual Discharge (kg/yr)	Daily Discharge (Corresponding to Maximum Daily Discharge) (kg/day)	Annual Release Days (days/yr)
Talladega Main WWTP, Talladega, AL	DMR-Direct Discharges	2	7.9E−03	2.3	9.2E−03	250
Tapia WRF, Los Angeles, CA	DMR-Direct Discharges	5.5	2.2E−02	9.4	3.8E−02	250
Tawas Utility Authority WWTP, Iosco, MI	DMR-Direct Discharges	6.2	2.5E−02	6.2	2.5E−02	250
The Scranton Sewer Authority WWTP, Lackawanna, PA	DMR-Direct Discharges	32	0.13	32	0.13	250
Third Creek WWTP, Iredell, NC	DMR-Direct Discharges	15	5.9E−02	20	7.8E−02	250
Timber Lane Utility District WWTP, Harris, TX	DMR-Direct Discharges	20	8.0E−02	665	2.7	250
Tinicum Twp WWTP, Delaware, PA	DMR-Direct Discharges	646	2.6	646	2.6	250
Tolleson WWTP, Maricopa, AZ	DMR-Direct Discharges	1.9	7.7E−03	3.5	1.4E−02	250
Town of Gila Bend - WWTP, Maricopa, AZ	DMR-Direct Discharges	1.8	7.3E−03	1.8	7.3E−03	250
Township of Wayne, Passaic, NJ	DMR-Direct Discharges	28	0.11	89	0.36	250
Tuba City WWTP, Coconino, AZ	DMR-Direct Discharges	2.5	9.9E−03	2.5	9.9E−03	250
Turlock RWQCF, Stanislaus, CA	DMR-Direct Discharges	2.2	8.7E−03	2.2	8.7E−03	250
Two Rivers Water Reclamation Authority, Monmouth, NJ	DMR-Direct Discharges	15	6.2E−02	17	6.6E−02	250
Ulster (T) SD STP, Ulster, NY	DMR-Direct Discharges	5	2.0E−02	6.5	2.6E−02	250
Uniontown STP, Fayette, PA	DMR-Direct Discharges	9.1	3.6E−02	32	0.13	250

Site Identity	Source-Discharge Type[a]	Median Annual Discharge (kg/yr)	Daily Discharge (Corresponding to Median Annual Discharge) (kg/day)	Maximum Annual Discharge (kg/yr)	Daily Discharge (Corresponding to Maximum Daily Discharge) (kg/day)	Annual Release Days (days/yr)
Upper Saucon Twp STP, Lehigh, PA	DMR-Direct Discharges	4.2	1.7E−02	5.1	2.0E−02	250
Valdosta (City Of) - Mud Creek WPCP, Lowndes, GA	DMR-Direct Discharges	1,228	4.9	2,435	9.7	250
Valley Sanitary District WWTP, Riverside, CA	DMR-Direct Discharges	3.1	1.2E−02	3.1	1.2E−02	250
Vidalia, City of (Swift Creek WPCP), Toombs, GA	DMR-Direct Discharges	7.2	2.9E−02	7.2	2.9E−02	250
Wadsworth WWTP, Medina, OH	DMR-Direct Discharges	21	8.5E−02	40	0.16	250
Wailua Wastewater Treatment Plant, Kauai, Hi	DMR-Direct Discharges	7.9	3.2E−02	7.9	3.2E−02	250
Warm Springs PSD, Morgan, WV	DMR-Direct Discharges	2	8.0E−03	2.9	1.1E−02	250
Warren Twp Sewer Auth Stage 4 WWTP, Somerset, NJ	DMR-Direct Discharges	0.43	1.7E−03	0.43	1.7E−03	250
Washburn Tunnel Facility, Harris, TX	DMR-Direct Discharges	2,497	10	2,497	10	250
Waste Water Treatment Plant, Mahoning, OH	DMR-Direct Discharges	42	0.17	114	0.45	250
Water Reclamation LLC, St. Charles, LA	DMR-Direct Discharges	0.27	1.1E−03	0.39	1.5E−03	250
Wauseon WWTP, Fulton, OH	DMR-Direct Discharges	3.6	1.4E−02	5.6	2.2E−02	250
West Goshen Township WWTP, Chester, PA	DMR-Direct Discharges	57	0.23	145	0.58	250
West Plains PWS-West Plains Treatment PLT, Howell, MO	DMR-Direct Discharges	15	5.9E−02	15	5.9E−02	250
Western Riverside Co Reg WWTP, Riverside, CA	DMR-Direct Discharges	0.77	3.1E−03	0.77	3.1E−03	250

Site Identity	Source-Discharge Type[a]	Median Annual Discharge (kg/yr)	Daily Discharge (Corresponding to Median Annual Discharge) (kg/day)	Maximum Annual Discharge (kg/yr)	Daily Discharge (Corresponding to Maximum Daily Discharge) (kg/day)	Annual Release Days (days/yr)
White Slough WPCF, San Joaquin, CA	DMR-Direct Discharges	72	0.29	72	0.29	250
Wildcat Hill WWTP, Coconino, AZ	DMR-Direct Discharges	34	0.13	47	0.19	250
Williamstown/Dry Ridge WRF, Grant, KY	DMR-Direct Discharges	2,298	9.2	7,151	29	250
Willows WWTP, Glenn, CA	DMR-Direct Discharges	0.13	5.3E−04	0.13	5.3E−04	250
Woodland WPCF, Yolo, CA	DMR-Direct Discharges	0.7	2.8E−03	0.7	2.8E−03	250
WSSC Seneca WRRF, Montgomery, MD	DMR-Direct Discharges	71	0.29	6,770	27	250
YCUA Regional Wastewater Treatment Plant, Washtenaw, MI	DMR-Direct Discharges	52	0.21	64	0.25	250
Yuba City Wastewater Treatment Facility, Sutter, CA	DMR-Direct Discharges	2.7	1.1E−02	23	9.3E−02	250

[a] Note: Entries for "TRI-Direct Discharges", "TRI-Transfers to POTW", and "TRI-Transfers to non-POTW" were not included in this table as no facilities reported to TRI under this OES.

3.16.4 Occupational Exposure Assessment

3.16.4.1 Worker Activities

At waste disposal sites, workers are potentially exposed via dermal contact with waste containing DEHP or via inhalation of DEHP vapor or dust. Depending on the concentration of DEHP in the waste stream, the route and level of exposure may be similar to that associated with container unloading activities. See Section 3.6.4.1 for the assessment of worker exposure from chemical unloading activities.

Municipal Waste Incineration

At municipal waste incineration facilities, there may be one or more technicians present on the tipping floor to oversee operations, direct trucks, inspect incoming waste, or perform other tasks as warranted by individual facility practices. These workers may wear protective gear such as gloves, safety glasses, or dust masks. Specific worker protocols are largely up to individual companies, although state or local regulations may require certain worker safety standards be met. Federal operator training requirements pertain more to the operation of the regulated combustion unit rather than operator health and safety.

Workers are potentially exposed via inhalation to vapors while working on the tipping floor. Potentially exposed workers include workers stationed on the tipping floor, including front-end loader and crane operators, as well as truck drivers. The potential for dermal exposures is minimized by the use of trucks and cranes to handle the wastes.

Hazardous Waste Incineration

More information is needed to determine the potential for worker exposures during hazardous waste incineration and any requirements for PPE. There is likely a greater potential for worker exposures for smaller scale incinerators that involve more direct handling of the wastes.

Municipal and Hazardous Waste Landfill

At landfills, typical worker activities may include operating refuse vehicles to weigh and unload the waste materials, operating bulldozers to spread and compact wastes, and monitoring, inspecting, and surveying and landfill site (CalRecycle, 2018).

3.16.4.2 Occupational Inhalation Exposure Results

EPA did not identify inhalation monitoring data for the Waste handling, treatment, and disposal OES during systematic review. Based on the presence of DEHP as an additive in plastics (U.S. CPSC, 2015), EPA assessed worker inhalation exposures to DEHP as an exposure to particulates of discarded plastic materials. Therefore, EPA estimated worker inhalation exposures during disposal using the *Generic Model for Central Tendency and High-End Inhalation Exposure to Total and Respirable Particulates Not Otherwise Regulated (PNOR)* (U.S. EPA, 2021b). Model approaches and parameters are described in Appendix D.

To estimate plastic particulate concentrations in the air, EPA used a subset of the PNOR (U.S. EPA, 2021b) data that came from facilities with the NAICS code starting with 56 (Administrative and Support and Waste Management and Remediation Services). This dataset consisted of 130 measurements. EPA used the highest expected concentration of DEHP in plastic products to estimate the concentration of DEHP present in particulates. For this OES, EPA selected 44 percent by mass as the highest expected DEHP concentration based on the product SDS for Vinoprene 647 (HB Chemical, 2015b). The estimated exposures assume that DEHP is present in particulates of the plastic at this fixed concentration throughout the working shift.

The model (U.S. EPA, 2021b) estimates an 8-hour TWA for particulate concentrations by assuming exposures outside the sample duration are zero. The model does not determine exposures during individual worker activities.

Table 3-94 summarizes the estimated 8-hour TWA concentration, AD, IADD, and ADD for worker exposures to DEHP during waste handling, treatment, and disposal operations. The high-end and central tendency exposures use 250 days per year as the exposure frequency since the default number of operating days in the release assessment exceeded 250 days per year, which is the expected maximum number of working days. Appendix A describes the approach for estimating AD, IADD, and ADD. The estimated exposures assume that the worker is exposed to DEHP in the form of plastic particulates and does not account for other potential inhalation exposure routes, such as the inhalation of vapors. As DEHP is not expected to be in liquid form, EPA does not expect exposure to vapors from volatilization to be a significant contribution to overall inhalation exposures. The *Occupational Exposures from Waste Handling for Diethylhexyl Phthalate (DEHP)* also contains information about model equations and parameters and contains calculation results; refer to Appendix J for a reference to this supplemental document.

Table 3-94. Summary of Estimated Worker Inhalation Exposures for Disposal

Modeled Scenario	Exposure Concentration Type	Central Tendency	High-End
Average Adult Worker	8-hour TWA Exposure Concentration (mg/m^3)	0.11	1.5
	Acute Dose (AD) (mg/kg/day)	1.3E−02	0.19
	Intermediate Average Daily Dose, Non-Cancer Exposures (IADD) (mg/m^3)	9.7E−03	0.14
	Chronic Average Daily Dose, Non-Cancer Exposures (ADD) (mg/kg/day)	9.1E−03	0.13
Female of Reproductive Age	8-hour TWA Exposure Concentration (mg/m^3)	0.11	1.5
	Acute Dose (AD) (mg/kg/day)	1.5E−02	0.21
	Intermediate Average Daily Dose, Non-Cancer Exposures (IADD) (mg/m^3)	1.1E−02	0.16
	Chronic Average Daily Dose, Non-Cancer Exposures (ADD) (mg/kg/day)	1.0E−02	0.15
ONU	8-hour TWA Exposure Concentration (mg/m^3)	0.11	
	Acute Dose (AD) (mg/kg/day)	1.3E−02	
	Intermediate Average Daily Dose, Non-Cancer Exposures (IADD) (mg/m^3)	9.7E−03	
	Chronic Average Daily Dose, Non-Cancer Exposures (ADD) (mg/kg/day)	9.1E−03	

3.16.4.3 Occupational Dermal Exposure Results

EPA estimated dermal exposures for this OES using the methodology outlined in Appendix C. The various "Exposure Concentration Types" from Table 3-95 are explained in Appendix A. Because workers may be exposed to solid-containing wastes during waste handling, disposal, and treatment, EPA assessed the absorptive flux of DEHP using dermal absorption data for solid DEHP (see Appendix C.2.1.2 for details). Table 3-95 summarizes the APDR, AD, IADD, and ADD for both average adult workers and female workers of reproductive age. Because dust or mist is expected to be deposited on surfaces from this OES, EPA assessed dermal exposures to ONUs from contact with surfaces. Dermal exposure parameters are described in Appendix C. The *Occupational Dermal Exposure Modeling*

Results for Diethylhexyl Phthalate (DEHP) also contains information about model equations and parameters and contains calculation results; refer to Appendix J for a reference to this supplemental document.

Table 3-95. Summary of Estimated Worker Dermal Exposures for Disposal

Worker Population	Exposure Concentration Type	Central Tendency	High-End
Average Adult Worker	Dose Rate (APDR, mg/day)	0.21	0.41
	Acute (AD, mg/kg-day)	2.6E−03	5.1E−03
	Intermediate (IADD, mg/kg-day)	1.9E−03	3.8E−03
	Chronic, Non-Cancer (ADD, mg/kg-day)	1.8E−03	3.5E−03
Female of Reproductive Age	Dose Rate (APDR, mg/day)	0.17	0.34
	Acute (AD, mg/kg-day)	2.4E−03	4.7E−03
	Intermediate (IADD, mg/kg-day)	1.7E−03	3.5E−03
	Chronic, Non-Cancer (ADD, mg/kg-day)	1.6E−03	3.2E−03
ONU	Dose Rate (APDR, mg/day)	0.21	
	Acute (AD, mg/kg-day)	2.6E−03	
	Intermediate (IADD, mg/kg-day)	1.9E−03	
	Chronic, Non-Cancer (ADD, mg/kg-day)	1.8E−03	

3.16.4.4 Occupational Aggregate Exposure Results

Inhalation and dermal exposure estimates were aggregated based on the approach described in Appendix A to arrive at the aggregate worker and ONU exposure estimates in Table 3-96 below. The *Occupational Risk Calculator for Diethylhexyl Phthalate (DEHP)* (U.S. EPA, 2025e) contains the calculations of aggregate exposure; refer to Appendix J for a reference to this supplemental document.

Table 3-96. Summary of Estimated Worker Aggregate Exposures for Disposal

Modeled Scenario	Exposure Concentration Type (mg/kg/day)	Central Tendency	High-End
Average Adult Worker	Acute (AD, mg/kg-day)	1.6E−02	0.20
	Intermediate (IADD, mg/kg-day)	1.2E−02	0.14
	Chronic, Non-Cancer (ADD, mg/kg-day)	1.1E−02	0.14
Female of Reproductive Age	Acute (AD, mg/kg-day)	1.7E−02	0.22
	Intermediate (IADD, mg/kg-day)	1.2E−02	0.16
	Chronic, Non-Cancer (ADD, mg/kg-day)	1.2E−02	0.15
ONU	Acute (AD, mg/kg-day)	1.6E−02	
	Intermediate (IADD, mg/kg-day)	1.2E−02	
	Chronic, Non-Cancer (ADD, mg/kg-day)	1.1E−02	

3.17 Distribution in Commerce

3.17.1 Process Description

Distribution in commerce involves loading and unloading activities (throughout various life cycle stages), transit activities, temporary storage, warehousing, and spill cleanup of DEHP. Loading and unloading activities are generally interpreted as part of Distribution in commerce; however, the releases and exposures resulting from these activities are covered within each individual OES where the activity occurs (*i.e.*, unloading of imported DEHP is covered under the import OES). Similarly, tank cleaning activities that occur after unloading of DEHP are also assessed as part of individual OESs where the activity occurs.

4 WEIGHT OF SCIENTIFIC EVIDENCE CONCLUSIONS

4.1 Environmental Releases

For each OES, EPA considered the assessment approach; the quality of the data and models; and the strengths, limitations, assumptions, and key sources of uncertainties in the assessment results to determine a weight of scientific evidence rating. EPA 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 or exposure data to the OES (*e.g.*, temporal relevance, locational relevance), and the representativeness of the estimate for the whole industry. EPA used the descriptors of robust, moderate, slight, or indeterminant to categorize the available scientific evidence using its best professional judgment, according to EPA's Application of Systematic Review in TSCA Risk Evaluations (U.S. EPA, 2021a). For example, EPA used moderate to categorize measured release data from a limited number of sources, such that there is a limited number of data points that may not cover most or all the sites within the OES. EPA used slight to describe limited information that does not sufficiently cover all sites within the OES, and for which the assumptions and uncertainties are not fully known or documented. See EPA's Application of Systematic Review in TSCA Risk Evaluations (U.S. EPA, 2021a) for additional information on weight of scientific evidence conclusions.

Table 4-1 provides a discussion on the weight of scientific evidence ratings.

Table 4-1. Discussion on Weight of Scientific Evidence for Environmental Releases by OES

OES	Weight of Scientific Evidence Conclusion in Release Estimates
Manufacturing	Air releases are assessed using reported releases from 2017 to 2022 TRI (U.S. EPA, 2022f), and 2017 and 2020 NEI (U.S. EPA, 2023a). A strength of NEI data is that NEI captures additional sources that are not included in TRI due to reporting thresholds. An additional strength is that the dataset includes two reporting sites under TRI and two reporting sites under NEI, which adds variability to the assessment. 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 (CDR), there is one additional manufacturing site that is not accounted for in this assessment. Land releases are assessed using reported releases from 2017 to 2022 TRI. The land release assessment is based on one reporting sites, with the other TRI site reporting zero land releases. EPA did not have additional sources to estimate land releases from this OES. Based on other reporting databases (CDR, DMR, NEI, etc.), there are two additional manufacturing sites that are not accounted for in this assessment. Water releases are assessed using reported releases from 2017 to 2022 from both the TRI and DMR databases (U.S. EPA, 2014a). The primary strength of TRI data is that TRI compiles reasonably available release data for all reporting facilities along with chemical activities and uses. The primary limitation is that the water release assessment is based on one site reporting nonzero releases to both TRI and DMR. and a second TRI site reporting zero water releases. EPA did not have additional sources to estimate water releases from this OES. Based on other reporting databases (CDR, NEI, etc.), there is one additional manufacturing site that are not accounted for in this assessment. The data that EPA has presented are reasonably available public information, meeting the TSCA standard under section 26(k). Based on this information, EPA has concluded that the weight of scientific evidence for this assessment is moderate to robust and provides a plausible estimate of releases in consideration of the strengths and limitations of reasonably available data.
Rubber manufacturing	Air releases are assessed using reported releases from 2017 to 2022 TRI (U.S. EPA, 2022f), and 2017 and 2020 NEI (U.S. EPA, 2023a). A strength of NEI data is that NEI captures additional sources that are not included in TRI due to reporting thresholds. An additional strength is that the dataset includes 58 NEI reporting sites and 29 TRI reporting sites which adds variability to the assessment. 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. Land releases are assessed using reported releases from 2017 to 2022 TRI. The land release assessment is based on 19 reporting sites under TRI, with the remainder of TRI sites mapped to this OES reporting zero land releases. Factors that decrease the overall confidence for this OES include the uncertainty in the accuracy of reported releases, the limitations in representativeness to all sites because TRI may not capture all relevant sites, and EPA did not have additional sources to estimate land releases from this OES. Water releases are assessed using reported releases from 2017 to 2022 TRI. The primary strength of TRI data is that TRI compiles reasonably available release data for all reporting facilities along with chemical activities and uses. The primary limitation is that the water release assessment is based on eight reporting sites, and EPA did not have additional sources to estimate water releases from

OES	Weight of Scientific Evidence Conclusion in Release Estimates
	this OES. Other 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 may not capture all relevant sites, and EPA did not have additional sources to estimate water releases from this OES. The data that EPA has presented are reasonably available public information, meeting the TSCA standard under section 26(k). Based on this information, EPA has concluded that the weight of scientific evidence for this assessment is moderate to robust and provides a plausible estimate of releases in consideration of the strengths and limitations of reasonably available data.
Plastics compounding	Air releases are assessed using reported releases from 2017 to 2022 TRI (U.S. EPA, 2022f), and 2017 and 2020 NEI (U.S. EPA, 2023a). A strength of NEI data is that NEI captures additional sources that are not included in TRI due to reporting thresholds. An additional strength is that the data includes 14 NEI reporting sites and 22 TRI reporting sites which adds variability to the assessment. 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. Land releases are assessed using reported releases from 2017 to 2022 TRI. The primary limitation is that the land releases assessment is based on nine reporting sites, with the remainder of TRI sites mapped to this OES reporting zero land releases. Other factors that decrease the overall confidence for this OES include the uncertainty in the accuracy of reported releases, the limitations in representativeness to all sites because TRI may not capture all relevant sites, and EPA did not have additional sources to estimate land releases from this OES. Water releases are assessed using reported releases from 2017 to 2022 from both the TRI and DMR databases (U.S. EPA, 2014a). The primary strength of TRI data is that TRI compiles reasonably available release data for all reporting facilities along with chemical activities and uses. An additional strength is that the dataset includes 28 DMR reporting sites and 13 TRI reporting sites which adds variability to the assessment. The remaining TRI sites mapped within this OES reported zero water releases. 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 DMR may not capture all relevant sites. The data that EPA has presented are reasonably available public information, meeting the TSCA standard under section 26(k). Based on this information, EPA has concluded that the weight of scientific evidence for this assessment is moderate to robust and provides a plausible estimate of releases in consideration of the strengths and limitations of reasonably available data.
Plastics converting	Air releases are assessed using reported releases from 2017 to 2022 TRI (U.S. EPA, 2022f), and 2017 and 2020 NEI (U.S. EPA, 2023a). A strength of NEI data is that NEI captures additional sources that are not included in TRI due to reporting thresholds. An additional strength is that the data include 23 NEI reporting sites and 48 TRI reporting sites which adds variability to the assessment. 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. Land releases are assessed using reported releases from 2017 to 2022 TRI. The land release assessment is based on 30 reporting sites under TRI with the remainder of TRI sites mapped to this OES reporting zero land releases. Factors that decrease the overall

OES	Weight of Scientific Evidence Conclusion in Release Estimates
	confidence for this OES include the uncertainty in the accuracy of reported releases, the limitations in representativeness to all sites because TRI may not capture all relevant sites, and EPA did not have additional sources to estimate land releases from this OES. Water releases are assessed using reported releases from 2017 to 2022 from both the TRI and DMR databases (U.S. EPA, 2014a). The primary strength of TRI data is that TRI compiles reasonably available release data for all reporting facilities along with chemical activities and uses. An additional strength is that the dataset includes two DMR reporting sites and 13 TRI reporting sites which adds variability to the assessment. The remaining TRI sites mapped within this OES reported zero water releases. 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 DMR may not capture all relevant sites. The data that EPA has presented are reasonably available public information, meeting the TSCA standard under section 26(k). Based on this information, EPA has concluded that the weight of scientific evidence for this assessment is moderate to robust and provides a plausible estimate of releases in consideration of the strengths and limitations of reasonably available data.
Incorporation into formulation, mixture, or reaction product	Air releases are assessed using reported releases from 2017 to 2022 TRI (U.S. EPA, 2022f), and 2017 and 2020 NEI (U.S. EPA, 2023a). A strength of NEI data is that NEI captures additional sources that are not included in TRI due to reporting thresholds. An additional strength is that the data include 71 NEI reporting sites and 19 TRI reporting sites which adds variability to the assessment. 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. Land releases are assessed using reported releases from 2017 to 2022 TRI. The primary limitation is that the land releases assessment is based on three reporting sites, with the remainder of TRI sites mapped to this OES reporting zero land releases. Other factors that decrease the overall confidence for this OES include the uncertainty in the accuracy of reported releases, the limitations in representativeness to all sites because TRI may not capture all relevant sites, and EPA did not have additional sources to estimate land releases from this OES. Water releases are assessed using reported releases from 2017 to 2022 from both the TRI and DMR databases (U.S. EPA, 2014a). The primary strength of TRI data is that TRI compiles reasonably available release data for all reporting facilities along with chemical activities and uses. An additional strength is that the dataset includes 38 DMR reporting sites and eight TRI reporting sites which adds variability to the assessment. The remaining TRI sites mapped within this OES reported zero water releases. 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 DMR may not capture all relevant sites. The data that EPA has presented are reasonably available public information, meeting the TSCA standard under section 26(k). Based on this information, EPA has concluded that the weight of scientific evidence for this assessment is moderate to robust and provides a plausible estimate of releases in consideration of the strengths and limitations of reasonably available data.
Repackaging	Air releases are assessed using reported releases from 2017 to 2022 TRI (U.S. EPA, 2022f), and 2017 and 2020 NEI (U.S. EPA, 2023a). A strength of NEI data is that NEI captures additional sources that are not included in TRI due to reporting thresholds. An

OES	Weight of Scientific Evidence Conclusion in Release Estimates
	additional strength is that the data include 16 NEI reporting sites and 24 TRI reporting sites which adds variability to the assessment. 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. Land releases are assessed using reported releases from 2017 to 2022 TRI. The primary limitation is that the land releases assessment is based on one reporting site, with the remainder of TRI sites mapped to this OES reporting zero land releases. Other factors that decrease the overall confidence for this OES include the uncertainty in the accuracy of reported releases, the limitations in representativeness to all sites because TRI may not capture all relevant sites, and EPA did not have additional sources to estimate land releases from this OES. Water releases are assessed using reported releases from 2017 to 2022 from both the TRI and DMR databases (U.S. EPA, 2014a). The primary strength of TRI data is that TRI compiles reasonably available release data for all reporting facilities along with chemical activities and uses. An additional strength is that the dataset includes eight DMR reporting sites and 19 TRI reporting sites which adds variability to the assessment. The remaining TRI sites mapped within this OES reported zero water releases. 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 DMR may not capture all relevant sites. The data that EPA has presented are reasonably available public information, meeting the TSCA standard under section 26(k). Based on this information, EPA has concluded that the weight of scientific evidence for this assessment is moderate to robust and provides a plausible estimate of releases in consideration of the strengths and limitations of reasonably available data.
Application of paints, coatings, adhesives and sealants	Air releases are assessed using reported releases from 2017 to 2022 TRI (U.S. EPA, 2022f), and 2017 and 2020 NEI (U.S. EPA, 2023a). A strength of NEI data is that NEI captures additional sources that are not included in TRI due to reporting thresholds. An additional strength is that the data include 117 NEI reporting sites and two TRI reporting sites which adds variability to the assessment. 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. Land releases are assessed using reported releases from 2017 to 2022 TRI. The primary limitation is that the land releases assessment is based on one reporting site, with the remainder of TRI sites mapped to this OES reporting zero land releases. Other factors that decrease the overall confidence for this OES include the uncertainty in the accuracy of reported releases, the limitations in representativeness to all sites because TRI may not capture all relevant sites, and EPA did not have additional sources to estimate land releases from this OES. Water releases are assessed using reported releases from 2017 to 2022 from both the TRI and DMR databases (U.S. EPA, 2014a). The primary strength of TRI data is that TRI compiles reasonably available release data for all reporting facilities along with chemical activities and uses. An additional strength is that the dataset includes 21 DMR reporting sites and one TRI reporting site which adds variability to the assessment. The remaining TRI sites mapped within this OES reported zero water releases. Factors that

OES	Weight of Scientific Evidence Conclusion in Release Estimates
	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 DMR may not capture all relevant sites. The data that EPA has presented are reasonably available public information, meeting the TSCA standard under section 26(k). Based on this information, EPA has concluded that the weight of scientific evidence for this assessment is moderate to robust and provides a plausible estimate of releases in consideration of the strengths and limitations of reasonably available data.
Textile finishing	Air releases are assessed using reported releases from 2017 to 2022 TRI (U.S. EPA, 2022f), and 2017 and 2020 NEI (U.S. EPA, 2023a). A strength of NEI data is that NEI captures additional sources that are not included in TRI due to reporting thresholds. An additional strength is that the data include nine NEI reporting sites and two TRI reporting sites which adds variability to the assessment. 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. All TRI sites within this OES reported zero land releases. EPA did not have additional sources to estimate land releases from this OES. There is uncertainty if all sites within this OES that are not captured by TRI have zero land releases. Water releases are assessed using reported releases from 2017 to 2022 from both the TRI and DMR databases (U.S. EPA, 2014a). The primary strength of TRI data is that TRI compiles reasonably available release data for all reporting facilities along with chemical activities and uses. The primary limitation is that the water release assessment is based on one reporting site under DMR and one reporting site under TRI. The remaining TRI sites mapped within this OES reported zero water releases. Other 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 DMR may not capture all relevant sites. The data that EPA has presented are reasonably available public information, meeting the TSCA standard under section 26(k). Based on this information, EPA has concluded that the weight of scientific evidence for this assessment is slight yet provides a plausible estimate of releases in consideration of the strengths and limitations of reasonably available data.
Fabrication and final use of products or articles	Air releases are assessed using reported releases from 2017 to 2022 TRI (U.S. EPA, 2022f), and 2017 and 2020 NEI (U.S. EPA, 2023a). A strength of NEI data is that NEI captures additional sources that are not included in TRI due to reporting thresholds. An additional strength is that the data include 13 NEI reporting sites and three TRI reporting sites which adds variability to the assessment. 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. All TRI sites within this OES reported zero land releases. EPA did not have additional sources to estimate land releases from this OES. There is uncertainty if all sites within this OES that are not captured by TRI have zero land releases. All TRI sites reported zero water releases and no DMR facilities were mapped to this OES. EPA did not have additional sources to estimate land releases from this OES. There is uncertainty if all sites within this OES that are not captured by TRI have zero water releases.

OES	Weight of Scientific Evidence Conclusion in Release Estimates
	The data that EPA has presented are reasonably available public information, meeting the TSCA standard under section 26(k). Based on this information, EPA has concluded that the weight of scientific evidence for this assessment is slight yet provides a plausible estimate of releases in consideration of the strengths and limitations of reasonably available data.
Use of dyes, pigments, and fixing agents	No TRI and NEI facilities were mapped within this OES. EPA did not have additional sources to estimate air or land releases from this OES. Water releases are assessed using reported releases from 2017 to 2022 from both the TRI and DMR databases (U.S. EPA, 2014a). The primary strength of DMR data is that DMR compiles reasonably available water release data for all permitted reporting facilities. The primary limitation is that the water release assessment is based on five reporting sites under DMR. Other factors that decrease the overall confidence for this OES include the uncertainty in the accuracy of reported releases, the limitations in representativeness to all sites because DMR may not capture all relevant sites, and EPA did not have additional sources to estimate water releases from this OES. The data that EPA has presented are reasonably available public information, meeting the TSCA standard under section 26(k). Based on this information, EPA has concluded that the weight of scientific evidence for this assessment is slight yet provides a plausible estimate of releases in consideration of the strengths and limitations of reasonably available data.
Formulations for diffusion bonding	Air releases are assessed using reported releases from 2017 and 2020 NEI (U.S. EPA, 2023a). A strength of NEI data is that NEI captures additional sources that are not included in other databases due to reporting thresholds. The primary limitation is that the air release assessment is based on 13 reporting sites under NEI. Other factors that decrease the overall confidence for this OES include the uncertainty in the accuracy of reported releases, the limitations in representativeness to all sites because NEI may not capture all relevant sites, and EPA did not have additional sources to estimate air releases from this OES. All TRI sites within this OES reported zero land releases. EPA did not have additional sources to estimate land releases from this OES. There is uncertainty if all sites within this OES that are not captured by TRI have zero land releases. Water releases are assessed using reported releases from 2017 to 2022 from both the TRI and DMR databases (U.S. EPA, 2014a). The primary strength of DMR data is that DMR compiles the reasonably available water release data for all permitted reporting facilities. The primary limitation is that the water release assessment is based on one reporting site under DMR. Other factors that decrease the overall confidence for this OES include the uncertainty in the accuracy of reported releases, the limitations in representativeness to all sites because DMR may not capture all relevant sites, and EPA did not have additional sources to estimate water releases from this OES. The data that EPA has presented are reasonably available public information, meeting the TSCA standard under section 26(k). Based on this information, EPA has concluded that the weight of scientific evidence for this assessment is slight yet provides a plausible estimate of releases in consideration of the strengths and limitations of reasonably available data.

OES	Weight of Scientific Evidence Conclusion in Release Estimates
Use of laboratory chemicals	EPA identified two DMR facilities reporting water releases and four NEI facilities reporting air releases of DEHP; however, EPA determined these data are not sufficient to capture the entirety of environmental releases for this scenario. Therefore, EPA assessed releases to the environment using the Draft GS on the Use of Laboratory Chemicals, which has a high data quality rating based on systematic review (U.S. EPA, 2023b). EPA used EPA/OPPT models combined with Monte Carlo modeling to estimate releases to the environment, and media of release using assumptions from the GS and EPA/OPPT models for solid and liquid DEHP lab materials. EPA believes the strength of the Monte Carlo modeling approach is that variation in model input values and a range of potential release values are more likely to capture actual releases than discrete values. Monte Carlo modeling also considers a large number of data points (simulation runs) and the full distributions of input parameters. EPA used SDSs from identified laboratory DEHP products to inform product concentration and material states. EPA believes the primary limitation to be the uncertainty in the representativeness of values toward the true distribution of potential releases. In addition, EPA lacks data on DEHP laboratory chemical throughput and number of laboratories; therefore, EPA based the number of laboratories and throughput estimates on stock solution throughputs from the Draft GS on the Use of Laboratory Chemicals and on CDR reporting thresholds. Additionally, because no entries in CDR indicate a laboratory use case and there were no other sources to estimate the volume of DEHP used in this OES, EPA developed a high-end bounding estimate based on the CDR reporting threshold, which, by definition, is expected to over-estimate the average release case. Based on this information, EPA concluded that the weight of scientific evidence for this assessment is moderate and the assessment provides a plausible estimate of releases, considering the strengths and limitations of reasonably available data.
Use of automotive care products	EPA identified one DMR facility reporting water releases of DEHP; however, EPA determined these data are not sufficient to capture the entirety of environmental releases for this scenario. Therefore, EPA assessed releases to the environment using the Automotive Detailing MRD, which has a high data quality rating based on systematic review (U.S. EPA, 2022b). EPA used EPA/OPPT models combined with Monte Carlo modeling to estimate releases to the environment, and media of release using assumptions from the MRD and EPA/OPPT models for paste/liquid DEHP automotive care product materials. EPA believes the strength of the Monte Carlo modeling approach is that variation in model input values and a range of potential release values are more likely to capture actual releases than discrete values. Monte Carlo modeling also considers a large number of data points (simulation runs) and the full distributions of input parameters. EPA used SDSs from identified automotive detailing products to inform product concentration and material states. EPA believes the primary limitation to be the uncertainty in the representativeness of values toward the true distribution of potential releases. In addition, EPA lacks data on DEHP automotive detailing throughput and number of sites; therefore, EPA based the number of sites and throughput estimates on total number of automotive detailing sites known to operate and use rate of product used per car provided by the Automotive Detailing MRD. Additionally, because no entries in CDR indicate an automotive detailing case and there were no other sources to estimate the volume of DEHP used in this OES, EPA developed a high-end bounding estimate based on the CDR reporting threshold, which by definition is expected to over-estimate the average release case.

OES	Weight of Scientific Evidence Conclusion in Release Estimates
	Based on this information, EPA concluded that the weight of scientific evidence for this assessment is moderate and the assessment provides a plausible estimate of releases, considering the strengths and limitations of reasonably available data.
Use in hydraulic fracturing	EPA found limited chemical specific data for the use in hydraulic fracturing OES and assessed releases to the environment using the Draft ESD on Chemicals Used in Hydraulic Fracturing and FracFocus 3.0, which has a high data quality rating based on systematic review (U.S. EPA, 2023b; FracFocus, 2022). EPA used EPA/OPPT models combined with Monte Carlo modeling to estimate releases to the environment, and media of release using assumptions from the ESD and EPA/OPPT models for liquid DEHP formulations. EPA believes the strength of the Monte Carlo modeling approach is that variation in model input values and a range of potential release values are more likely to capture actual releases than discrete values. Monte Carlo modeling also considers a large number of data points (simulation runs) and the full distributions of input parameters. EPA used FracFocus distributions from identified DEHP products to inform product concentration and material states. EPA believes the primary limitation to be the uncertainty in the representativeness of values toward the true distribution of potential releases. Additionally, EPA lacks data on DEHP hydraulic fracturing throughput and number of sites; therefore, EPA based the number of sites and throughput estimates on FracFocus Data. Based on this information, EPA concluded that the weight of scientific evidence for this assessment is moderate and the assessment provides a plausible estimate of releases, considering the strengths and limitations of reasonably available data.
Recycling	Air releases are assessed using reported releases from 2017 to 2022 TRI (U.S. EPA, 2022f). The primary strength of TRI data is that TRI compiles the best readily available release data for all reporting facilities. The primary limitation is that the air release assessment is based on one reporting site under TRI. Other factors that decrease the overall confidence for this OES include the uncertainty in the accuracy of reported releases, the limitations in representativeness to all sites because TRI may not capture all relevant sites, and EPA did not have additional sources to estimate air releases from this OES. The singular TRI site within this OES reported zero land and water releases. No DMR and NEI facilities were mapped within this OES. EPA did not have additional sources to estimate water or land releases from this OES. The data that EPA has presented are reasonably available public information, meeting the TSCA standard under section 26(k). Based on this information, EPA has concluded that the weight of scientific evidence for this assessment is slight yet provides a plausible estimate of releases in consideration of the strengths and limitations of reasonably available data.
Waste handling, treatment, and disposal	***General Waste Handling, Treatment, and Disposal*** Air releases for non-POTW sites are assessed using reported releases from 2017 to 2022 TRI (U.S. EPA, 2022f), and 2017 and 2020 NEI (U.S. EPA, 2023a). A strength of NEI data is that NEI captures additional sources that are not included in TRI due to reporting thresholds. An additional strength is that the data include 514 NEI reporting sites and 21 TRI reporting sites which adds variability to the assessment. 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.

OES	Weight of Scientific Evidence Conclusion in Release Estimates
	Land releases for non-POTW are assessed using reported releases from 2017 to 2022 TRI. The primary limitation is that the land releases assessment is based on seven reporting sites, with the remainder of TRI sites mapped to this OES reporting zero land releases. Other factors that decrease the overall confidence for this OES include the uncertainty in the accuracy of reported releases, the limitations in representativeness to all sites because TRI may not capture all relevant sites, and EPA did not have additional sources to estimate land releases from this OES. Water releases for non-POTW sites are assessed using reported releases from 2017 to 2022 from both the TRI and DMR databases (U.S. EPA, 2014a). The primary strength of TRI data is that TRI compiles reasonably available release data for all reporting facilities along with chemical activities and uses. For non-POTW sites, the primary limitation is that the water release assessment is based on one reporting site under TRI and one reporting site under DMR. The remaining TRI sites mapped within this OES reported zero water releases. Other 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 DMR may not capture all relevant sites. The data that EPA has presented are reasonably available public information, meeting the TSCA standard under section 26(k). Based on this information, EPA has concluded that the weight of scientific evidence for this assessment is moderate to robust and provides a plausible estimate of releases in consideration of the strengths and limitations of reasonably available data. ***Waste Handling, Treatment, and Disposal (POTW and Remediation)*** Water releases for POTW and remediation sites are assessed using reported releases from 2017 to 2022 DMR (U.S. EPA, 2014a), which has a medium overall data quality determination from the systematic review process. A strength of using DMR data and the Pollutant Loading Tool used to pull the DMR data 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. However, this approach assumes average quantities, concentrations, and hydrologic flows for a given period are representative of other times of the year. The data that EPA has presented are reasonably available public information, meeting the TSCA standard under section 26(k). Based on this information, for POTW releases, EPA has concluded that the weight of scientific evidence for this assessment is moderate to robust and provides a plausible estimate of releases in consideration of the strengths and limitations of reasonably available data.

4.2 Occupational Exposures

For each OES, EPA considered the assessment approach, the quality of the data and models, and the strengths, limitations, assumptions, and key sources of uncertainties in the assessment results to determine a weight of scientific evidence rating. EPA considered factors that increase or decrease the strength of the evidence supporting the release estimate—including quality of the data/information, applicability of the release or exposure data to the OES (including considerations of temporal relevance, locational relevance) and the representativeness of the estimate for the whole industry. The best professional judgment is summarized using the descriptors of robust, moderate, slight, or indeterminant, according to EPA's *Application of Systematic Review in TSCA Risk Evaluations* (U.S. EPA, 2021a). For example, a conclusion of moderate is appropriate where there is measured release data from a limited number of sources such that there is a limited number of data points that may not cover most or all the 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 EPA's *Application of Systematic Review in TSCA Risk Evaluations* (U.S. EPA, 2021a) for additional information on weight of scientific evidence conclusions.

Table 4-2 provides discussion on the weight of scientific evidence ratings.

Table 4-2 Discussion on Weight of Scientific Evidence for Occupational Exposures by OES

OES	Weight of Scientific Evidence Conclusion in Exposure Estimates
Manufacturing	EPA used PBZ air concentration data to assess inhalation exposures, with the data sources having a medium and high data quality rating from the systematic review process (Liss and Hartel, 1983; Nuodex Inc., 1983). Data from these sources were DEHP-specific from two separate DEHP manufacturing facilities. The primary strength is the use of directly applicable monitoring data, which are preferrable to other assessment approaches such as modeling or the use of OELs. The primary limitations of these data include the uncertainty of the representativeness of these data toward the true distribution of inhalation concentrations in this scenario, the lack of ONU exposure data, for which EPA used worker data as surrogate data, and that the data come from only two DEHP manufacturing facilities. EPA also assumed 8 exposure hours per day and 250 exposure days per year based on continuous DEHP exposure each working day for a typical worker schedule; it is uncertain whether this captures actual worker schedules and exposures. The data that EPA has presented are reasonably available public information, meeting the TSCA standard under section 26(k). Based on these strengths and limitations, EPA has concluded that the weight of scientific evidence for this assessment is moderate to robust and provides a plausible estimate of exposures.
Rubber manufacturing	EPA used monitoring data from a single rubber calendaring site to estimate worker inhalation exposures to vapor, which had a data quality rating of high. This source provided TWA exposures from six samples which had unknown worker classifications, one of which was an area sample (ECB, 2003). The primary strength of this approach is that it uses monitoring data specific to this OES, which is preferrable to other assessment approaches, such as modeling or the use of OELs. The primary limitations of these data include uncertainty in the representativeness of the monitoring data in capturing the true distribution of inhalation concentrations for this OES and the lack of ONU exposure data, for which EPA used worker data as surrogate data. Additionally, the monitoring dataset consisted of data points for unknown worker classifications and the sample type (PBZ vs. area) was not known for five of the six samples. Finally, EPA assumed 8 exposure hours per day and 250 exposure days per year based on continuous DEHP exposure each working day for a typical worker schedule; it is uncertain whether this captures actual worker schedules and exposures. The data that EPA has presented are reasonably available public information, meeting the TSCA standard under section 26(k). Based on these strengths and limitations, EPA has concluded that the weight of scientific evidence for this assessment is moderate and provides a plausible estimate of exposures.
Plastics compounding	EPA used monitoring data collected between 2014 and 2022 from three PVC compounding and processing sites to estimate worker inhalation exposures to vapor. This data source has a high data quality rating from the systematic review process. and provided 15 PBZ exposure samples (Vinyl Institute, 2025). Additionally, these data are from worker activities specific to this OES: bagging, blending, mixing. No ONU exposure data were identified. However, the central tendency value for worker exposures was used as a surrogate for actual ONU exposure monitoring data. There are no summary statistics provided for these data. The primary strength of this approach is that it uses recent monitoring data specific to this OES, which is preferrable to other assessment approaches, such as modeling or the use of OELs.

OES	Weight of Scientific Evidence Conclusion in Exposure Estimates
	The primary limitations of these data include uncertainty in the representativeness of the monitoring data in capturing the true distribution of inhalation concentrations for this OES; However, the relative recency of the data collection and the inherent heterogeneity of the data from three sites and multiple worker activities may mitigate the uncertainty in the representativeness. The data that EPA has presented are reasonably available public information, meeting the TSCA standard under section 26(k). Based on these strengths and limitations, EPA has concluded that the weight of scientific evidence for this assessment is moderate to robust and provides a plausible estimate of exposures.
Plastics converting	EPA used monitoring data collected between 2014 and 2022 from three PVC compounding and processing (converting) sites to estimate worker inhalation exposures. This data source has a high data quality rating from the systematic review process, and provided 15 PBZ exposure samples (Vinyl Institute, 2025). Additionally, these data are from worker activities specific to this OES: extrusion (calendering) and hose extrusion. No ONU exposure data were identified. However, the central tendency value for worker exposures was used as a surrogate for actual ONU exposure monitoring data. There are no summary statistics provided for these data. The primary strength of this approach is that it uses recent monitoring data specific to this OES, which is preferrable to other assessment approaches, such as modeling or the use of OELs. The primary limitations of these data include uncertainty in the representativeness of the monitoring data in capturing the true distribution of inhalation concentrations for this OES and the lack of ONU exposure data, for which EPA used worker data as surrogate data; and that the data came from a single company. However, the relative recency of the data collection and the inherent heterogeneity of the data from three sites and multiple worker activities may mitigate the uncertainty in the representativeness. The data that EPA has presented are reasonably available public information, meeting the TSCA standard under section 26(k). Based on these strengths and limitations, EPA has concluded that the weight of scientific evidence for this assessment is moderate to robust and provides a plausible estimate of exposures.
Incorporation into formulation, mixture, or reaction product	EPA used surrogate monitoring data from two DEHP manufacturing facilities to estimate worker inhalation exposures due to limited data available for incorporation into formulation, mixture, or reaction product inhalation exposures. EPA used PBZ air concentration data to assess inhalation exposures, with the data sources having medium and high data quality ratings from the systematic review process (Liss and Hartel, 1983; Nuodex Inc., 1983). Data from these sources were DEHP-specific from two separate DEHP manufacturing facilities, The primary strength is the use of monitoring data, which are preferrable to other assessment approaches such as modeling or the use of OELs. The primary limitations of these data include the uncertainty of the representativeness of these data toward this OES and the true distribution of inhalation concentrations in this scenario; the lack of ONU exposure data, for which EPA used worker data as surrogate; and that the data come from only two DEHP manufacturing facilities. EPA also assumed 8 exposure hours per day and 250 exposure days per year based on continuous DEHP exposure each working day for a typical worker schedule; it is uncertain whether this captures actual worker schedules and exposures.

OES	Weight of Scientific Evidence Conclusion in Exposure Estimates
	The data that EPA has presented is reasonably available public information, meeting the TSCA standard under section 26(k). Based on these strengths and limitations, EPA has concluded that the weight of scientific evidence for this assessment is moderate and provides a plausible estimate of exposures.
Repackaging	EPA used monitoring data from two studies that sampled drumming activities to estimate worker inhalation exposures to vapor, with the data sources both having a high data quality rating from the systematic review process (ECJRC, 2008, 2003). The primary strength of this approach is that it uses monitoring data specific to this OES, which is preferrable to other assessment approaches, such as modeling or the use of OELs. The primary limitations of these data include uncertainty in the representativeness of the monitoring data in capturing the true distribution of inhalation concentrations for this OES and the lack of ONU exposure data, for which EPA used worker data as surrogate. Additionally, the vapor monitoring dataset consisted of an unknown number of data points with unknown sample durations. Finally, EPA assumed 8 exposure hours per day and 250 exposure days per year based on continuous DEHP exposure each working day for a typical worker schedule; it is uncertain whether this captures actual worker schedules and exposures. The data that EPA has presented are reasonably available public information, meeting the TSCA standard under section 26(k). Based on these strengths and limitations, EPA has concluded that the weight of scientific evidence for this assessment is slight to moderate and provides a plausible estimate of exposures.
Spray application of paints, coatings, adhesives, and sealants	EPA used surrogate mist monitoring data from the ESD on Coating Application via Spray-Painting in the Automotive Refinishing Industry, which the systematic review process rated high for data quality, to estimate inhalation exposures (OECD, 2011a). The primary strength of this approach is that it uses surrogate monitoring data, which is preferrable to other assessment approaches, such the use of OELs. EPA used SDSs and product data sheets from identified DEHP-containing products to identify product concentrations, which were then applied to the surrogate mist data to estimate DEHP-specific exposures. The primary limitation is the lack of DEHP-specific monitoring data, with the ESD serving as a surrogate source of monitoring data representing the level of exposure that could be expected at a typical worksite for the given spray application method. The inhalation monitoring data used were specific to the spray application of coating materials, so the estimates may not be representative of exposure during other application methods. Additionally, it is uncertain whether the substrates coated, and products used to generate the surrogate data are representative of those associated with DEHP-containing diffusion bonding formulations. EPA only assessed mist exposures to DEHP over a full 8-hour work shift to estimate the level of exposure, though other activities may result in vapor exposures other than mist and application duration may be variable depending on the job site. Additionally, the lack of ONU exposure data requires the use of worker data as surrogate data, which may not be fully representative of ONU exposures. EPA assessed 250 days of exposure per year based on workers using diffusion bonding formulations on every working day, however, application sites may use DEHP-containing diffusion bonding formulations at much lower or variable frequencies. The data that EPA has presented are reasonably available public information, meeting the TSCA standard under section 26(k). Based on these strengths and limitations, EPA has concluded that the weight of scientific evidence for this assessment is moderate and provides a plausible estimate of exposures.

OES	Weight of Scientific Evidence Conclusion in Exposure Estimates
Non-spray application of paints, coatings, adhesives, and sealants	EPA used PBZ and area monitoring data from a rubber calendering plant to estimate worker inhalation exposures to vapor, which had a data quality rating of high from the systematic review process (ECJRC, 2003). The primary strength of this approach is that it uses monitoring data which is preferrable to other assessment approaches such as modeling or assuming an air concentration at an OEL. The primary limitations of these data include uncertainty in the representativeness of the monitoring data in capturing the true distribution of inhalation concentrations for this OES and the lack of ONU exposure data, for which EPA used central tendency worker data as surrogate. Based on the high data quality and in consideration of the uncertainty in the representativeness of the exposure data source to the OES, exposure data from mixed operations (worker activities), lack of knowledge in the relevance of the worker practices to the OES, EPA has concluded that the weight of scientific evidence for this assessment provides slight confidence in the estimate of exposures in consideration of the strengths and limitations of reasonably available data. EPA has lower confidence in the exposure estimates for ONUs because there are no specific ONU monitoring data, and EPA relied on worker exposure estimates at central tendency as a surrogate for ONU exposure.
Textile finishing	EPA utilized the Generic Model for Central Tendency and High-End Inhalation Exposure to Total and Respirable Particulates Not Otherwise Regulated (PNOR) (U.S. EPA, 2021b) to estimate worker inhalation exposure to solid particulate. A strength of the model is that the respirable PNOR range was refined using OSHA CEHD datasets, which EPA tailored to the textile manufacturing industry and the resulting dataset contains 71 discrete sample data points. The systematic review process rated the source high for data quality (OSHA, 2020). EPA estimated the highest expected concentration of DEHP in particulate using industry provided data on DEHP concentration in fabric finishing products. These data were also rated high for data quality in the systematic review process. The primary limitations are the uncertainty in the representativeness of values toward the true distribution of potential inhalation exposures and the lack of ONU exposure data, for which EPA used worker data as surrogate. EPA assumed 8 exposure hours per day and 215 exposure days per year based on continuous DEHP exposure each working day for a typical worker schedule; it is uncertain whether this captures actual worker schedules and exposures. The exposure days were based on the release days for the OES. The data that EPA has presented are reasonably available public information, meeting the TSCA standard under section 26(k). Based on these strengths and limitations, EPA has concluded that the weight of scientific evidence for this assessment is moderate and provides a plausible estimate of exposures.
Fabrication of final products from articles	EPA used monitoring data from OSHA CEHD to estimate worker and ONU inhalation exposures (OSHA, 2020). The systematic review process rated the source high for data quality (OSHA, 2020). The primary strength is this approach is that it uses monitoring data specific to this OES, which is preferrable to other assessment approaches such as modeling or the use of OELs. The primary limitations of these data include uncertainty in the representativeness of the monitoring data in capturing the true distribution of inhalation concentrations for this OES. Additionally, due to the lack of discrete TWA data, samples from the OSHA CEHD were combined by inspection number, establishment name, and sample number to calculate an 8-hour TWA in cases where

OES	Weight of Scientific Evidence Conclusion in Exposure Estimates
	the sum of sampling time was greater than 3 hours. This method assumes that workers are exposed to DEHP for 3 hours during their shift, which may underestimate exposures if they were to be exposed for the full shift duration. Due to the lack of data for ONUs, EPA used a discrete TWA area sample for both the high-end and central tendency exposures. Finally, EPA assumed 8 exposure hours per day and 238 exposure days per year based on continuous DEHP exposure each working day for a typical worker schedule and the release days in the NEI data; it is uncertain whether this captures actual worker schedules and exposures. The data that EPA has presented are reasonably available public information, meeting the TSCA standard under section 26(k). Based on these strengths and limitations, EPA has concluded that the weight of scientific evidence for this assessment is moderate and provides a plausible estimate of exposures.
Use of dyes, pigments, and fixing agents	Due to limited data available for use of dyes, pigments, and fixing agents, EPA used surrogate monitoring data from a rubber manufacturing site which had a data quality rating of high from the systematic review process (ECJRC, 2003). The primary strength is the use of monitoring data, which are preferrable to other assessment approaches such as modeling or assuming air concentration at an OELs. The primary limitations of these data include the uncertainty of the representativeness of these data toward this OES and the true distribution of inhalation concentrations in this scenario as well as the lack of ONU exposure data, for which EPA used central tendency worker data as surrogate. Based on the use of a surrogate OES, high data quality, and in consideration of the uncertainty regarding the representativeness of the surrogate OES to Use of Dyes, Pigments, and Fixing Agents, EPA has concluded that the weight of scientific evidence for this assessment provides slight confidence in the estimate of exposures in consideration of the strengths and limitations of reasonably available data. EPA has lower confidence in the exposure estimates for ONUs because there are no specific ONU monitoring data, and EPA relied on worker exposure estimates at central tendency as a surrogate for ONU exposure.
Formulations for diffusion bonding	EPA used surrogate mist monitoring data from the ESD on Coating Application via Spray-Painting in the Automotive Refinishing Industry, which the systematic review process rated high for data quality, to estimate inhalation exposures (OECD, 2011a). The primary strength of this approach is that it uses surrogate monitoring data, which is preferrable to other assessment approaches, such the use of OELs. EPA used SDSs and product data sheets from identified DEHP-containing products to identify product concentrations, which were then applied to the surrogate mist data to estimate DEHP-specific exposures. The primary limitation is the lack of DEHP-specific monitoring data, with the ESD serving as a surrogate source of monitoring data representing the level of exposure that could be expected at a typical worksite for the given spray application method. The inhalation monitoring data used were specific to the spray application of coating materials, so the estimates may not be representative of exposure during other application methods. Additionally, it is uncertain whether the substrates coated, and products used to generate the surrogate data are representative of those associated with DEHP-containing diffusion bonding formulations. EPA only assessed mist exposures to DEHP over a full 8-hour work shift to estimate the level of exposure, though other activities may result in vapor exposures other than mist and application duration may be variable depending on the job site. Additionally, the lack of ONU exposure data requires the use of worker data as surrogate data, which may not be fully representative of ONU exposures. EPA

OES	Weight of Scientific Evidence Conclusion in Exposure Estimates
	assessed 250 days of exposure per year based on workers using diffusion bonding formulations on every working day, however, application sites may use DEHP-containing diffusion bonding formulations at much lower or variable frequencies. The data that EPA has presented are reasonably available public information, meeting the TSCA standard under section 26(k). Based on these strengths and limitations, EPA has concluded that the weight of scientific evidence for this assessment is moderate and provides a plausible estimate of exposures.
Use of laboratory chemicals	EPA used monitoring data from two studies that sampled laboratories to estimate worker inhalation exposures to vapor. These data had data quality ratings ranging from medium to high (ECJRC, 2008; Modigh et al., 2002). EPA used the maximum of three full shift area samples for the high-end worker exposures and the minimum of two full shift PBZ samples, which was below the LOD, for the central tendency worker exposures. The primary strength of this approach is that it uses monitoring data specific to this OES, which is preferrable to other assessment approaches, such as modeling or the use of OELs. The primary limitations of these data include uncertainty in the representativeness of the monitoring data in capturing the true distribution of inhalation concentrations for this OES and the lack of ONU exposure data, for which EPA used worker data as surrogate. Finally, EPA assumed 8 exposure hours per day and the 95th percentile and 50th percentile operating days from the release assessment, 238 and 250 days respectively, as the exposure days per year based on continuous DEHP exposure each working day for a typical worker schedule; it is uncertain whether this captures actual worker schedules and exposures. The data that EPA has presented are reasonably available public information, meeting the TSCA standard under section 26(k). Based on these strengths and limitations, EPA has concluded that the weight of scientific evidence for this assessment ranging from slight to moderate and provides a plausible estimate of exposures.
Use of automotive care products	EPA used monitoring data from one study that sampled a site which applies car sealings and under coatings to estimate worker inhalation exposures. These data had a data quality rating of high (ECJRC, 2008). EPA used the maximum full shift concentration from an unknown number of samples and unknown worker classification for the high-end worker exposures and the midpoint between the maximum and LOD, due to the minimum being below the LOD, for the central tendency worker exposure. The primary strength of this approach is that it uses monitoring data specific to this OES, which is preferrable to other assessment approaches, such as modeling or the use of OELs. The primary limitations of these data include uncertainty in the representativeness of the vapor monitoring data in capturing the true distribution of inhalation concentrations for this OES and the lack of ONU exposure data, for which EPA used worker data as surrogate. Finally, EPA assumed 8 exposure hours per day and the 95th percentile and 50th percentile operating days from the release assessment, 238 and 250 days respectively, as the exposure days per year based on continuous DEHP exposure each working day for a typical worker schedule; it is uncertain whether this captures actual worker schedules and exposures. The data that EPA has presented are reasonably available public information, meeting the TSCA standard under section 26(k). Based on these strengths and limitations, EPA has concluded that the weight of scientific evidence for this assessment is slight to moderate and provides a plausible estimate of exposures.

OES	Weight of Scientific Evidence Conclusion in Exposure Estimates
Use in hydraulic fracturing	EPA used surrogate monitoring data from two DEHP manufacturing facilities to estimate worker inhalation exposures due to limited data available for use in hydraulic fracturing inhalation exposures. EPA used PBZ air concentration data to assess inhalation exposures, with the data sources having medium and high data quality ratings from the systematic review process (Liss and Hartel, 1983; Nuodex Inc., 1983). Data from these sources were DEHP-specific from two separate DEHP manufacturing facilities. The primary strength is the use of monitoring data, which are preferrable to other assessment approaches such as modeling or the use of OELs. The primary limitations of these data include the uncertainty of the representativeness of these data toward this OES and the true distribution of inhalation concentrations in this scenario; the lack of ONU exposure data, for which EPA used worker data as surrogate; and that the data come from only two DEHP manufacturing facilities. EPA also assumed 8 exposure hours per day and 1 to 3 exposure days per year based on data obtained from Frac Focus (2022); it is uncertain whether this captures actual worker schedules and exposures. The data that EPA has presented are reasonably available public information, meeting the TSCA standard under section 26(k). Based on these strengths and limitations, EPA has concluded that the weight of scientific evidence for this assessment is moderate and provides a plausible estimate of exposures.
Recycling	EPA used surrogate monitoring data from the plastics converting OES collected between 2014 and 2022 from three PVC compounding and processing (converting) sites to estimate worker inhalation exposures. This data source has a high data quality rating from the systematic review process, and provided 15 PBZ exposure samples (Vinyl Institute, 2025). Worker activities and resulting exposures for Plastic converting are expected to be sufficiently comparable to those from recycling to serve as a surrogate in the absence of OES-specific exposure data. Data from these sources were DEHP-specific. The primary strength is the use of monitoring data, which are preferrable to other assessment approaches such as modeling or the use of OELs. The primary limitations of these data include the uncertainty of the representativeness of these data toward this OES and the true distribution of inhalation concentrations in this scenario; the lack of ONU exposure data, for which EPA used worker data as surrogate; and that the data come from a single company. The data that EPA has presented are reasonably available public information, meeting the TSCA standard under section 26(k). Based on these strengths and limitations, EPA has concluded that the weight of scientific evidence for this assessment is moderate to robust and provides a plausible estimate of exposures.
Waste handling, disposal, and treatment	EPA utilized the Generic Model for Central Tendency and High-End Inhalation Exposure to Total and Respirable Particulates Not Otherwise Regulated (PNOR) (U.S. EPA, 2021b) to estimate worker inhalation exposure to solid particulate. A strength of the model is that the respirable PNOR range was refined using OSHA CEHD datasets, which EPA tailored to the waste handling industry and the resulting dataset contains 130 discrete sample data points. The systematic review process rated the source high for data quality (OSHA, 2020). EPA estimated the highest expected concentration of DEHP in waste that is handled using industry provided data on DEHP concentration in plastic products. These data were also rated high for data quality in the systematic review process.

OES	Weight of Scientific Evidence Conclusion in Exposure Estimates
	The primary limitations are the uncertainty in the representativeness of values toward the true distribution of potential inhalation exposures and the lack of ONU exposure data, for which EPA used worker data as surrogate. Additionally, the representativeness of the CEHD dataset and the identified DEHP maximum concentration in plastics for this specific OES is uncertain. EPA lacks facility and DEHP-containing waste handling, treatment, and disposal rates, methods, and operating times and EPA assumed 8 exposure hours per day and 250 exposure days per year based on continuous DEHP exposure each working day for a typical worker schedule; it is uncertain whether this captures actual worker schedules and exposures. The exposure days were based on the assumption of working 5 days per week and 50 weeks per year. The data that EPA has presented are reasonably available public information, meeting the TSCA standard under section 26(k). Based on these strengths and limitations, EPA has concluded that the weight of scientific evidence for this assessment is moderate and provides a plausible estimate of exposures.
Dermal – liquids	EPA used dermal absorption data for dilute DEHP to estimate occupational dermal exposures to workers since the absorptive flux of dilute DEHP is greater than the absorptive flux of neat DEHP (Hopf et al., 2014). Because the absorptive flux of dilute DEHP is greater than the neat absorptive flux, EPA expects using the dilute absorptive flux for anything less than 90% DEHP to be a protective approach for assessing dermal exposures. Also, it is acknowledged that variations in chemical concentration and co-formulant components affect the rate of dermal absorption. However, it is assumed that absorption of the dilute chemical serves as a reasonable upper bound across chemical compositions and the data received a medium rating through EPA's systematic review process. For occupational dermal exposure assessment, EPA assumed a standard 8-hour workday and that the chemical is contacted at least once per day. Because DEHP has low volatility and low absorption, it is possible that the chemical remains on the surface of the skin after a dermal contact until the skin is washed. Therefore, absorption of DEHP from occupational dermal contact with materials containing DEHP may extend up to 8 hours per day (U.S. EPA, 1991a). For average adult workers, the surface area of contact was assumed equal to the front and back area of one hand (*i.e.*, 535 cm^2), or two hands (*i.e.*, 1,070 cm^2), for central tendency exposures, or high-end exposures, respectively (U.S. EPA, 2011). The standard sources for exposure duration and area of contact received high ratings through EPA's systematic review process. The occupational dermal exposure assessment for contact with liquid materials containing DEHP was based on dermal absorption data for the dilute material, as well as standard occupational inputs for exposure duration and area of contact, as described above. Based on the strengths and limitations of these inputs, EPA has concluded that the weight of scientific evidence for this assessment is moderate and provides a plausible estimate of occupational dermal exposures.
Dermal – solids	EPA used dermal absorption data from an *in vivo* absorption study using male F344 rats and DEHP contained within PVC film (Chemical Manufacturers Association, 1991) to estimate occupational dermal exposures of workers and ONUs to solid materials as described in Appendix C. These data had a data quality rating of medium from systematic review. It is acknowledged that variations in chemical concentration and co-formulant components affect the rate of dermal absorption. In a typical occupational exposure setting, the duration of exposure is not expected to exceed the shift time (typically, 8 to 12 hours). Therefore, EPA used the 24-hour average absorptive flux from the Chemical Manufacturers Association to estimate occupational exposures (Chemical Manufacturers

OES	Weight of Scientific Evidence Conclusion in Exposure Estimates
	Association, 1991). Because this duration exceeds the occupational exposure duration and because the Chemical Manufacturers Association show that the absorptive flux increased with longer test durations, EPA expects the use of the average absorptive flux data from Chemical Manufacturers Association to be protective of the duration of dermal exposures in occupational settings (Chemical Manufacturers Association, 1991). For occupational dermal exposure assessment, EPA assumed a standard 8-hour workday and that the chemical is contacted at least once per day. Because DEHP has low volatility and low absorption, it is possible that the chemical remains on the surface of the skin after a dermal contact until the skin is washed. Therefore, absorption of DEHP from occupational dermal contact with materials containing DEHP may extend up to 8 hours per day (U.S. EPA, 1991a). For average adult workers, the surface area of contact was assumed equal to the front and back area of one hand (*i.e.*, 535 cm^2), or two hands (*i.e.*, 1,070 cm^2), for central tendency exposures, or high-end exposures, respectively (U.S. EPA, 2011). The standard sources for exposure duration and area of contact received high ratings through EPA's systematic review process. The occupational dermal exposure assessment for contact with solid materials containing DEHP was based on *in vivo* dermal absorption data using male F344 rats, as well as standard occupational inputs for exposure duration and area of contact, as described above. Based on the strengths and limitations of these inputs, EPA has concluded that the weight of scientific evidence for this assessment is moderate and provides a plausible estimate of occupational dermal exposures.

REFERENCES

3M. (2011). Material Safety Data Sheet (MSDS): 3M™ Economy Vinyl Electrical Tape 1400, 1400C. St. Paul, MN. https://rexel-cdn.com/Products/Shurtape/EWG7060.pdf?i=C01BE392-38A7-4B50-8BF3-AD2266582BE9

3M. (2017). 3M One-Step Rust Converter, PN 3513. https://multimedia.3m.com/mws/mediawebserver?mwsId=SSSSSuUn_zu8l00xM8teoxtvmv70k17zHvu9lxtD7SSSSSS--

3M. (2018). 3M Scotchcast Poly Plus (Colors). 3M Company. http://multimedia.3m.com/mws/mediawebserver?mwsId=SSSSSuUn_zu8l00xMx_1Ox2Gnv70k17zHvu9lxtD7SSSSSS--

3M Company. (2010). Material Safety Data Sheet: 3M™ Vinyl Tape 764, 766, 767, & 3903. St. Paul, MN: 3M Company. https://www.g3sk.sk/download/vip/764-06/764-06-3m-univerzalni-oznacovaci-paska-bila-bezpecnostni-list-eng.pdf

3M Company. (2019). 3M™ Finesse-It Polish - Finishing Material, 13084, 28792, 81235, 83058. http://multimedia.3m.com/mws/mediawebserver?mwsId=SSSSSu9n_zu8l00xm8tZP8_9lv70k17zHvu9lxtD7xt1evSSSSSS-

ACC. (2019). Global automotive declarable substance list. https://www.gadsl.org/

Adams Plastics LP. (2016). Material Safety Data Sheet (MSDS): Flexible polyvinyl chloride. Rolling Meadows, IL. https://adamsplastics.com/wp-content/uploads/Adams-MSDS-Universal.pdf

Airserco Manufacturing Company LLC. (2009). Material Safety Sheet. Airserco Manufacturing Company LLC. https://www.heritageparts.com/medias/TML0086.pdf?context=bWFzdGVyfHBkZi1tYW51YWxzfDExMzk0MHxhcHBsaWNhdGlvbi9wZGZ8cGRmLW1hbnVhbHMvaDIxL2gyNi84OTg1ODg3MDQ3NzEwLnBkZnw0MzM3N2VjN2U2YTYwNTA4NTdlMzVlNGRmZWUzODE0ZjVjNDA2M2E3OTYyNzQwOTg3MDcxYmNhNDNmYjhhMjc1

ANAMET Electrical Inc. (2012). Material Safety Data Sheet (MSDS): Anaconda Type MTC Blk 1-1/4. Mattoon, IL. https://flexiblewiringconduits.anacondasealtite.com/viewitems/sealtite-non-ul/l-conduit-liquid-tight-flexible-metal-conduit-lfmc

APR. (2023). Model Bale Specifications: 1-7 ALL Rigid Plastics. Washington, DC.

Arnold, F; Engel, AJ. (2001). Evaporation of pure liquids from open surfaces. In JBHJ Linders (Ed.), (pp. 61-71). The Netherlands: Kluwer Academic Publishers. http://dx.doi.org/10.1007/978-94-010-0884-6_6

Athena Champion. (2013). Material Safety Data Sheet (MSDS): Champ-Lube(TM) 20 Plus. Earth City, MO. https://www.dhpionline.com/msds/571-CL4499.pdf

ATSDR. (2002). Toxicological profile for di(2-ethylhexyl) phthalate [ATSDR Tox Profile]. Atlanta, GA: U.S. Department of Health and Human Services, Public Health Service. http://www.atsdr.cdc.gov/ToxProfiles/tp.asp?id=684&tid=65

Axalta. (2021). Safety Data Sheet (SDS): Rapid Dry Multi-Surface Gray Primer. Glen Mills, PA. http://www.ellispaint.com/sds/hy-lux%20solventborne%20primers/633_RAPID%20DRY%20MULTI-SURFACE%20GRAY%20PRIMER_SDS%20US_English_02-MAR-2016.pdf

Baldwin, PE; Maynard, AD. (1998). A survey of wind speed in indoor workplaces. Ann Occup Hyg 42: 303-313. http://dx.doi.org/10.1016/S0003-4878(98)00031-3

Barber, ED; Teetsel, NM; Kolberg, KF; Guest, D. (1992). A comparative study of the rates of in vitro percutaneous absorption of eight chemicals using rat and human skin. Fundam Appl Toxicol 19: 493-497. http://dx.doi.org/10.1016/0272-0590(92)90086-W

Björklund, K. (2010). Substance flow analyses of phthalates and nonylphenols in stormwater. Water Sci Technol 62: 1154-1160. http://dx.doi.org/10.2166/wst.2010.923

Bryant. (1993). Kirk-Othmer Encyclopedia of Chemical Technology (4th ed.). New York, NY: John Wiley and Sons.
CalRecycle. (2018). Beyond 2000: California's Continuing Need for Landfills [Website]. https://www.calrecycle.ca.gov/SWFacilities/Landfills/NeedFor
Carlton Hardwood Flooring. (NA). Prime WPC/Prime Essentials/Prime SPC. Carlton Hardwoord Flooring.
CDC. (2009). Fourth national report on human exposure to environmental chemicals. Atlanta, GA: U.S. Department of Health and Human Services, Centers for Disease Control and Prevention. http://www.cdc.gov/exposurereport/
CETCO. (2014). Safety Data Sheet (SDS): LDC 60V. Hoffman Estates, IL. https://www.buildsite.com/pdf/cetco/LDC-60-SDS-B34786.pdf
Chao, KP; Huang, CS; Wei, CY. (2015). Health risk assessments of DEHP released from chemical protective gloves. J Hazard Mater 283: 53-59. http://dx.doi.org/10.1016/j.jhazmat.2014.09.010
Chemical Manufacturers Association. (1991). Chloride film in male Fischer 344 rats (final report) with attachments and cover sheet dated 042491 [TSCA Submission]. (EPA/OTS Doc #86-910000794). https://ntrl.ntis.gov/NTRL/dashboard/searchResults/titleDetail/OTS0529426.xhtml
Chemsol. (2020). TT-L-58E [Material Safety Data Sheet]. Chemsol.
Cherrie, JW; Semple, S; Brouwer, D. (2004). Gloves and Dermal Exposure to Chemicals: Proposals for Evaluating Workplace Effectiveness. Ann Occup Hyg 48: 607-615. http://dx.doi.org/10.1093/annhyg/meh060
Clemons Concrete Coatings. (2018). Cure Seal 100 Plus. Clemons Concrete Coatings. http://www.scofield.com/tdbpdf/SDS/SCOFIELD-CureSeal-100Plus.pdf
Comet Chemical Company Ltd. (2016). Safety Data Sheet (SDS): Dioctyl phthalate. Innisfill, ON, Canada. http://www.cometchemical.com/MSDS/Dioctyl%20PhthalateEN.pdf
Danish EPA. (2010). Survey and health assessment of products for interior car care. In Survey of Chemical Substances in Consumer Products, No 105 2010. Denmark: Danish Ministry of the Environment. https://www2.mst.dk/udgiv/publications/2010/978-87-92548-93-1/pdf/978-87-92548-94-8%20.pdf
Dirven, HAAM; van den Broek, PHH; Arends, AMM; Nordkamp, HH; de Lepper, AJGM; Henderson, PT; Jongeneelen, FJ. (1993). Metabolites of the plasticizer di(2-ethylhexyl)phthalate in urine samples of workers in polyvinylchloride processing industries. Int Arch Occup Environ Health 64: 549-554. http://dx.doi.org/10.1007/BF00517699
Dupli-Color Products Company. (2017). Dupli-Color® Bed Armor™, material safety data sheet. Dupli-Color Products Company. https://img0.fastenal.com/productimages/supplemental/product_docs/SDS13194303.pdf
Duro Dyne Corporation. (2014). Duro Dyne Durolon Fabric. Duro Dyne Corporation. http://www.durodyne.com/msds/DFD-Durolon_SDS.pdf
Eagle. (2015). Safety Data Sheet (SDS): Eagle Supreme Seal & Eagle Gloss Coat. Nashville, TN. https://images.homedepot-static.com/catalog/pdfImages/a4/a4379415-69af-4760-895c-014a3071658f.pdf
Eagle I.F.P. Company. (2015). Eagle Paver Sealer. Eagle I.F.P. Company. https://images-na.ssl-images-amazon.com/images/I/71dHe21E6TL.pdf
Eastman Kodak. (1989). The in vito percutaneous absorption of di(2-ethylhexyl) phthalate through human stratum corneum and full thickness rat (F-344) skin with attached appendix and cover letter dated 062789 [TSCA Submission]. (OTS0520374. 86-890000936. TSCATS/403833). https://ntrl.ntis.gov/NTRL/dashboard/searchResults/titleDetail/OTS0520374.xhtml
ECB. (2003). European Union risk assessment report: 1,2-Benzenedicarboxylic acid, di-C8-10-branched alkyl esters, C9-rich - and di-"isononyl" phthalate (DINP). In 2nd Priority List, Volume: 35. (EUR 20784 EN). Luxembourg, Belgium: Office for Official Publications of the European

Communities. http://bookshop.europa.eu/en/european-union-risk-assessment-report-pbEUNA20784/
ECB. (2008). European Union risk assessment report: 1,3,4,6,7,8-hexahydro-4,6,6,7,8,8-hexamethylcyclopenta-γ-2-benzopyran (HHCB). Luxembourg: European Union, European Chemicals Bureau, Institute for Health and Consumer Protection. https://echa.europa.eu/documents/10162/947def3b-bbbf-473b-bc19-3bda7a8da910
ECHA. (2009). Data on manufacture, import, export, uses and releases of bis(2-ethylhexyl)phthalate (DEHP) as well as information on potential alternatives to its use. (ECHA/2008/02/SR1/ECA.224). Helsinki, Finland. https://echa.europa.eu/documents/10162/13640/tech_rep_dehp_en.pdf/8fd5a74b-6807-42b6-ae1f-d1d7f04f40f8
ECHA. (2010). Evaluation of new scientific evidence concerning the restrictions contained in annex XVII to regulation (EC) no 1907/2006 (REACH): Review of new available information for bis(2-ethylhexyl) phthalate (DEHP). European Union, European Chemicals Agency.
ECHA. (2011). Annex XV restriction report: Proposal for a restriction, version 2. Substance name: bis(2-ehtylhexyl)phthlate (DEHP), benzyl butyl phthalate (BBP), dibutyl phthalate (DBP), diisobutyl phthalate (DIBP). Copenhagen, Denmark: Danish Environmental Protection Agency :: Danish EPA. https://echa.europa.eu/documents/10162/c6781e1e-1128-45c2-bf48-8890876fa719
ECHA. (2012). Committee for Risk Assessment (RAC) Committee for Socio-economic Analysis (SEAC): Background document to the Opinion on the Annex XV dossier proposing restrictions on four phthalates. Helsinki, Finland. http://echa.europa.eu/documents/10162/3bc5088a-a231-498e-86e6-8451884c6a4f
ECJRC. (2003). European Union risk assessment report: 1,2-Benzenedicarboxylic acid, di-C8-10-branched alkyl esters, C9-rich - and di-"isononyl" phthalate (DINP). In European Union Risk Assessment Report, Vol 35. (EUR 20784 EN). Luxembourg, Belgium: Office for Official Publications of the European Communities. http://bookshop.europa.eu/en/european-union-risk-assessment-report-pbEUNA20784/
ECJRC. (2008). European Union risk assessment report: Bis(2-ethylhexyl)phthalate (DEHP) [Standard]. In 2nd Priority List. (EUR 23384 EN). Luxembourg: Office for Official Publications of the European Communities. https://op.europa.eu/en/publication-detail/-/publication/80eaeafa-5985-4481-9b83-7b5d39241d52
Elsisi, AE; Carter, DE; Sipes, IG. (1989). Dermal absorption of phthalate diesters in rats. Fundam Appl Toxicol 12: 70-77. http://dx.doi.org/10.1016/0272-0590(89)90063-8
Ennis-Flint. (2015). Safety Data Sheet (SDS): SB WHT 150 VOC HWVW1. Thomasville, NC. https://www.alpinemarkings.com/wp-content/uploads/2012/09/985691.pdf
ESIG. (2020). SPERC Factsheet – Use in rubber production and processing. Brussels, Belgium. https://www.esig.org/wp-content/uploads/2020/05/19_industrial_rubber-production_processing.pdf
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.
Focus Chemical Inc. (2016). DOP. Focus Chemical Inc. https://www.palmerholland.com/Assets/User/Documents/Product/45087/6022/MITM04628.pdf
FracFocus. (2022). FracFocus: Chemical disclosure registry [Database]. https://fracfocus.org/data-download
Gaudin, R; Marsan, P; Ndaw, S; Robert, A; Ducos, P. (2011). Biological monitoring of exposure to di(2-ethylhexyl) phthalate in six French factories: a field study. Int Arch Occup Environ Health 84: 523-531. http://dx.doi.org/10.1007/s00420-010-0566-7
Gaudin, R; Marsan, P; Robert, A; Ducos, P; Pruvost, A; Lévi, M; Bouscaillou, P. (2008). Biological monitoring of occupational exposure to di(2-ethylhexyl) phthalate: Survey of workers exposed to

plastisols. Int Arch Occup Environ Health 81: 959-966. http://dx.doi.org/10.1007/s00420-007-0289-6
Glidden. (1999). Material Safety Data Sheet (MSDS): Woodmaster polyurethane clear finish-gloss. Cleveland, OH. https://core-docs.s3.amazonaws.com/documents/asset/uploaded_file/233144/GLIDDEN_Woodmaster_Polyurethane.pdf
HB Chemical. (2014). Safety Data Sheet (SDS): DOP. Twinsburg, OH. http://hbchemical.com/wp-content/uploads/2014/04/DOP-SDS.pdf
HB Chemical. (2015a). Safety Data Sheet (SDS): DOP DLD Drum. Twinsburg, OH. http://www.hbchemical.com/wp-content/uploads/2014/04/DOP-DLD-Drum-SDS.pdf
HB Chemical. (2015b). Safety Data Sheet (SDS): VINOPRENE 647. Twinsburg, OH. https://web.archive.org/web/20210506161832/https://www.hbchemical.com/wp-content/uploads/2014/04/VINOPRENE-647-SDS.pdf
HB Chemical. (2015c). Synplast mixed phthalate. HB Chemical. http://www.hbchemical.com/wp-content/uploads/2014/04/Mixed-phthalate-SDS.pdf
HB Chemical. (2019). Safety Data Sheet (SDS): HB C-90. Twinsburg, OH. http://www.hbchemical.com/wp-content/uploads/2014/04/HB-C-90D-SDS1.pdf
Heitbrink, W. (1993). In-depth survey report: Control technology for autobody repair and painting shops at Team Chevrolet, Colorado Springs, Colorado. Heitbrink, W. https://www.cdc.gov/niosh/surveyreports/pdfs/179-18a.pdf?id=10.26613/NIOSHEPHB17918a
Heitbrink, W; Cooper, T; Edmonds, M; Bryant, C; Ruch, W. (1993). In-depth survey report: control technology for autobody repair and painting shops at Valley Paint and Body Shop, Amelia, Ohio. Heitbrink, W; Cooper, T; Edmonds, M; Bryant, C; Ruch, W. https://www.cdc.gov/niosh/surveyreports/pdfs/179-14a.pdf?id=10.26613/NIOSHEPHB17914a
Henrotin, JB; Feigerlova, Ev; Robert, A; Dziurla, M; Burgart, M; Lambert-Xolin, AM; Jeandel, F; Weryha, G. (2020). Decrease in serum testosterone levels after short-term occupational exposure to diisononyl phthalate in male workers. 77: 214-222. https://heronet.epa.gov/heronet/index.cfm/reference/download/reference_id/7978431
Hines, CJ; Nilsen Hopf, NB; Deddens, JA; Calafat, AM; Silva, MJ; Grote, AA; Sammons, DL. (2009). Urinary phthalate metabolite concentrations among workers in selected industries: A pilot biomonitoring study. Ann Occup Hyg 53: 1-17. http://dx.doi.org/10.1093/annhyg/men066
Hopf, NB; Berthet, A; Vernez, D; Langard, E; Spring, P; Gaudin, R. (2014). Skin permeation and metabolism of di(2-ethylhexyl) phthalate (DEHP). Toxicol Lett 224: 47-53. http://dx.doi.org/10.1016/j.toxlet.2013.10.004
Hopf, NB; De Luca, HP; Borgatta, M; Koch, HM; Pälmke, C; Benedetti, M; Berthet, A; Reale, E. (2024). Human skin absorption of three phthalates. Toxicol Lett 398: 38-48. http://dx.doi.org/10.1016/j.toxlet.2024.05.016
Huang, LP; Lee, CC; Hsu, PC; Shih, TS. (2011). The association between semen quality in workers and the concentration of di(2-ethylhexyl) phthalate in polyvinyl chloride pellet plant air. Fertil Steril 96: 90-94. http://dx.doi.org/10.1016/j.fertnstert.2011.04.093
IARC. (1982). IARC monographs on the evaluation of the carcinogenic risk of chemicals to humans: Some industrial chemicals and dyestuffs. In IARC monographs on the evaluation of carcinogenic risks to humans (pp. 1-398). Lyon, France: International Agency for Research on Cancer :: IARC. http://monographs.iarc.fr/ENG/Monographs/vol29/volume29.pdf
Identity Group. (2016a). Blue Stamp-Ever stamp. Identity Group. https://content.oppictures.com/Master_Images/Master_PDF_Files/USSIB61_SDS.PDF
Identity Group. (2016b). Safety Data Sheet (SDS): Black Stamp-Ever stamp. Cookeville, TN. https://content.oppictures.com/Master_Images/Master_PDF_Files/USSIK60_SDS.PDF

Identity Group. (2016c). Safety Data Sheet (SDS): Green Stamp-Ever stamp. Cookeville, TN. https://content.oppictures.com/Master_Images/Master_PDF_Files/USSIG64_SDS.PDF
Identity Group. (2016d). Safety Data Sheet (SDS): Red Stamp-Ever stamp. Cookeville, TN. https://content.oppictures.com/Master_Images/Master_PDF_Files/USSIR62_SDS.PDF
Imperial Tools. (2015). Safety Data Sheet (SDS): Imperial Liqui-Vac. Ellicottville, NY. https://3tu2nw308x4p2v9d07240y1i-wpengine.netdna-ssl.com/wp-content/uploads/2017/07/4036-liquivac-sds-2015.pdf
Inland Vacuum Industries. (2005). Material Safety Data Sheet (MSDS): Octoil. Churchville, NY. https://www.idealvac.com/files/MSDS/Inland_OCTOIL_MSDS.pdf
Kim, HY. (2016). Risk assessment of di(2-ethylhexyl) phthalate in the workplace. Environmental Health and Toxicology 31: e2016011. http://dx.doi.org/10.5620/eht.e2016011
Kissel, JC. (2011). The mismeasure of dermal absorption. J Expo Sci Environ Epidemiol 21: 302-309. http://dx.doi.org/10.1038/jes.2010.22
Kitto, JB; Stultz, SC. (1992). Steam: Its generation and use (40th ed.). Barberton, OH: Babcock & Wilcox.
Koch, HM; Angerer, J. (2011). Phthalates: Biomarkers and human biomonitoring. In LE Knudsen; DF Merlo (Eds.), Issues in Toxicology (pp. 179-233). Cambridge, UK: Royal Society of Chemistry. http://dx.doi.org/10.1039/9781849733373-00179
Kozumbo, WJ; Kroll, R; Rubin, RJ. (1982). Assessment of the mutagenicity of phthalate esters. Environ Health Perspect 45: 103-109. http://dx.doi.org/10.2307/3429391
Ladd Research. (2023). Safety Data Sheet (SDS): Mercox II Resin. Essex Junction, VT. https://www.laddresearch.com/lanotattachments/download/file/id/335/store/1/mercoxsds_1_1.pdf
Lansink, CJM; Breelen, MSC; Marquart, J; van Hemmen, JJ. (1996). Skin exposure to calcium carbonate in the paint industry. Preliminary modelling of skin exposure levels to powders based on field data. (V96.064). Rijswijk, The Netherlands: TNO Nutrition and Food Research Institute.
Laursen, SE; Hansen, J; Drøjdahl, A; Hansen, OC; Pommer, K; Pedersen, E; Bernth, N. (2003). Survey of chemical compounds in textile fabrics. (Survey of chemicals in consumer products No. 23). Odense, Denmark: Danish Environmental Protection Agency. https://eng.mst.dk/media/mst/69105/23.pdf
Liss, GM; Albro, PW; Hartle, RW; Stringer, WT. (1985). Urine phthalate determinations as an index of occupational exposure to phthalic anhydride and di(2-ethylhexyl)phthalate. Scand J Work Environ Health 11: 381-387. http://dx.doi.org/10.5271/sjweh.2209
Liss, GM; Hartel, RW. (1983). Health Hazard Evaluation Report No. HETA-82-032-1384, Badische Corporation, Kearny, New Jersey (pp. 82-032). (NIOSH/00178915). Liss, GM; Hartel, RW.
Lord Corporation. (2020). Safety Data Sheet (SDS): CIRCALOK 6410 A. Cary, NC. https://www.lord.com/sites/default/files/Documents/SafetyDataSheet/CIRCALOK%206410%20A.pdf
Lord Corporation. (2021). Safety Data Sheet (SDS): CIRCALOK 6410 B. Cary, NC. https://www.lord.com/sites/default/files/Documents/SafetyDataSheets/CIRCALOK_6410_B.pdf
Marquart, H; Franken, R; Goede, H; Fransman, W; Schinkel, J. (2017). Validation of the dermal exposure model in ECETOC TRA. Ann Work Expo Health 61: 854-871. http://dx.doi.org/10.1093/annweh/wxx059
Melnick, RL; Morrissey, RE; Tomaszewski, KE. (1987). Studies by the national toxicology program on di-2-ethylhexylphthalate. Toxicol Ind Health 3: 99-118. http://dx.doi.org/10.1177/074823378700300208
Modigh, CM; Bodin, SLV; Lillienberg, L; Dahlman-Höglund, A; Akesson, B; Axelsson, G. (2002). Time to pregnancy among partners of men exposed to di(2-ethylhexyl)phthalate. Scand J Work Environ Health 28: 418-428. http://dx.doi.org/10.5271/sjweh.694

Morgan Advanced Materials. (2016a). Safety Data Sheet (SDS): Stopyt Product 62A. Hayward, CA. http://www.morganadvancedmaterials.com/media/5354/sds-stopyt-62a-rr-15-apr-2016.pdf
Morgan Advanced Materials. (2016b). Safety Data Sheet (SDS): Stopyt product: Regular. Hayward, CA. http://www.morgantechnicalceramics.com/media/5356/sds-stopyt-regular-05-2016.pdf
Muchangos, LD; Xue, M; Zhou, L; Kojima, N; Machimura, T; Tokai, A. (2019). Flows, stocks, and emissions of DEHP products in Japan. Sci Total Environ 650: 1007-1018. http://dx.doi.org/10.1016/j.scitotenv.2018.09.077
NASA. (2020). Comment submitted by Denise Thaller, Director, Environmental Management Division, National Aeronautics and Space Administration (NASA) regarding draft scopes of the risk evaluations to be conducted for seven chemical substances under the Toxic Substance Control Act (TSCA). (EPA-HQ-OPPT-2018-0438-0057). Washington, DC. https://www.regulations.gov/document/EPA-HQ-OPPT-2018-0438-0057
Ng, KME; Chu, I; Bronaugh, RL; Franklin. (1992). Percutaneous absorption and metabolism of pyrene, benzo[a]pyrene, and di(2-ethylhexyl) phthalate: Comparison of in vitro and in vivo results in the hairless guinea pig. Toxicol Appl Pharmacol 115: 216-223. http://dx.doi.org/10.1016/0041-008X(92)90326-N
Nike-Tech Inc. (2015). TRU SEAL. Nike-Tech Inc. https://piercedirect.com/Ecommerce/site/PierceDirect/content/pdfs/Tru%20Seal%20SDS%20PW0422200.pdf
Nuodex Inc. (1983). Di-(2-ethylhexyl) phthalate monitoring - Chestertown memo CHMD-83-002 [TSCA Submission]. (OTS0206260. 878211174. TSCATS/018070). https://ntrl.ntis.gov/NTRL/dashboard/searchResults/titleDetail/OTS0206260.xhtml
NYSDEC. (2011). Supplemental Generic Environmental Impact Statement on The Oil, Gas and Solution Mining Regulatory Program. http://www.dec.ny.gov/data/dmn/rdsgeisfull0911.pdf
OECD. (2004a). Emission scenario document on additives in rubber industry. (ENV/JM/MONO(2004)11). Paris, France. http://www.oecd.org/officialdocuments/publicdisplaydocumentpdf/?cote=env/jm/mono(2004)11&doclanguage=en
OECD. (2004b). Emission scenario document on textile finishing industry. In OECD Series on Emission Scenario Documents. (OECD SESD No. 7; JT00166691). Paris, France. https://www.oecd.org/officialdocuments/publicdisplaydocumentpdf/?doclanguage=en&cote=env/jm/mono(2004)12
OECD. (2004c). Test No. 428: Skin absorption: In vitro method. Paris, France. http://dx.doi.org/10.1787/9789264071087-en
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
OECD. (2009b). Emission scenario document on plastic additives. (JT03267870). Paris, France: OECD Environmental Health and Safety Publications. http://www.oecd.org/officialdocuments/publicdisplaydocumentpdf/?cote=env/jm/mono(2004)8/rev1&doclanguage=en
OECD. (2009c). Emission scenario documents on coating industry (paints, lacquers and varnishes). (JT03267833). Paris, France. http://www.oecd.org/officialdocuments/publicdisplaydocumentpdf/?cote=env%20/jm/mono(2009)24&doclanguage=en
OECD. (2010a). Emission scenario document on formulation of radiation curable coatings, inks and adhesives. Paris, France: OECD Environmental Health and Safety Publications. https://www.oecd-ilibrary.org/docserver/9789264221109-

en.pdf?expires=1591023963&id=id&accname=guest&checksum=D62CF543E560282B5F4F943 55EB4DFC7
OECD. (2010b). Emission scenario document on the formulation of radiation curable coatings, inks and adhesives. http://www.oecd.org/officialdocuments/publicdisplaydocumentpdf/?cote=env/jm/mono(2009)2&doclanguage=en
OECD. (2010c). Scoping Document for Emission Scenario Document on Manufacturing and Use of Printing Inks. OECD Environmental Health and Safety Publications.
OECD. (2011a). Emission scenario document on coating application via spray-painting in the automotive refinishing industry. In OECD Series on Emission Scenario Documents No 11. (ENV/JM/MONO(2004)22/REV1). Paris, France: Organization for Economic Co-operation and Development. http://www.oecd.org/officialdocuments/publicdisplaydocumentpdf/?cote=env/jm/mono(2004)22/rev1&doclanguage=en
OECD. (2011b). Emission Scenario Document on the application of radiation curable coatings, inks, and adhesives via spray, vacuum, roll, and curtain coating.
OECD. (2011c). Guidance notes on dermal absorption. (ENV/JM/MONO(2011)36). https://www.oecd.org/env/ehs/testing/48532204.pdf
OECD. (2012). Emission scenario document on chemicals used in oil well production. (JT03318094). Paris, France. https://www.oecd-ilibrary.org/docserver/9789264220966-en.pdf?expires=1587647294&id=id&accname=guest&checksum=B15B4CD8B176EC15C6A050541C9B1F6A
OECD. (2015a). Emission scenario document on the use of adhesives. In Series on Emission Scenario Documents No 34. (JT03373626). Paris, France. http://www.oecd.org/officialdocuments/publicdisplaydocumentpdf/?cote=ENV/JM/MONO(2015)4&doclanguage=en
OECD. (2015b). Emission scenario document on use of adhesives. In Series on Emission Scenario Documents No 34. (Number 34). Paris, France. http://www.oecd.org/officialdocuments/publicdisplaydocumentpdf/?cote=ENV/JM/MONO(2015)4&doclanguage=en
OECD. (2017). Emission scenario document (ESD) on the use of textile dyes. In Emission Scenario Document, Series No 36. (ENV/JM/MONO(2015)50). Paris, France: OECD, Inter-Organization Programme for the Sound Management of Chemicals (IOMC). http://www.oecd.org/chemicalsafety/risk-assessment/emissionscenariodocuments.htm
OECD. (2024). Emission Scenario Document on chemicals used in fabric finishing or fabric coating. In Series on Emission Scenario Documents No 43. Paris, France: OECD Publishing. https://www.oecd.org/content/dam/oecd/en/publications/reports/2024/12/emission-scenario-document-on-chemicals-used-in-fabric-finishing-or-fabric-coating_2c23db49/53392feb-en.pdf
OEHHA. (1997). Public health goal for di(2-ethylhexyl)phthalate (DEHP) in drinking water. California: California Environmental Protection Agency, Office of Environmental Health Hazard Assessment, Pesticide and Environmental Toxicology Section. https://oehha.ca.gov/media/downloads/water/public-health-goal/dehpc.pdf
OSHA. (2019). Chemical exposure health data (CEHD) sampling results: CASRNs 75-34-3, 85-68-7, 84-74-2, 78-87-5, 117-81-7, 106-93-4, 50-00-0, 95-50-1, 85-44-9, 106-46-7, 79-00-5, and 115-86-6. Washington, DC: U.S. Department of Labor. https://www.osha.gov/opengov/healthsamples.html
OSHA. (2020). Chemical Exposure Health Data (CEHD). Washington, DC. https://www.osha.gov/opengov/healthsamples.html

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
Penn State Industries. (2016). PSI PolyClay Canes and PSI PolyClay Bricks. Penn State Industries. https://www.pennstateind.com/MSDS/POLYCLAY_MSDS.pdf
Phenova. (2017a). Safety Data Sheet (SDS): BN Extractables – Skinner List. Golden, CO. https://phenomenex.blob.core.windows.net/documents/f70366d3-2575-4ab0-92ac-3ff2b4391e9a.pdf
Phenova. (2017b). Safety Data Sheet (SDS): Custom 8061 Phthalates Mix. Golden, CO.
Phenova. (2017c). Safety Data Sheet (SDS): Custom 8270 Cal Standard. Golden, CO. https://phenomenex.blob.core.windows.net/documents/d3c37d14-aa1d-4bd5-9d09-b2b96958f49b.pdf
Phenova. (2017d). Safety Data Sheet (SDS): Custom 8270 Plus Cal Mix. Golden, CO. https://phenomenex.blob.core.windows.net/documents/16642d99-3ea5-4ae9-9c06-ec1ecccd79a4.pdf
Phenova. (2017e). SDS - Custom Low ICAL Mix. Phenova.
Phenova. (2018a). Custom 8270 Cal Mix 1. Phenova. https://phenomenex.blob.core.windows.net/documents/31013f05-5fd0-489e-b2b0-f687f596910c.pdf
Phenova. (2018b). Safety Data Sheet (SDS): Custom SS 8270 Cal Mix 1. Golden, CO. https://phenomenex.blob.core.windows.net/documents/da632ae2-232a-4128-a470-0fc53f6c5b16.pdf
Phenova. (2018c). Safety Data Sheet (SDS): EPA 525.2 Semivolatile Mix. Golden, CO. https://phenomenex.blob.core.windows.net/documents/6f2729bc-b8d5-4750-92d1-a894bede6c79.pdf
Quest Automotive Products. (2015). Red Glazing Putty 1# Tube. Quest Automotive Products. https://www.freemansupply.com/MSDS/Combined/Repair/GlazingPutty.pdf
Raabe Corporation. (1995). Material Safety Data Sheet (MSDS): BAD 6012 Rust Resistant Gray Primer. Menomonee Falls, WI. http://archpdfs.lps.org/Chemicals/GrayPrimer-Playworld.PDF
Ramuc Specialty Pools. (2010). Ramuc Type A - 311 White. Ramuc Specialty Pools. https://www.ramucpoolpaint.com/media/1035/typeawhitesdsus.pdf
Reddy, JK; Rao, MS. (1986). Peroxisome proliferators and cancer: mechanisms and implications. Trends Pharmacol Sci 7: 438-443. http://dx.doi.org/10.1016/0165-6147(86)90416-5
Renew. (2008). Renew UR 40 Part A. Renew. http://www.renewmaterials.com/MSDS/RenewUR40.pdf
Republic Powdered Metals. (2002). Material Safety Data Sheet (MSDS): Ramuc Type A - White & Colors. Beachwood, OH. http://www.lincolnaquatics.com/Documents/231.PDF
Restek. (2019a). 33227/EPA Method 8061A Phthalate Esters Mixture. https://www.restek.com/documentation/msds/33227_useng.pdf
Restek. (2019b). Safety Data Sheet (SDS): 31850/8270 MegaMix®. Bellefonte, PA. https://www.restek.com/documentation/msds/31850_useng.pdf
Restek. (2023a). Safety Data Sheet (SDS): 31031/606 Phthalate esters calibration mix. https://m.restek.com/documentation/msds/31031_ukeng.pdf
Restek. (2023b). Safety Data Sheet (SDS): 31845/EPA Method 506 Phthalate and Adipate Esters. Bellefonte, PA. https://www.restek.com/documentation/msds/31845_useng.pdf
Restek. (2023c). Safety Data Sheet (SDS): 31903/CLP 04.1 B/N MegaMix Mix A (Revision 2). Bellefonte, PA. https://www.restek.com/documentation/msds/31903_useng.pdf
Restek. (2024a). Safety Data Sheet (SDS): 31420/Bis(2-ethylhexyl) Phthalate Standard. Bellefonte, PA. https://m.restek.com/documentation/msds/31420_useng.pdf

Restek. (2024b). Safety Data Sheet (SDS): 31621/8270 Calibration Mix #4. Bellefonte, PA. https://www.restek.com/documentation/msds/31621_useng.pdf
Rockwool. (2017). Material Safety Data Sheet (MSDS): ROCKWOOL® Intumescent Pipe Wraps. Pencoed, Wales, UK. https://www.rockwool.com/siteassets/rw-uk/downloads/msds/intumescent-pipe-wraps-msds.pdf
Rogers Corporation. (2020). Safety Data Sheet (SDS): ENDUR ® NBR Rollers. Rogers, CT. https://www.rogerscorp.com/documents/1497/msds/ec/ENDUR-NBR-Rollers.pdf
Royal Adhesives and Sealants Canada Ltd. (2019). Safety Data Sheet (SDS): BD Loops Loop Goop2 Iso. Toronto, ON, Canada: Royal Adhesives and Sealants Canada Ltd. http://www.bdloops.com/BD_Loop_Goop_USA_MSDS.PDF
Salisbury, S. (1984). Health hazard evalution report, No. HETA-79-034-1440, Intex Plastics, Corinth, Mississippi. Salisbury, S. https://www.cdc.gov/niosh/hhe/reports/pdfs/79-34-1440.pdf
Scott, RC; Dugard, PH; Ramsey, JD; Rhodes, C. (1987). In vitro absorption of some o-phthalate diesters through human and rat skin. Environ Health Perspect 74: 223-227. http://dx.doi.org/10.2307/3430452
Sherwin Williams. (2019). Safety Data Sheet (SDS): PLANET COLOR™ FX Rubber Black. Warrensville Heights, OH: Sherwin-Williams Company. https://www.paintdocs.com/docs/webPDF.jsp?SITEID=AUTOESTORE&doctype=SDS&lang=2&prodno=PCFX10
Sigma Aldrich. (2024). Safety Data Sheet (SDS): Dioctyl phthalate. St. Louis, MO. https://www.nwmissouri.edu/naturalsciences/sds/d/Dioctyl%20phthalate.pdf
Sika. (2018). Safety Data Sheet (SDS): SCOFIELD® CureSeal 350. Lyndhurst, NJ. https://www.buildsite.com/pdf/sikascofield/SCOFIELD-CureSeal-350-SDS-1597063.pdf
Smooth-On Inc. (2007a). Material Safety Data Sheet (MSDS): PMC-744 Part A. Easton, PA. http://www.sculpt.com/2017/Tech/MsdsTechSheets/MSDS_PMC-744.pdf
Smooth-On Inc. (2007b). Material Safety Data Sheet (MSDS): ReoflexTM Series Part A. Easton, PA. http://www.sculpt.com/2017/Tech/MsdsTechSheets/MSDS_Reoflex_Series.pdf
Smooth-On Inc. (2008). Material Safety Data Sheet (MSDS): VytaFlexTM Series Part A. Easton, PA. http://www.sculpt.com/2017/Tech/MsdsTechSheets/MSDS_Vytaflex_Series.pdf
Spectrum Chemical Mfg. Corp. (2015). Safety Data Sheet (SDS): Dioctyl phthalate. Gardena, CA. https://www.spectrumchemical.com/MSDS/D1049-AGHS.pdf
SPEX CertiPrep LLC. (2016). Safety Data Sheet (SDS): Haloethers & Phthalates. Metuchen, NJ. https://www.spexcertiprep.com/MSDS/CLPS-C.pdf
SPEX CertiPrep LLC. (2017a). Phthalates in polyethylene standard: Safety data sheet [Fact Sheet]. Metuchen, NJ. https://www.spexcertiprep.com/MSDS/CRM-PE001.pdf
Spex CertiPrep LLC. (2017b). Safety data sheet: Phthalate standard. Metuchen, NJ. https://www.spexcertiprep.com/MSDS/C1001-09.pdf
Spex CertiPrep LLC. (2017c). Safety data sheet: Phthalates in Poly(vinyl chloride). Metuchen, NJ. https://www.spexcertiprep.com/MSDS/CRM-PVC001.pdf
Spex CertiPrep LLC. (2017d). Safety data sheet: Phthalates in polyethylene standard w/BPA. Metuchen, NJ. https://www.spexcertiprep.com/MSDS/CRM-PE002.pdf
SPEX CertiPrep LLC. (2019). Base/Neutrals Mix 1. SPEX CertiPrep LLC. https://www.spexcertiprep.com/MSDS/ECS-A-030.pdf
SPEX CertiPrep LLC. (2023). Safety Data Sheet (SDS): bis(2-Ethylhexyl)phthalate. Metuchen, NJ: SPEX CertiPrep LLC. https://www.spexcertiprep.com/MSDS/CRM-PE-DEHP.pdf
SPIN. (2019). Di(2-ethylhexyl) phthalate. http://www.spin2000.net/spinmyphp/
StatSpin. (2004). Material Safety Data Sheet (SDS): Hematocrit tube sealant pad. Norwood, MA. https://www.pattersonvet.com/Sds?publicItemNumber=078540138&effectiveDate=2004-07-01T00:00:00

Tekstur. High Density Cork. Tekstur. https://www.ecosupplycenter.com/assets/docs/Tekstur_MSDS.pdf
TMI International LLC. (2014). Safety Data Sheet (SDS): 10 Compound Flexible PVC. Pittsburgh, PA. http://www.tmi-pvc.com/documents/SDSPVCRolls01.pdf
Tomer, A; Kane, J. (2015). The great port mismatch. U.S. goods trade and international transportation. The Global Cities Initiative. A joint project of Brookings and JPMorgan Chase. https://www.brookings.edu/wp-content/uploads/2015/06/brgkssrvygcifreightnetworks.pdf
Tremco. (2015). Safety Data Sheet (SDS): Vulkem 45 SSL White. Toronto, ON, Canada. http://www.tremcosealants.com/fileshare/msds/445806_333_C.pdf
Tremco Canadian Sealants. (2015a). Safety Data Sheet (SDS): Universal C/P Beach. Toronto, ON, Canada. http://www.tremcosealants.com/fileshare/msds/015144_529_C.pdf
Tremco Canadian Sealants. (2015b). Safety Data Sheet (SDS): Universal C/P Cotton. Toronto, ON, Canada. http://www.tremcosealants.com/fileshare/msds/015227_529_C.pdf
Tremco Incorporated. (2018). Safety Data Sheet (SDS):TREMproof 250 GC R LV. Beachwood, OH. http://bennettgroup.ca/MSDS/data/Paint%20and%20Paint%20Products/TREMPROOF%20250%20GC-R-LV%205.pdf
Tremco U.S. Roofing. (2018). Rock-It® Adhesive. Tremco U.S. Roofing. https://www.tremcoroofing.com/fileshare/msds/364600A855_U.pdf
Tremco U.S. Sealants. (2015a). Safety Data Sheet (SDS): Universal C/P Eggshell Cream. Toronto, ON, Canada. https://www.tremcosealants.com/fileshare/msds/015146_529_C.pdf
Tremco U.S. Sealants. (2015b). Safety Data Sheet (SDS): Universal C/P LT. Cream. Beachwood, OH. https://www.tremcosealants.com/fileshare/msds/015148_529_U.pdf
Tremco U.S. Sealants. (2015c). Safety Data Sheet (SDS): Universal C/P Mint. Beachwood, OH. https://www.tremcosealants.com/fileshare/msds/015230_529_U.pdf
Tremco U.S. Sealants. (2015d). Safety Data Sheet (SDS): Universal C/P Parchment. Beachwood, OH. https://www.tremcosealants.com/fileshare/msds/015268_529_U.pdf
Tremco U.S. Sealants. (2015e). Safety Data Sheet (SDS): Universal C/P Super White. Beachwood, OH. https://www.tremcosealants.com/fileshare/msds/015271_529_U.pdf
Tremco U.S. Sealants. (2016). Safety data sheet: Universal C/P Sunset Yellow (pp. 1-15). (Material: 015270 529). Beachwood, OH. https://www.tremcosealants.com/fileshare/msds/015270_529_U.pdf
TSE Industries Inc. (2015). Millathane CM Premilled. TSE Industries Inc. https://www.tse-industries.com/sites/default/files/data-msds-brochures/Millathane%20CM%20Premilled.pdf
Turnbull, D; Rodricks, JV. (1985). Assessment of possible carcinogenic risk to humans resulting from exposure to di-2-ethylhexylphthalate. J Am Coll Toxicol 4: 111-146. http://dx.doi.org/10.3109/10915818509014509
U. S. House of Representatives. (2011). Chemicals used in hydraulic fracturing. U.S. House of Representatives. http://ecolo.org/documents/documents_in_english/gas-_Hydraulic-Fract-chemicals-2011-report.pdf
U.S. BLS. (2014). Employee Tenure News Release. 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 [Website]. http://www.bls.gov/oes/tables.htm
U.S. BLS. (2023). U.S. Census Bureau of Labor Statistics Data from 2021. https://www.bls.gov/oes/tables.htm
U.S. Census Bureau. (2012). Statistics of U.S. businesses: Historical data available for downloading - 2012 [Website]. Suitland, MD. https://www.census.gov/data/datasets/2012/econ/susb/2012-susb.html
U.S. Census Bureau. (2015). Statistics of U.S. Businesses (SUSB). https://www.census.gov/data/tables/2015/econ/susb/2015-susb-annual.html

U.S. CPSC. (2015). Exposure assessment: Composition, production, and use of phthalates. Cincinnati, OH: Prepared by: Toxicology Excellence for Risk Assessment Center at the University of Cincinnati. https://web.archive.org/web/20190320060357/https://www.cpsc.gov/s3fs-public/pdfs/TERAReportPhthalates.pdf

U.S. EPA. (1991a). Chemical engineering branch manual for the preparation of engineering assessments. (68-D8-0112). Cincinnati, OH: US Environmental Protection Agency, Office of Toxic Substances. https://nepis.epa.gov/Exe/ZyNET.exe/P10000VS.txt?ZyActionD=ZyDocument&Client=EPA&Index=1991%20Thru%201994&Docs=&Query=&Time=&EndTime=&SearchMethod=1&TocRestrict=n&Toc=&TocEntry=&QField=&QFieldYear=&QFieldMonth=&QFieldDay=&UseQField=&IntQFieldOp=0&ExtQFieldOp=0&XmlQuery=&File=D%3A%5CZYFILES%5CINDEX%20DATA%5C91THRU94%5CTXT%5C00000019%5CP10000VS.txt&User=ANONYMOUS&Password=anonymous&SortMethod=h%7C-&MaximumDocuments=1&FuzzyDegree=0&ImageQuality=r75g8/r75g8/x150y150g16/i425&Display=hpfr&DefSeekPage=x&SearchBack=ZyActionL&Back=ZyActionS&BackDesc=Results%20page&MaximumPages=233&ZyEntry=1

U.S. EPA. (1991b). Chemical engineering branch manual for the preparation of engineering assessments. Volume I. Ceb Engineering Manual. Washington, DC: Office of Pollution Prevention and Toxics, US Environmental Protection Agency. https://nepis.epa.gov/Exe/ZyPURL.cgi?Dockey=P10000VS.txt

U.S. EPA. (1992a). Guidelines for exposure assessment. Federal Register 57(104):22888-22938 [EPA Report]. (EPA/600/Z-92/001). Washington, DC. http://cfpub.epa.gov/ncea/cfm/recordisplay.cfm?deid=15263

U.S. EPA. (1992b). A laboratory method to determine the retention of liquids on the surface of hands [EPA Report]. (EPA/747/R-92/003). Washington, DC.

U.S. EPA. (1994). Guidelines for Statistical Analysis of Occupational Exposure Data: Final. United States Environmental Protection Agency :: U.S. EPA.

U.S. EPA. (1999). Background document for identification and listing of the deferred dye and pigment wastes. https://archive.epa.gov/epawaste/hazard/web/pdf/listing.pdf

U.S. EPA. (2004). Spray coatings in the furniture industry - 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. (2010). Manufacture and use of printing inks - generic scenario for estimating occupational exposures and environmental releases: Draft. Washington, DC. https://www.epa.gov/tsca-screening-tools/chemsteer-chemical-screening-tool-exposures-and-environmental-releases#genericscenarios

U.S. EPA. (2011). Exposure factors handbook: 2011 edition [EPA Report]. (EPA/600/R-090/052F). 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. (2014a). Discharge monitoring report (DMR) pollutant loading tool. Washington, DC. https://cfpub.epa.gov/dmr/index.cfm

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. (2014c). Generic scenario draft on the use of additives in plastic compounding. Washington, DC.

U.S. EPA. (2014d). Generic scenario on coating application via spray painting in the automotive refinishing industry.

U.S. EPA. (2014e). Generic scenario on use of textile dyes.
U.S. EPA. (2014f). Use of additive in plastic compounding - 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. (2014g). Use of additives in the thermoplastic converting industry - generic scenario for estimating occupational exposures and environmental releases. Washington, DC. https://www.epa.gov/tsca-screening-tools/using-predictive-methods-assess-exposure-and-fate-under-tsca
U.S. EPA. (2015). 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. (2016). Chemical Data Reporting (CDR): Complete 2016 submissions. Washington, DC.
U.S. EPA. (2017). Learn the Basics of Hazardous Waste. https://www.epa.gov/hw/learn-basics-hazardous-waste
U.S. EPA. (2018). Hazardous Waste Management Facilities and Units. https://www.epa.gov/hwpermitting/hazardous-waste-management-facilities-and-units
U.S. EPA. (2019a). Chemical data reporting (2012 and 2016 CBI CDR database). Washington, DC: U.S. Environmental Protection Agency, Office of Pollution Prevention and Toxics. https://www.epa.gov/chemical-data-reporting
U.S. EPA. (2019b). Chemical data reporting (2012 and 2016 public CDR database). Washington, DC: U.S. Environmental Protection Agency, Office of Pollution Prevention and Toxics. https://www.epa.gov/chemical-data-reporting
U.S. EPA. (2020a). 2020 CDR data [Database]. Washington, DC: U.S. Environmental Protection Agency, Office of Pollution Prevention and Toxics. https://www.epa.gov/chemical-data-reporting/access-cdr-data
U.S. EPA. (2020b). 2020 CDR: Commercial and consumer use. Washington, DC.
U.S. EPA. (2020c). Final risk evaluation for n-Methylpyrrolidone (NMP), supplemental information on occupational exposure assessment. (Docket EPA-HQ-OPPT-2019-0236). Washington, DC. https://beta.regulations.gov/docket/EPA-HQ-OPPT-2019-0236
U.S. EPA. (2020d). Final Scope of the Risk Evaluation for Di-ethylhexyl Phthalate (1,2-Benzenedicarboxylic acid, 1,2-bis(2-ethylhexyl) ester). (EPA-740-R-20-017). Washington, DC: U.S. Environmental Protection Agency, Office of Chemical Safety and Pollution Prevention. https://www.epa.gov/sites/default/files/2020-09/documents/casrn_117-81-7_di-ethylhexyl_phthalate_final_scope.pdf
U.S. EPA. (2020e). Final scope of the risk evaluation for di-ethylhexyl phthalate (1,2-benzenedicarboxylic acid, 1,2-bis(2-ethylhexyl) ester); CASRN 117-81-7 [EPA Report]. (EPA-740-R-20-017). Washington, DC: Office of Chemical Safety and Pollution Prevention. https://www.epa.gov/sites/default/files/2020-09/documents/casrn_117-81-7_di-ethylhexyl_phthalate_final_scope.pdf
U.S. EPA. (2021a). 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
U.S. EPA. (2021b). Generic model for central tendency and high-end inhalation exposure to total and respirable Particulates Not Otherwise Regulated (PNOR). Washington, DC: Office of Pollution Prevention and Toxics, Chemical Engineering Branch.

U.S. EPA. (2021c). National analysis TRI dataset (TRI): Data used for TSCA risk evaluations, reporting year 2019 [Database]. https://www.epa.gov/toxics-release-inventory-tri-program/tri-listed-chemicals
U.S. EPA. (2021d). Use of additives in plastic compounding – Generic scenario for estimating occupational exposures and environmental releases (Revised draft) [EPA Report]. Washington, DC: Office of Pollution Prevention and Toxics, Risk Assessment Division.
U.S. EPA. (2021e). Use of additives in plastics converting – Generic scenario for estimating occupational exposures and environmental releases (revised draft). Washington, DC: Office of Pollution Prevention and Toxics.
U.S. EPA. (2022a). Chemical repackaging - Generic scenario for estimating occupational exposures and environmental releases (revised draft) [EPA Report]. Washington, DC.
U.S. EPA. (2022b). Commercial use of automotive detailing products - Generic scenario for estimating occupational exposures and environmental releases (Methodology review draft) [EPA Report]. Washington, DC: U.S. Environmental Protection Agency, Office of Pollution Prevention and Toxics, Risk Assessment Division.
U.S. EPA. (2022c). Discharge Monitoring Report (DMR) data: Di (2-ethylhexyl)phthalate (CASRN 117-81-7), 2017-2022 [Database]. Washington, DC. https://echo.epa.gov/trends/loading-tool/water-pollution-search
U.S. EPA. (2022d). Emission scenario document on chemicals used in hydraulic fracturing (draft). In OECD Environmental Health and Safety Publications, Series on Emission Scenario Documents. Paris, France: Organization for Economic Co-operation and Development.
U.S. EPA. (2022e). National emissions inventory (NEI) [Website]. https://www.epa.gov/air-emissions-inventories/national-emissions-inventory
U.S. EPA. (2022f). Toxics Release Inventory (TRI) data: Di (2-ethylhexyl)phthalate (CASRN 117-81-7), 2017-2022 [Database]. Washington, DC. https://www.epa.gov/toxics-release-inventory-tri-program/tri-data-and-tools
U.S. EPA. (2023a). 2020 National Emissions Inventory (NEI) Data (August 2023 version) (August 2023 ed.). Washington, DC: US Environmental Protection Agency. https://www.epa.gov/air-emissions-inventories/2020-national-emissions-inventory-nei-data
U.S. EPA. (2023b). 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.
U.S. EPA. (2025a). Environmental Media and General Population and Environmental Exposure for Diethylhexyl Phthalate (DEHP). Washington, DC: Office of Pollution Prevention and Toxics.
U.S. EPA. (2025b). Environmental Release and Occupational Exposure Assessment for Dibutyl Phthalate (DBP). Washington, DC: Office of Pollution Prevention and Toxics.
U.S. EPA. (2025c). Environmental Release and Occupational Exposure Assessment for Dicyclohexyl Phthalate (DCHP). Washington, DC: Office of Pollution Prevention and Toxics.
U.S. EPA. (2025d). Non-cancer Human Health Hazard Assessment for Diethylhexyl Phthalate (DEHP). Washington, DC: Office of Pollution Prevention and Toxics.
U.S. EPA. (2025e). Occupational Risk Calculator for Diethylhexyl Phthalate (DEHP). Washington, DC: Office of Pollution Prevention and Toxics.
U.S. EPA. (2025f). Risk Evaluation for Diethylhexyl Phthalate (DEHP). Washington, DC: Office of Pollution Prevention and Toxics.
Ultraflex Systems. (2018). Material Safety Data Sheet (MSDS): BriteLine Banner. Riverview, FL. https://www.gobriteline.com/cmss_files/attachmentlibrary/BriteLine-Product-Sheet-PDFs/BriteLine-Banner-MSDS.pdf

UltraScientific. (2014). Base/Neutrals mixture #1. https://ca.vwr.com/assetsvc/asset/en_CA/id/20768999/contents
Valero Marketing and Supply Company. (2014). Safety Data Sheet (SDS): Modified Asphalt. San Antonio, TX: Valero Marketing & Supply Company and Affiliates. https://www.valero.com/en-us/Documents/OSHA_GHS_SDS/SDS%20US%20-%20212-GHS%20Modified%20Asphalt%20Rev1.pdf
Valspar. (2017). Safety Data Sheet (SDS): Red glazing putty 1# tube. Minneapolis, MN. http://images.myautoproducts.com/images/Product_Media/SDS/USC/USC-32035_SDS.pdf
Valspar. (2019). Pronto Putty. The Valspar Corporation. https://www.uschem.com/en/compliance/?item=32046
Valspar. (2024). Safety Data Sheet (SDS): Pronto Kombi Spot Putty. Massillon, OH. https://www.uschem.com/wservices/msds/asset/USCHEM/EN/US/MzIwNDY=/1594831321923.pdf
Vinyl Institute. (2025). Comment from Vinyl Institute regarding the Draft Risk Evaluation for Diethylhexyl Phthalate; EPA-HQ-OPPT2018-0433-0117. Washington, DC.
Wasser Corporation. (2009). Material Safety Data Sheet (MSDS): MC-Luster 100 White. Auburn, WA. http://wassercoatings.com/docs/ProductSpecs/MSDS/W211.7%20(MC-Luster%20100)%20MSDS%20May%2009.pdf
Wasser Corporation. (2021a). Material Safety Data Sheet (MSDS): Polyflex 411A Iso-Catalyst. Auburn, WA. http://www.wassercoatings.com/docs/ProductSpecs/MSDS/Polyflex%20411%20A+B.pdf
Wasser Corporation. (2021b). Safety Data Sheet (SDS): MC-Shieldcoat 100. Auburn, WA. http://www.wassercoatings.com/docs/ProductSpecs/Data/MC-Shieldcoat100_w511.7_004.pdf
WE Cork Inc. (2018). Material Safety Data Sheet (MSDS): WECU Soundless/WECU Soundless+. Exeter, NH. https://www.wecork.com/wp-content/forms/Soundless_Soundless+MSDS.pdf
Wellington Fragrance. (2014). Chocolate. Wellington Fragrance. https://shop.perfumersapprentice.com/Images/Chocolate-UNGHSsds-OSHA.pdf
Xu, Y; Cohen Hubal, EA; Little, JC. (2010). Predicting residential exposure to phthalate plasticizer emitted from vinyl flooring: Sensitivity, uncertainty, and implications for biomonitoring. Environ Health Perspect 118: 253-258. http://dx.doi.org/10.1289/ehp.0900559

APPENDICES

Appendix A EQUATIONS FOR CALCULATING ACUTE, INTERMEDIATE, AND CHRONIC (NON-CANCER) INHALATION AND DERMAL EXPOSURES

This report assesses DEHP inhalation exposures to workers in occupational settings, presented as 8-hour time weighted average (TWA). The full shift TWA exposures are then used to calculate acute doses (AD), intermediate average daily doses (IADD), and average daily doses (ADD) for chronic non-cancer risks. This report also assesses DEHP dermal exposures to workers in occupational settings, presented as a dermal acute potential dose rate (APDR). The APDRs are then used to calculate the AD, IADD, and ADD. This appendix presents the equations and input parameter values used to estimate each exposure metric.

A.1 Equations for Calculating Acute, Intermediate, Chronic (Non-Cancer), and Chronic (Cancer) Inhalation Exposure

EPA used AD to estimate acute risks (*i.e.*, risks occurring as a result of exposure for less than one day) from workplace inhalation exposures as follows:

Equation A-1.

$$\boldsymbol{AD = \frac{C \times BR \times ED}{BW}}$$

Where:

AD = Acute dose (mg/kg/day)
C = Contaminant concentration in air (TWA mg/m^3)
ED = Exposure duration (h/day)
BR = Breathing rate (m^3/h)
BW = Body weight (kg)

EPA used IADD to estimate intermediate risks from workplace exposures as follows:

Equation A-2.

$$IADD = \frac{C \times BR \times ED \times EF_{int}}{BW \times ID}$$

Where:

IADD = Intermediate average daily dose (mg/kg/day)
EF_{int} = Intermediate exposure frequency (day/yr)
ID = Days for intermediate duration (day/yr)

EPA used ADD and LADD to estimate chronic non-cancer risks and cancer risks from workplace exposures as follows:

Equation A-3.

$$ADD\ or\ LADD = \frac{C \times BR \times ED \times EF \times WY}{BW \times 365\frac{days}{yr} \times (WY\ or\ LT)}$$

Where:

ADD = Average daily dose for chronic non-cancer risk calculations (mg/kg-day)

EF = Exposure frequency (day/yr)
WY = Working years per lifetime (yr) – used in the denominator for ADD (can be canceled out if ADD is being calculated)
LT = Lifetime years (yr) – used in the denominator for LADD

A.2 Equations for Calculating Acute, Intermediate, and Chronic (Non-Cancer) Dermal Exposures

EPA used AD to estimate acute risks from workplace dermal exposures using Equation A-4.

Equation A-4.

$$AD = \frac{APDR}{BW}$$

Where:

AD = Acute retained dose (mg/kg-day)
APDR = Acute potential dose rate (mg/day)
BW = Body weight (kg)

EPA used IADD to estimate intermediate risks from workplace dermal exposures using Equation A-5.

Equation A-5.

$$IADD = \frac{APDR \times EF_{int}}{BW \times ID}$$

Where:

IADD = Intermediate average daily dose (mg/kg/day)
EF_{int} = Intermediate exposure frequency (day/yr)
ID = Days for intermediate duration (day/yr)

EPA used ADD and LADD to estimate chronic non-cancer risks and cancer risks from workplace dermal exposures using Equation A-6.

Equation A-6.

$$ADD\ or\ LADD = \frac{APDR \times EF \times WY}{BW \times 365 \frac{days}{yr} \times (WY\ or\ LT)}$$

Where:

ADD = Average daily dose for chronic non-cancer risk calculations (mg/kg-day)
EF = Exposure frequency (day/yr)
WY = Working years per lifetime (yr) – used in the denominator for ADD (can be canceled out if ADD is being calculated)
LT = Lifetime years (yr) – used in the denominator for LADD

A.3 Calculating Aggregate Exposure

EPA combined the expected dermal and inhalation exposures for each occupational exposure scenario (OES) and worker type into a single aggregate exposure to reflect the potential total dose from both exposure routes.

Equation A-7.

$$AD_{aggregate} = AD_{dermal} + AD_{inhalation}$$

Where:

AD_{Dermal} = Dermal exposure acute retained dose (mg/kg-day)
$AD_{Inhalation}$ = Inhalation exposure acute retained dose (mg/kg-day)
$AD_{Aggregate}$ = Aggregated acute retained does (mg/kg-day).

IADD and ADD also follow the same approach for defining aggregate exposures.

A.4 Acute, Intermediate, and Chronic (Non-Cancer) Equation Inputs

EPA used the input parameter values in Table_Apx A-1 to calculate acute, intermediate, and chronic inhalation exposure risks. Where EPA calculated exposures using probabilistic modeling, EPA integrated the calculations into a Monte Carlo simulation. The EF and EF_{int} used for each OES can differ, and the appropriate sections of this report describe these values and their selection. This Section describes the values that EPA used in the equations in Appendix A.1 and A.2 and summarized in Table_Apx A-1.

Table_Apx A-1. Parameter Values for Calculating Inhalation Exposure Estimates

Parameter Name	Symbol	Value	Unit
Exposure Duration	ED	8	h/day
Breathing Rate	BR	1.25	m^3/h
Exposure Frequency	EF	1–250 [a]	days/yr
Exposure Frequency, Intermediate	EF_{int}	22	days
Days for Duration, Intermediate	ID	30	days
Working years	WY	31 (50th percentile) 40 (95th percentile)	years
Lifetime Years	LT	78	years
Body Weight	BW	80 (average adult worker) 72.4 (female of reproductive age)	kg

[a] Depending on OES

A.4.1 Exposure Duration (ED)

EPA generally used an exposure duration of eight hours per day for averaging full shift exposures.

A.4.2 Breathing Rate

EPA used a breathing rate, based on average worker breathing rates. The breathing rate accounts for the amount of air a worker breathes during the exposure period. The typical worker breathes about 10 m^3 of air in 8 hours or 1.25 m^3/hour (U.S. EPA, 1991b).

A.4.3 Exposure Frequency (EF)

EPA generally used a maximum exposure frequency of 250 days per year. However, for some OES where a range of exposure frequency was possible, EPA used probabilistic modeling to estimate exposures and the associated exposure frequencies, resulting in exposure frequencies below 250 days per year. The relevant sections of this report describe EPA's estimation of exposure frequency and the associated distributions for each OES.

EF is expressed as the number of days per year a worker is exposed to the chemical being assessed. In some cases, it may be reasonable to assume a worker is exposed to the chemical on each working day. In other cases, it may be more appropriate to assume a worker's exposure to the chemical occurs during a subset of the worker's annual working days (AWD). The relationship between exposure frequency and AWD can be described mathematically as follows:

Equation A-8.

$$EF = AWD \times f$$

Where:

EF	= exposure frequency, the number of days per year a worker is exposed to the chemical (day/yr)
AWD	= annual working days, the number of days per year a worker works (day/yr)
f	= fractional number of annual working days during which a worker is exposed to the chemical (unitless)

The Bureau of Labor Statistics (BLS) provides data on the total number of work hours and total number of employees by each industry North American Industry Classification System (NAICS) code. BLS provides these data from the 3- to 6-digit NAICS level (where 3-digit NAICS are less granular and 6-digit NAICS are the most granular). Dividing the total, annual hours worked by the number of employees yields the average number of hours worked per employee per year for each NAICS.

EPA identified approximately 140 NAICS codes applicable to the multiple conditions of use for the first ten chemicals that underwent risk evaluation. For each NAICS code of interest, EPA looked up the average hours worked per employee per year at the most granular NAICS level available (*i.e.*, 4-digit, 5-digit, or 6-digit). EPA converted the working hours per employee to working days per year per employee assuming employees work an average of eight hours per day. The average number of working days per year, or AWD, ranges from 169 to 282 days per year, with a 50th percentile value of 250 days per year. EPA repeated this analysis for all NAICS codes at the 4-digit level. The average AWD for all 4-digit NAICS codes ranges from 111 to 282 days per year, with a 50th percentile value of 228 days per year. 250 days per year is approximately the 75th percentile of the distribution AWD for the 4-digit NAICS codes. In the absence of industry- and DEHP-specific data, EPA assumed the parameter, f, is equal to one for all OES.

A.4.4 Intermediate Exposure Frequency (EF_{int})

For DEHP, the ID was set at 30 days per year. EPA estimated the maximum number of working days within the ID, using the following equation and assuming 5 working days/week:

Equation A-9.

$$\boldsymbol{EF_{SC}(max) = 5\,\frac{working\ days}{wk} \times \frac{30\ total\ days}{7\,\frac{total\ days}{wk}} = 21.4\ days, rounded\ up\ to\ 22\ days}$$

A.4.5 Intermediate Duration (ID)

EPA assessed an intermediate duration of 30 days based on the available health data.

A.4.6 Working Years (WY)

EPA developed a triangular distribution for number of lifetime working years using the following parameters:

- **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 of the tenure data with all employers from Survey of Income and Program Participation (SIPP) as a mode value for the number of lifetime working years: 36 years; and
- **Maximum value:** The maximum of the 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 to represent the central tendency and high-end number of working years in the ADC and LADC calculations, respectively.

The 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. BLS releases CPS data every two years. The data are available by demographic characteristics and by generic industry sectors, but not by NAICS codes.

The U.S. Census Bureau (2016) 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. BLS, 2016). 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. BLS, 2016). 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 (T_{AGE}); and years of work experience *with all employers* over the surveyed individual's lifetime[1] Census household surveys use different industry codes than the NAICS codes, so EPA converted these industry codes to NAICS using a published crosswalk (U.S. Census Bureau, 2012). EPA calculated the average tenure for the following age groups: 1) workers aged 50 and older; 2) workers aged 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 aged 50 and older from SIPP data. Although the tenure may differ for any given industry sector, there is no significant variability between the 50th

[1] 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).

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
Manufacturing sectors (NAICS 31–33)	35.7	36	39	40
Non-manufacturing sectors (NAICS 42–81)	36.1	36	39	44
Source: (U.S. BLS, 2016) Note: Industries where sample size is less than five are excluded from this analysis.				

BLS CPS data provide 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 for number of working years, EPA used 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	4.1	4.4	4.6	4.6
16–17 years	0.7	0.7	0.7	0.7
18–19 years	0.8	1.0	0.8	0.8
20–24 years	1.3	1.5	1.3	1.3
25+ years	5.1	5.2	5.4	5.5
25–34 years	2.7	3.1	3.2	3.0
35–44 years	4.9	5.1	5.3	5.2
45–54 years	7.6	7.8	7.8	7.9
55–64 years	9.9	10.0	10.3	10.4
65+ years	10.2	9.9	10.3	10.3
Source: (U.S. BLS, 2014)				

A.4.7 Lifetime Years (LT)

EPA assumed a lifetime of 78 years for all worker demographics.

A.4.8 Body Weight (BW)

EPA assumes a BW of 80 kg for average adult workers. EPA assumed a BW of 72.4 kg for females of reproductive age, per Chapter 8 of the *Exposure Factors Handbook* (U.S. EPA, 2011).

Appendix B SAMPLE CALCULATIONS FOR CALCULATING ACUTE AND CHRONIC (NON-CANCER) INHALATION AND DERMAL EXPOSURES

Sample calculations for high-end (HE) and central tendency (CT) acute and chronic (non-cancer) doses for one condition of use (Processing – incorporation – plastic compounding), are demonstrated below for an average adult worker. The explanation of the equations and parameters used is provided in Appendix A.

B.1 Inhalation Exposures

B.1.1 Example High-End AD, IADD, and ADD Calculations

Calculating AD_{HE}:

$$AD_{HE} = \frac{C_{HE} \times BR \times ED}{BW}$$

$$AD_{HE} = \frac{2.8\,\frac{mg}{m^3} \times 1.25\,\frac{m^3}{h} \times 8\,\frac{h}{day}}{80\ kg} = 0.35\ \frac{\frac{mg}{kg}}{day}$$

Calculating $IADD_{HE}$:

$$IADD_{HE} = \frac{C_{HE} \times BR \times ED \times EF_{int}}{BW \times ID}$$

$$IADD_{HE} = \frac{2.8\,\frac{mg}{m^3} \times 1.25\,\frac{m^3}{h} \times 8\,\frac{h}{day} \times 22\,\frac{days}{year}}{80\ kg \times 30\,\frac{days}{year}} = 0.25\ \frac{\frac{mg}{kg}}{day}$$

Calculating ADD_{HE}:

$$ADD_{HE} = \frac{C_{HE} \times BR \times ED \times EF \times WY}{BW \times 365\ \frac{days}{year} \times WY}$$

$$ADD_{HE} = \frac{2.8\,\frac{mg}{m^3} \times 1.25\,\frac{m^3}{h} \times 8\,\frac{h}{day} \times 250\,\frac{days}{year} \times 40\ years}{80\ kg \times 365\,\frac{days}{year} \times 40\ years} = 0.24\,\frac{\frac{mg}{kg}}{day}$$

B.1.2 Example Central Tendency AD, IADD, and ADD Calculations

Calculating AD_{CT}:

$$AD_{CT} = \frac{C_{CT} \times BR \times ED}{BW}$$

$$AD_{CT} = \frac{0.30 \frac{mg}{m^3} \times 1.25 \frac{m^3}{h} \times 8 \frac{h}{day}}{80\ kg} = 3.8 \times 10^{-2} \frac{\frac{mg}{kg}}{day}$$

Calculating $IADD_{CT}$:

$$IADD_{CT} = \frac{C_{CT} \times BR \times ED \times EF_{int}}{BW \times ID}$$

$$IADD_{CT} = \frac{0.30 \frac{mg}{m^3} \times 1.25 \frac{m^3}{h} \times 8 \frac{h}{day} \times 22 \frac{days}{year}}{80\ kg \times 30 \frac{days}{year}} = 2.8 \times 10^{-2} \frac{\frac{mg}{kg}}{day}$$

Calculating ADD_{CT}:

$$ADD_{CT} = \frac{C_{CT} \times BR \times ED \times EF \times WY}{BW \times 365 \frac{days}{year} \times WY}$$

$$ADD_{CT} = \frac{0.30 \frac{mg}{m^3} \times 1.25 \frac{m^3}{h} \times 8 \frac{h}{day} \times 250 \frac{days}{year} \times 31\ years}{80\ kg \times 365 \frac{days}{year} \times 31\ years} = 2.6 \times 10^{-2} \frac{\frac{mg}{kg}}{day}$$

B.2 Dermal Exposures

B.2.1 Example High-End AD, IADD, and ADD Calculations

Calculating AD_{HE}:

$$AD_{HE} = \frac{APDR}{BW}$$

$$AD_{HE} = \frac{0.011 \frac{mg}{day}}{80\ kg} = 1.4 \times 10^{-4} \frac{mg}{kg\text{-}day}$$

Calculate $IADD_{HE}$:

$$IADD_{HE} = \frac{APDR \times EF_{int}}{BW \times ID}$$

$$IADD_{HE} = \frac{0.011 \frac{mg}{day} \times 22 \frac{day}{yr}}{80\ kg \times 30 \frac{day}{yr}} = 1 \times 10^{-4} \frac{mg}{kg\text{-}day}$$

Calculate ADD_{HE} (non-cancer):

$$ADD_{HE} = \frac{APDR \times EF \times WY}{BW \times 365\,\frac{day}{yr} \times WY}$$

$$ADD_{HE} = \frac{0.011\,\frac{mg}{day} \times 250\,\frac{day}{yr} \times 40\ years}{80\ kg \times 365\,\frac{day}{yr} \times 40\ years} = 9.5 \times 10^{-5}\,\frac{mg}{kg\text{-}day}$$

Calculate $LADD_{HE}$ (cancer):

$$LADD_{HE} = \frac{APDR \times EF \times WY}{BW \times 365\,\frac{day}{yr} \times LT}$$

$$LADD_{HE} = \frac{0.011\,\frac{mg}{day} \times 250\,\frac{day}{yr} \times 40\ years}{80\ kg \times 365\,\frac{day}{yr} \times 78\ years} = 4.9 \times 10^{-5}\,\frac{mg}{kg\text{-}day}$$

B.2.2 Example Central Tendency AD, IADD, and ADD Calculations

Calculating AD_{CT}:

$$AD_{CT} = \frac{APDR}{BW}$$

$$AD_{CT} = \frac{5.6 \times 10^{-3}\,\frac{mg}{day}}{80\ kg} = 7.0 \times 10^{-5}\,\frac{mg}{kg\text{-}day}$$

Calculating $IADD_{CT}$:

$$IADD_{CT} = \frac{APDR \times EF_{int}}{BW \times ID}$$

$$IADD_{CT} = \frac{5.6 \times 10^{-3}\,\frac{mg}{day} \times 22\,\frac{days}{yr}}{80\ kg \times 30\,\frac{days}{yr}} = 5.1 \times 10^{-5}\,\frac{mg}{kg\text{-}day}$$

Calculate ADD_{CT} (non-cancer):

$$ADD_{CT} = \frac{APDR \times EF \times WY}{BW \times 365\,\frac{day}{yr} \times WY}$$

$$ADD_{CT} = \frac{5.6 \times 10^{-3}\,\frac{mg}{day} \times 223\,\frac{days}{yr} \times 31\,yrs}{80\,kg \times 365\,\frac{day}{yr} \times 31\,yrs} = 4.8 \times 10^{-5}\,\frac{mg}{kg\text{-}day}$$

Calculate $LADD_{CT}$ (cancer):

$$LADD_{CT} = \frac{APDR \times EF \times WY}{BW \times 365\,\frac{day}{yr} \times LT}$$

$$LADD_{CT} = \frac{5.6 \times 10^{-3}\,\frac{mg}{day} \times 223\,\frac{days}{yr} \times 31\,yrs}{80\,kg \times 365\,\frac{day}{yr} \times 78\,yrs} = 1.9 \times 10^{-5}\,\frac{mg}{kg\text{-}day}$$

Appendix C DERMAL EXPOSURE ASSESSMENT METHOD

C.1 Dermal Dose Equation

As described in Section 2.4.3, occupational dermal exposures to DEHP are characterized using a flux-based approach to dermal exposure estimation. Therefore, EPA used Equation C-1 to estimate the APDR from occupational dermal exposures. The APDR (units of mg/day) characterizes the quantity of chemical that is potentially absorbed by a worker on a given workday.

Equation C-1.

$$APDR = \frac{J \times S \times t_{abs}}{PF}$$

Where:

J	=	Average absorptive flux through and into skin (mg/cm^2/h);
S	=	Surface area of skin in contact with the chemical formulation (cm^2);
t_{abs}	=	Duration of absorption (h/day)
PF	=	Glove protection factor (unitless, PF ≥ 1)

The inputs to the dermal dose equation are described in Appendix C.2.

C.2 Parameters of the Dermal Dose Equation

Table_Apx C-1 summarizes the dermal dose equation 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 following this table.

Table_Apx C-1. Summary of Dermal Dose Equation Values

Input Parameter	Symbol	Value	Unit	Rationale
Absorptive Flux	J	Dermal Contact with Liquids: 1.30E−06 (neat DEHP, ≥ 90 wt %) 2.50E−05 (formulations of DEHP, <90wt%) Dermal Contact with Solids: 4.80E−05	mg/cm^2/h	See Appendix C.2.1
Surface Area	S	Workers: 535 (central tendency) 1,070 (high-end) Females of reproductive age: 445 (central tendency) 890 (high-end)	cm^2	See Appendix C.2.2
Absorption time	t_{abs}	8	h	See Appendix C.2.3
Glove Protection Factor	PF	1; 5; 10; or 20	unitless	See Appendix C.2.4

C.2.1 Absorptive Flux

C.2.1.1 Dermal Contact with Liquids or Formulations Containing DEHP

As described in Section 2.4.3.1, the work of the Hopf et al. (2014) showed that the steady-state absorptive flux was as 1.310^{-6}mg/cm^2/hour for neat DEHP and 2.5×10^{-5} mg/cm^2/hour for dilute DEHP in an aqueous solution (1.66 µg DEHP/mL). EPA considered two distinct scenarios for dermal exposures to liquid DEHP, one for neat concentrations of DEHP (EPA considered anything greater than or equal 90 percent DEHP to be a neat liquid) using the steady-state absorptive flux for neat DEHP from Hopf et al. (2014) and the other for dilute formulations of DEHP (EPA considered anything less than 90 percent DEHP to be a dilute formulation) using the steady-state absorptive flux for aqueous solution of DEHP from Hopf et al. (2014). Using the flowchart presented in Figure 3 in OECD 156 (OECD, 2011c), it is suggested that an exposure assessor should use dermal absorption data from a realistic surrogate formulation or material if there are no data on absorption of the exact material under investigation. Because the absorptive flux of dilute DEHP is greater than the neat absorptive flux, EPA expects using the dilute absorptive flux for anything less than 90 percent DEHP to be a protective approach for assessing dermal exposures.

Hopf et al. (2014) found that neat DEHP did not permeate into the skin until after 30 hours of exposure. For aqueous DEHP, Hopf et al. (2014) found that DEHP did not permeate the skin until after eight hours of exposure. In both cases, only a DEHP metabolite was detected in the receptor fluid indicating that DEHP is extensively metabolized *in vitro* in human viable skin (Hopf et al., 2014). In a typical occupational exposure setting, the duration of exposure is not expected to exceed the shift time (typically, 8 to 12 hours). Therefore, EPA expects the use of the steady-state absorptive flux data from Hopf et al. (2014) to be protective of the duration of dermal exposures in occupational settings.

Using the work of Kissel (2011) to interpret the absorption data from the Hopf et al. (2014), it was determined that dermal absorption of DEHP may be flux-limited, even for finite doses (*i.e.*, less than 10 µL/cm^2 for liquids (OECD, 2004c)). Therefore, the steady-state flux (*i.e.*, 1.3×10^{-6} mg/cm^2/h or 2.5×10^{-5} mg/cm^2/h) reported by the Hopf et al. was assumed for the duration of chemical retention on the skin, which is expected to last up to eight hours in occupational settings. However, it is also important to consider the magnitude of dermal loading of DEHP in occupational settings to ensure there is enough material present on the skin to support the assumption of the steady-state flux for an eight-hour shift. For contact with liquids in occupational settings, EPA assumes a range of dermal loading between 0.7 and 2.1 mg/cm^2 (U.S. EPA, 1992b) for tasks such as product sampling, loading/unloading, and cleaning as shown in the ChemSTEER Manual (U.S. EPA, 2015). More specifically, EPA has utilized the raw data of the (U.S. EPA, 1992b) study to determine a central tendency (50th percentile) dermal loading value of 1.4 mg/cm^2 and a high-end (95th percentile) dermal loading value of 2.1 mg/cm^2 for dermal exposure to liquids. For scenarios where liquid exposure occurs, EPA assumes a range of dermal loading between 1.3 and 10.3 mg/cm^2 (U.S. EPA, 1992b) for tasks such as spray coating as shown in the ChemSTEER Manual (U.S. EPA, 2015). More specifically, EPA has utilized the raw data of the (U.S. EPA, 1992b) study to determine a central tendency (50th percentile) value of 3.8 mg/cm^2 and a high-end (95th percentile) value of 10.3 mg/cm^2 for scenarios aligned with dermal immersion in liquids.

The absorptive flux of DEHP reported by Hopf et al. (2014) would result in maximum absorption of 1.0×10^{-5} for neat DEHP and 2×10^{-4} mg/cm^2 for dilute DEHP over an eight-hour period. Therefore, the high-end dermal exposure estimates for liquids containing DEHP is quite reasonable with respect to the amount of material that may be available for absorption in an occupational setting.

C.2.1.2 Dermal Contact with Solids or Articles Containing DEHP

The work of the Chemical Manufacturers Association (1991) showed that the mean expected absorptive flux of DEHP within a PVC film applied to rat skin *in vivo* was estimated as 4.8×10^{-5} mg/cm^2/hour over a 24-hour period and 1.19×10^{-4} mg/cm^2/hour over a 168-hour period. Due to the lack of granular data, EPA considers the dermal absorption data from the Chemical Manufacturers Association to be representative of occupational dermal exposures to solids or articles containing DEHP (Chemical Manufacturers Association, 1991). Using flowchart presented in Figure 3 in OECD 156 (OECD, 2011c), it is suggested that an exposure assessor should use dermal absorption data from a realistic surrogate formulation or material if there are no data on absorption of the exact material under investigation. Because there was not acceptable dermal absorption data for all solid products containing DEHP, EPA considered the dermal absorption Chemical Manufacturers Association to be representative across chemical concentrations and products (Chemical Manufacturers Association, 1991).

In a typical occupational exposure setting, the duration of exposure is not expected to exceed the shift time (typically, 8-12 hours). Therefore, EPA used the 24-hour mean absorptive flux of 4.8×10^{-5} mg/cm^2/hour from Chemical Manufacturers Association to estimate occupational exposures as the timeframe more closely approximates occupational exposure durations. Because this duration exceeds the occupational exposure duration and because Chemical Manufacturers Association that the absorptive flux increased with longer test durations, EPA expects the use of the mean absorptive flux data from Chemical Manufacturers Association to be protective of the duration of dermal exposures in occupational settings (Chemical Manufacturers Association, 1991).

Using the work of Kissel (2011) to interpret the dermal modeling results for aqueous DEHP, it was determined that dermal absorption of DEHP may be flux-limited, even for finite doses (*i.e.*, typically 1 to 5 mg/cm^2 for solids (OECD, 2004c)). Therefore, the 8-hour time-weighted average (TWA) flux (*i.e.*, 4.8×10^{-5} mg/cm^2/h) of solid DEHP was assumed for the duration of chemical retention on the skin, which is expected to last up to eight hours in occupational settings. However, it is also important to consider the magnitude of dermal loading of DEHP in occupational settings to ensure there is enough material present on the skin to support the assumption of the steady-state flux for an eight-hour shift. For contact with solids or powders in occupational settings, EPA generally assumes a range of dermal loading between 900 and 3,100 mg/day (50th to 95th percentile from Lansink et al. (1996)) as shown in the ChemSTEER manual (U.S. EPA, 2015). For contact with materials such as solder/pastes in occupational settings, EPA assumes a range of dermal loading between 450 and 1,100 mg/day (50th to 95th percentile from Lansink et al. (1996)) as shown in the ChemSTEER Manual (U.S. EPA, 2015).

The absorptive flux of DEHP reported by Chemical Manufacturers Association (1991) would result in maximum absorption of 3.8×10^{-4} mg/cm^2 over an 8-hour period. Therefore, the high-end dermal exposure estimate for solids containing DEHP is quite reasonable with respect to the amount of material that may be available for absorption in an occupational setting.

C.2.2 Surface Area

Regarding surface area of occupational dermal exposure, EPA assumed a high-end value of 1,070 cm^2 for male workers and 890 cm^2 for female workers. These high-end occupational dermal exposure surface area values are based on the mean two-hand surface area for adults of age 21 or older from Chapter 7 of EPA's *Exposure Factors Handbook* (U.S. EPA, 2011). For central tendency estimates, 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 cm^2 for male workers and 445 cm^2 for female 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 or two hands for the central tendency and high-end exposure scenario, respectively.

C.2.3 Absorption Time

Though a splash or contact-related transfer of material onto the skin may occur instantaneously, the material may remain on the skin surface until the skin is washed. Because DEHP does not rapidly absorb or evaporate, and the worker may contact the material multiple times throughout the workday, EPA assumes that absorption of DEHP in occupational settings may occur throughout the entirety of an eight-hour work shift (U.S. EPA, 1991a).

C.2.4 Glove Protection Factors

Gloves may mitigate dermal exposures, if used correctly and consistently. However, data regarding the frequency of effective glove use in industrial settings is limited. 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 should be explored by considering different percentages of effectiveness (*e.g.*, 25% vs. 50% effectiveness).

Gloves only offer barrier protection until the chemical breaks through the glove material. Using a conceptual model, Cherrie et al. (2004) proposed a glove workplace protection factor – the ratio of estimated uptake through the hands without gloves to the estimated uptake though the hands while wearing gloves; this protection factor is driven by flux, and thus varies with time. The European Centre for Ecotoxicology and Toxicology of Chemicals Targeted Risk Assessment (ECETOC TRA) model represents the protection factor of gloves as a fixed, APF equal to 5, 10, or 20 (Marquart et al., 2017). Where, similar to the APR for respiratory protection, the inverse of the protection factor is the fraction of the chemical that penetrates the glove.

Given the limited state of knowledge about the protection afforded by gloves in the workplace, it is reasonable to utilize the PF values of the ECETOC TRA model (Marquart et al., 2017), rather than attempt to derive new values. Table_Apx C-2 presents the PF values from ECETOC TRA model (Version 3). In the exposure data used to evaluate the ECETOC TRA model, Marquart et al. (2017) reported that the observed glove protection factor was 34, compared to PF values of 5 or 10 used in the model.

Table_Apx C-2. Exposure Control Efficiencies and Protection Factors for Different Dermal Protection Strategies from ECETOC TRA v3

Dermal Protection Characteristics	Affected User Group	Indicated Efficiency (%)	Protection Factor (PF)
a. Any glove / gauntlet without permeation data and without employee training	Both industrial and professional users	0	1
b. Gloves with available permeation data indicating that the material of construction offers good protection for the substance		80	5
c. Chemically resistant gloves (*i.e.*, as b above) with "basic" employee training		90	10
d. Chemically resistant gloves in combination with specific activity training (*e.g.*, procedure for glove removal and disposal) for tasks where dermal exposure can be expected to occur	Industrial users only	95	20

Appendix D MODEL APPROACH AND PARAMETERS

D.1 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 occupational exposure scenarios (OESs). The models were developed through review of the literature and consideration of existing EPA/OPPT models, Emission Scenario Documents (ESDs), and/or Generic Scenarios (GSs). An individual model input parameter could either have a discrete value or a distribution of values. EPA 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.

D.1.1 EPA/OPPT Standard Models

This appendix discusses the standard models used by EPA to estimate environmental releases of chemicals and occupational inhalation exposures. All the models presented in this section are models that were previously developed by EPA 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 which have been provided in other documents such as the *ChemSTEER User Guide* (U.S. EPA, 2015), *Chemical Engineering Branch Manual for the Preparation of Engineering Assessments, Volume 1* (U.S. EPA, 1991b), *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 include loss fraction models as well as models for 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 and occupational inhalation exposures to DEHP.

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:

Equation D-1.

$$G_{activity} = \frac{(8.24 \times 10^{-8}) * (MW_{DEHP}^{0.835}) * F_{correction\_factor} * VP * \sqrt{Rate_{air\_speed}} * (0.25\pi D_{opening}^2) \sqrt[4]{\frac{1}{29} + \frac{1}{MW_{DEHP}}}}{T^{0.05} * \sqrt{D_{opening}} * \sqrt{P}}$$

Where:

$G_{activity}$	=	Vapor generation rate for activity [g/s]
MW_{DEHP}	=	DEHP molecular weight [g/mol]
$F_{correction\_factor}$	=	Vapor pressure correction factor [unitless]
VP	=	DEHP 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 D-2.

$$G_{activity} = \frac{(1.93 \times 10^{-7}) * \left(MW_{DEHP}{}^{0.78}\right) * F_{correction\_factor} * VP * Rate_{air\_speed}^{0.78} * (0.25\pi D_{opening}^{2})^{3}\sqrt{\frac{1}{29} + \frac{1}{MW_{DEHP}}}}{T^{0.4} D_{opening}^{0.11} (\sqrt{T} - 5.87)^{2/3}}$$

Where:

$G_{activity}$	=	Vapor generation rate for activity [g/s]
MW_{DEHP}	=	DEHP molecular weight [g/mol]
$F_{correction\_factor}$	=	Vapor pressure correction factor [unitless]
VP	=	DEHP 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. This model 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:

Equation D-3.

$$G_{activity} = \frac{F_{saturation\_factor} * MW_{DEHP} * V_{container} * 3785.4\frac{cm^3}{gal} * F_{correction\_factor} * VP * \frac{RATE_{fill}}{3600\frac{s}{hr}}}{R * T}$$

Where:

$G_{activity}$	=	Vapor generation rate for activity [g/s]
$F_{saturation\_factor}$	=	Saturation factor [unitless]
MW_{DEHP}	=	DEHP molecular weight [g/mol]
$V_{container}$	=	Volume of container [gal/container]

$F_{correction\_factor}$	=	Vapor pressure correction factor [unitless]
VP	=	DEHP vapor pressure [torr]
$RATE_{fill}$	=	Fill rate of container [containers/h]
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 DEHP in the liquid of interest. However, in most cases, EPA did not have data on the molecular weights of other components in the liquid formulations; therefore, EPA approximated the mole fraction using the mass fraction of DEHP in the liquid of interest. Using the mass fraction of DEHP to estimate mole fraction does create uncertainty in the vapor generation rate model. If other components in the liquid of interest have similar molecular weights as DEHP, then mass fraction is a reasonable approximation of mole fraction. However, if other components in the liquid of interest have much lower molecular weights than DEHP, the mass fraction of DEHP will be an overestimate of the mole fraction. If other components in the liquid of interest have much higher molecular weights than DEHP, the mass fraction of DEHP will underestimate the mole fraction.

If calculating an environmental release, the vapor generation rate calculated from one of the above models (Equation D-1, Equation D-2, and Equation D-3) is then used along with an operating time to calculate the release amount:

Equation D-4.

$$Release_Year_{activity} = Time_{activity} \times G_{activity} \times 3600\,\frac{s}{hr} \times 0.001\,\frac{kg}{g}$$

Where:

$Release\_Year_{activity}$	=	DEHP released for activity per site-year [kg/site-yr]
$Time_{activity}$	=	Operating time for activity [h/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
- EPA/OPPT Solid Residuals in Transport Containers 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 DEHP 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 based on the approaches described for each OES:

Equation D-5.

$$Release\_Year_{activity} = PV * F_{activity\_loss}$$

Where:

$Release\_Year_{activity}$ = DEHP released for activity per site-year [kg/site-yr]
PV = Production volume throughput of DEHP [kg/site-yr]
$F_{activity\_loss}$ = Loss fraction for activity [unitless]

The EPA/OPPT Generic Model to Estimate Dust Releases from Transfer/Unloading/Loading Operations of Solid Powders estimates a loss fraction of dust that may be generated during the transferring/unloading of solid powders. This model can be used to estimate a loss fraction of dust both when the facility does not employ capture technology (*e.g.*, local exhaust ventilation, hoods) or dust control/removal technology (*e.g.*, cyclones, electrostatic precipitators, scrubbers, or filters), and when the facility does employ capture and/or control/removal technology. The model explains that when dust is uncaptured, the release media is fugitive air, water, incineration, or landfill. When dust is captured but uncontrolled, the release media is to stack air. When dust is captured and controlled, the release media is to incineration or landfill. The EPA/OPPT Generic Model to Estimate Dust Releases from Transfer/Unloading/Loading Operations of Solid Powders calculates the amount of dust not captured, captured but not controlled, and both captured and controlled, using the following equations (U.S. EPA, 2021b):

Equation D-6.

$$\boldsymbol{Elocal_{dust\_not\_captured} = Elocal_{dust\_generation} * \left(1 - F_{dust\_capture}\right)}$$

Where:

$Elocal_{dust\_not\_captured}$ = Daily amount emitted from transfers/unloading that is not captured [kg not captured/site-day]
$Elocal_{dust\_generation}$ = Daily release of dust from transfers/unloading [kg generated/site-day]
$F_{dust\_capture}$ = Capture technology efficiency [kg captured/kg generated]

Equation D-7.

$$Elocal_{dust\_cap\_uncontrol} = Elocal_{dust\_generation} * F_{dust\_capture} * \left(1 - F_{dust\_control}\right)$$

Where:

$Elocal_{dust\_cap\_uncontrol}$ = Daily amount emitted from control technology from transfers/unloading [kg not controlled/site-day]
$Elocal_{dust\_generation}$ = Daily release of dust from transfers/unloading [kg generated/site-day]
$F_{dust\_capture}$ = Capture technology efficiency [kg captured/kg generated]
$F_{dust\_control}$ = Control technology removal efficiency [kg controlled/kg captured]

Equation D-8.

$$Elocal_{dust\_cap\_control} = Elocal_{dust\_generation} * F_{dust\_capture} * F_{dust\_control}$$

Where:

$Elocal_{dust\_cap\_control}$ = Daily amount captured and removed by control technology from transfers/unloading [kg controlled/site-day]
$Elocal_{dust\_generation}$ = Daily release of dust from transfers/unloading [kg generated/site-day]
$F_{dust\_capture}$ = Capture technology efficiency [kg captured/kg generated]
$F_{dust\_control}$ = Control technology removal efficiency [kg controlled/kg captured]

EPA uses the above equations in the DEHP environmental release models, and EPA references the model equations by model name and/or equation number within 1.1.1.1.1Appendix A.

D.2 Use in Hydraulic Fracturing Model Approaches and Parameters

This appendix presents the modeling approach and equations used to estimate environmental releases for DEHP during the use in hydraulic fracturing OES. This approach utilizes the *Draft ESD on Chemicals used in Hydraulic Fracturing* (U.S. EPA, 2022d) and FracFocus 3.0 data (FracFocus, 2022) combined with Monte Carlo simulation (a type of stochastic simulation).

Based on Hydraulic Fracturing ESD (U.S. EPA, 2022d), EPA identified the following release sources from fracking operations:

- Release source 1: Transfer Operation Losses to Fugitive Air During Unloading Volatile Chemicals
- Release source 2: Release to Uncertain Media (Surface Water, Incineration, or Landfill) from Container Residuals
- Release source 3: Open Surface Losses to Fugitive Air During Transport Container Cleaning
- Release source 4: Release to Uncertain Media (Surface Water, Incineration, or Landfill) from Container Cleaning
- Release source 5: Open Surface Losses to Fugitive Air During Equipment and Storage Tank Cleaning
- Release source 6: Release to Surface Water (13%), Land (Soil) (64%), and Landfill or Incineration (23%) from Spills
- Release source 7: Release to Deep Well Injection from the Portion of Fracturing Fluid that Remains Underground after Hydraulic Fracturing (and does not return in flowback or produced water)
- Release source 8: Flowback and Produced Wastewater Release to Recycle/Reuse (5%), Deep Well Injection (70%), On- or Off-Site Treatment and Discharge to Surface Water (19%), or Land (6%)

Environmental releases for DEHP during use in hydraulic fracturing are a function of DEHP'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 rate, DEHP concentration, air speed, diameter of openings, saturation factor, container size, and loss fractions. 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.

D.2.1 Model Equations

Table_Apx D-1 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 in hydraulic fracturing 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 D.2.2. The Monte Carlo simulation calculated the total DEHP 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 D-1. Models and Variables Applied for Release Sources in the Use in Hydraulic Fracturing OES

Release Source	Model(s) Applied	Variables Used
Release source 1: Transfer Operation Losses to Fugitive Air During Unloading Volatile Chemicals	*EPA/OAQPS AP-42 Loading Model*	Vapor Generation Rate: F_{sat}; MW; V_{cont}; $RATE_{drum}$; $F_{DEHP\_additive}$; VP; T; R Operating Hours: $N_{cont\_unload\_yr}$; OD; $RATE_{drum}$
Release source 2: Release to Uncertain Media (Surface Water, Incineration, or Landfill) from Container Residuals	*EPA/OPPT Drum Residual Model* and *EPA/OPPT Bulk Container Residual Model*, based on container volume (Appendix E.1)	LF_{drum}; LF_{tote}; $F_{DEHP\_additive}$; V_{cont}; $N_{cont\_unload\_yr}$
Release source 3: Open Surface Losses to Fugitive Air During Transport Container Cleaning	*EPA/OPPT Mass Transfer Coefficient Model*, based on air speed (Appendix E.1)	$N_{cont\_unload\_yr}$; $RATE_{drum}$; OD; MW; VP; $F_{DEHP\_additive}$; $RATE_{air\_speed}$; $D_{container\_opening}$; T; R
Release source 4: Release to Uncertain Media (Surface Water, Incineration, or Landfill) from Container Cleaning	*EPA/OPPT Multiple Process Vessel Residual Model* (Appendix D.1)	LF_{equip}; PV_{site_day}
Release source 5: Open Surface Losses to Fugitive Air During Equipment and Storage Tank Cleaning	*EPA/OPPT Mass Transfer Coefficient Model*, based on air speed (Appendix D.1)	$N_{cont\_unload\_yr}$; $RATE_{drum}$; OD; MW; VP; F_{DEHP_fluid}; $RATE_{air\_speed}$; $D_{equip\_opening}$; T; R
Release source 6: Release to Surface Water (13%), Land (Soil) (64%), and Landfill or Incineration (23%) from Spills	See Equation E-9	LF_{spill}; PV_{site_day}
Release source 7: Release to Deep Well Injection from the Portion of Fracturing Fluid that Remains Underground after Hydraulic Fracturing (and does not return in flowback or produced water)	See Equation E-10	LF_{equip}; PV_{site_day}; LF_{drum}; LF_{tote}; $F_{recovered}$
Release source 8: Flowback and Produced Wastewater Release to Recycle/Reuse (5%), Deep Well Injection (70%), On- or Off-Site Treatment and Discharge to Surface Water (19%), or Land (6%)	See Equation E-11	LF_{equip}; PV_{site_day}; LF_{drum}; LF_{tote}; $F_{recovered}$; $Days_{flowback}$

Release source 6 daily release (Release to Surface Water (13%), Land (Soil) (64%), and Landfill or Incineration (23%) from Spills) is calculated using the following equation:

Equation D-9.

$$DR_{RS6} = PV_{site\_day} * LF_{spill}$$

Where:

DR_{RS6}	=	DEHP released for release source 1 [kg/site-day]
PV_{site_day}	=	Daily facility throughput of DEHP [kg/site-day]

LF_{spill}	=	Loss fraction for when a spill occurs [unitless]

Release source 7 annual release (Release to Deep Well Injection from the Portion of Fracturing Fluid that Remains Underground after Hydraulic Fracturing (and does not return in flowback or produced water)) is calculated using the following equation:

Equation D-10.

$$AR_{RS7} = (PV_{site} - AR_{RS6}) * \left(1 - LF_{equip} - (LF_{drum}\ OR\ LF_{tote})\right) * (1 - F_{recovered})$$

Where:

AR_{RS7}	=	Annual DEHP released for release source 7 [kg/site-year]
PV_{site_day}	=	Daily facility throughput of DEHP [kg/site-day]
AR_{RS6}	=	Annual DEHP released for release source 6 [kg/site-year]
LF_{equip}	=	Equipment residue loss fraction [kg/kg]
LF_{drum}	=	Drum residual loss fraction [kg/kg]
LF_{tote}	=	Tote residual loss fraction [kg/kg]
$F_{recovered}$	=	Fraction of DEHP recovered [kg/kg]

Release source 8 annual release (Flowback and Produced Wastewater Release to Recycle/Reuse (5%), Deep Well Injection (70%), On- or Off-Site Treatment and Discharge to Surface Water (19%), or Land (6%)) is calculated using the following equation:

Equation D-11.

$$AR_{RS8} = (PV_{site} - AR_{RS6}) * \left(1 - LF_{equip} - (LF_{drum}\ OR\ LF_{tote})\right) * F_{recovered}$$

Where:

AR_{RS8}	=	Annual DEHP released for release source 8 [kg/site-year]
PV_{site_day}	=	Daily facility throughput of DEHP [kg/site-day]
AR_{RS6}	=	Annual DEHP released for release source 6 [kg/site-year]
LF_{equip}	=	Equipment residue loss fraction [kg/kg]
LF_{drum}	=	Drum residual loss fraction [kg/kg]
LF_{tote}	=	Tote residual loss fraction [kg/kg]
$F_{recovered}$	=	Fraction of DEHP recovered [kg/kg]

D.2.2 Model Input Parameters

Table_Apx D-2 summarizes the model parameters and their values for the Use in Hydraulic Fracturing Monte Carlo simulation. Additional explanations of EPA's selection of the distributions for each parameter are provided after this table.

Table_Apx D-2. Summary of Parameter Values and Distributions Used in the Use of Hydraulic Fracturing Model

Input Parameter	Symbol	Unit	Deterministic Values	Uncertainty Analysis Distribution Parameters				Rationale / Basis
			Value	Lower Bound	Upper Bound	Mode	Distribution Type	
Operating Days	OD	days/year	1	1	3	1	Triangular	See D.2.3
Annual Use Rate of Fracturing Fluids containing DEHP	Q_{fluid_yr}	gal/site-yr	41,599	15,250	1,212,136	—	Discrete	See D.2.4
Mass Fraction of DEHP in Hydraulic Fracturing Fluid	F_{DEHP_fluid}	kg/kg	0.00001	6.9121E−-16	1.61	—	Discrete	See D.2.4
Drum Size	V_{drum}	gal	55	20	100	55	Triangular	See D.2.7
Tote Size	V_{tote}	gal	550	100	1,000	550	Triangular	See D.2.7
Saturation Factor	F_{sat}	kg/kg	0.5	0.5	1.45	0.5	Triangular	See D.2.8
Drum Residual Fraction	LF_{drum}	kg/kg	2.5	2.5	10	2.5	Triangular	See D.2.8
Bulk Container Residue Fraction	LF_{tote}	kg/kg	0.0007	0.0002	0.002	0.0007	Triangular	See D.2.8
Spill Loss Fraction	LF_{spill}	kg/kg	1.30E−04	4.50E−07	0.0018	1.30E−04	Triangular	See D.2.9
Fraction DEHP Recovered	$F_{recovered}$	kg/kg	0.75	0.02	1	0.75	Triangular	See D.2.10
Molar Volume	V_m	L/mol	24.45	—	—	—	—	Standard molar volume
Temperature	T	K	298	—	—	—	—	Standard ambient temperature
Vapor Pressure	VP	torr	1.42E−07	—	—	—	—	Physical property
Molecular Weight	MW	g/mol	390.57	—	—	—	—	Physical property
Density of Fracturing Fluid	ρ_{fluid}	kg/L	1	—	—	—	—	Physical property
Air Speed	$RATE_{air\_speed}$	ft/min	440	—	—	—	—	See D.2.11

Input Parameter	Symbol	Unit	Deterministic Values	Uncertainty Analysis Distribution Parameters				Rationale / Basis
			Value	Lower Bound	Upper Bound	Mode	Distribution Type	
Diameter of Container Opening	$D_{container\_opening}$	cm	5.08	—	—	—	—	See D.2.12
Diameter of Equipment Opening	$D_{equip\_opening}$	cm	92	—	—	—	—	See D.2.12
Number of Sites	N_{sites}	sites	44	—	—	—	—	See D.2.13
Mass Fraction of DEHP in Additive	$F_{DEHP\_additive}$	kg/kg	0.05	—	—	—	—	See D.2.4
Equipment Residue Fraction	LF_{equip}	kg/kg	0.02	—	—	—	—	See D.2.14
Equipment Cleaning Operating Hours	OH_{equip}	hours/day	4	—	—	—	—	See D.2.15
Spill Frequency	P_{spill}	unitless	0.122	—	—	—	—	See D.2.16
Percent of Release Source #6 to Water	$\%_{RS6\_water}$	unitless	0.13	—	—	—	—	Release factor from Hydraulic Fracturing ESD (U.S. EPA, 2022d)
Percent of Release Source #6 to Soil	$\%_{RS6\_soil}$	unitless	0.64	—	—	—	—	Release factor from Hydraulic Fracturing ESD (U.S. EPA, 2022d)
Percent of Release Source #6 to Land	$\%_{RS6\_land}$	unitless	0.23	—	—	—	—	Release factor from Hydraulic Fracturing ESD (U.S. EPA, 2022d)
Flowback Days (Release Source #8)	$Days_{flowback}$	days/yr	30	—	—	—	—	Release factor from Hydraulic Fracturing ESD (U.S. EPA, 2022d)
Percent of Release Source #8 to Recycle	$\%_{RS8\_recycle}$	unitless	0.05	—	—	—	—	Release factor from Hydraulic Fracturing ESD (U.S. EPA, 2022d)

Input Parameter	Symbol	Unit	Deterministic Values	Uncertainty Analysis Distribution Parameters				Rationale / Basis
			Value	Lower Bound	Upper Bound	Mode	Distribution Type	
Percent of Release Source #8 to Deep Well	$\%_{RS8\_deep}$	unitless	0.7	—	—	—	—	Release factor from Hydraulic Fracturing ESD (U.S. EPA, 2022d)
Percent of Release Source #8 to Water	$\%_{RS8\_water}$	unitless	0.19	—	—	—	—	Release factor from Hydraulic Fracturing ESD (U.S. EPA, 2022d)
Percent of Release Source #8 to Soil	$\%_{RS8\_soil}$	unitless	0.06	—	—	—	—	Release factor from Hydraulic Fracturing ESD (U.S. EPA, 2022d)
Drum/Tote Unloading Rate	$RATE_{drum}$	containers/h	20	—	—	—	—	See Appendix D.2.17
Universal Gas Constant	R	atm-cm^3/gmol-K	82.05	—	—	—	—	Physical property

D.2.3 Operating Days

EPA modeled the operating days per year using a triangular distribution with a lower bound of 1 day per year, an upper bound of 3 days per year, and a mode of 1 day per year. Discrete data points on the number of operating days were taken from FracFocus 3.0 for the 44 sites that reported using fracturing fluids containing DEHP (FracFocus, 2022). The upper bound, lower bound, and mode of the triangular distribution were based on the statistics of the DEHP-specific FracFocus dataset.

D.2.4 Annual Use Rate of Fracturing Fluids containing DEHP

EPA modeled the annual use rate of fracturing fluids containing DEHP using a discrete distribution based on data obtained from FracFocus 3.0 for the 44 sites that reported using fracturing fluids containing DEHP (FracFocus, 2022). The distribution was calculated using an equal probability for each of the submissions from FracFocus 3.0.

D.2.5 Mass Fraction of DEHP in the Fracturing Fluid Additive

All of the sites which reported DEHP in hydraulic fracturing additive through FracFocus (2022) reported a concentration of 0.05 kg/kg DEHP in the hydraulic fracturing additive.

D.2.6 Mass Fraction of DEHP in the Fracturing Fluid

EPA modeled the mass fraction of DEHP in the hydraulic fracturing fluid using a discrete distribution based on data obtained from FracFocus 3.0 for the 44 sites that reported using fracturing fluids containing DEHP (FracFocus, 2022). The distribution was calculated using an equal probability for each of the submissions from FracFocus 3.0.

D.2.7 Container Sizes

The Draft ESD on Chemicals Used in Hydraulic Fracturing states that hydraulic fracturing chemicals are received in drums or bulk containers (U.S. EPA, 2022d). Therefore, EPA modeled container size using two different triangular distributions: one for drums and one for totes. The distribution for drums ranged from 20 to 100 gallons of liquid with a mode of 55 gallons. The distribution for totes ranged from 100 to 1,000 gallons of liquid with a mode of 550 gallons. Each of these distributions is based on the ChemSTEER User Guide (U.S. EPA, 2015) default volume distributions for drums and bulk containers.

Chemical Engineering Branch Manual for the Preparation of Engineering Assessments, Volume 1 [CEB Manual] (U.S. EPA, 1991b) indicates that the saturation concentration was reached or exceeded by misting with a maximum saturation factor of 1.45 during splash filling. The CEB manual indicates that the saturation factor for bottom filling was expected to be about 0.5 (U.S. EPA, 1991b). The underlying distribution of this parameter is not known; therefore, EPA assigned triangular distributions, since triangular distribution is completely defined by range and mode of a 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 (U.S. EPA, 2015). This value also corresponds to the typical value provided in the ChemSTEER User Guide (U.S. EPA, 2015) for the *EPA/OAQPS AP-42 Loading Model* for drums.

D.2.8 Container Residual Fractions

EPA modeled container residual fraction for totes using a triangular distribution with a lower bound of 0.0007 kg residual/kg fracturing fluid additive, and upper bound of 0.002 kg residual/kg fracturing fluid additive, and a mode of 0.0007 kg residual/kg fracturing fluid additive. The lower and upper bounds of this distribution are based on the central tendency and high-end values listed in the *EPA/OPPT Bulk Transport Residual Model* from the ChemSTEER User Guide (U.S. EPA, 2015). EPA used the central tendency value as the mode of the triangular distribution.

EPA modeled container residual fraction for drums using a triangular distribution with a lower bound of 0.017 kg residual/kg fracturing fluid additive, an upper bound of 0.03 kg residual/kg fracturing fluid additive, and a mode of 0.025 kg residual/kg fracturing fluid additive. The lower bound is based on the minimum value for pumping and the upper bound is based on the default high-end value in the *EPA/OPPT Drum Residual Model* from the ChemSTEER User Guide (U.S. EPA, 2015). EPA used the central tendency value for pumping as the mode of the triangular distribution.

D.2.9 Spill Loss Fraction

EPA assessed the spill loss fraction based on the value recommended in the Draft ESD on Chemicals Used in Hydraulic Fracturing for Release Source #6 (U.S. EPA, 2022d). The loss fraction is derived from spill data and the standard throughput of the Draft ESD which results in a triangular distribution ranging from 4.5×10^{-7} to 0.0018 with a mode of 1.3×10^{-4}.

D.2.10 Fraction DEHP Recovered

EPA modeled the fraction of injected fracturing fluid that returns to the surface using a triangular distribution with a lower bound of 0.02 kg returned/kg injected, an upper bound of 1 kg returned/kg injected, and a mode of 0.75 kg returned/kg injected. The Draft ESD on Chemicals Used in Hydraulic Fracturing provides a range of fractions from three separate data sources, with a total range of 10 to 100 percent of fracturing fluid that is injected into the ground being recovered at the surface (U.S. EPA, 2022d). The ESD uses the median amount of 75 percent as the default value, which EPA uses as the mode of the triangular distribution. The remaining amount is assumed to stay underground as a source of release (release point 6).

D.2.11 Air Speed

The ChemSTEER User Guide (U.S. EPA, 2015) provides a single air speed of 440 ft/min for outdoor activities.

D.2.12 Opening Diameters

The ChemSTEER User Guide (U.S. EPA, 2015) provides a single diameter of container openings as 5.08 cm. The ChemSTEER User Guide (U.S. EPA, 2015) provides a single diameter of equipment openings as 92 cm.

D.2.13 Number of Sites

EPA estimates 44 sites based on found the number of hydraulic fracturing sites that reported using fracturing fluids containing DEHP to FracFocus 3.0 (FracFocus, 2022).

D.2.14 Equipment Residue Fraction

The *EPA/OPPT Multiple Process Vessel Residual Model* provides a loss fraction 0.02 kg of material remaining as equipment residual per kg of material processed (U.S. EPA, 2015).

D.2.15 Equipment Cleaning Operating Hours

The ChemSTEER User Guide (U.S. EPA, 2015) provides a single duration of 4 hours/day for equipment cleaning of multiple vessels.

D.2.16 Spill Frequency

EPA provides an estimate of the spill frequency based on the value recommended in the Draft ESD on Chemicals Used in Hydraulic Fracturing for Release Source #6 (U.S. EPA, 2022d). The data assessed in the Draft ESD indicates that up to 12.2 spills may occur per 100 wells. Based on this, EPA assumes a spill frequency of once per year.

D.2.17 Container Fill Rates

The ChemSTEER User Guide (U.S. EPA, 2015) provides a typical fill rate of 20 containers per hour for drums and totes.

D.3 Use of Laboratory Chemicals Model Approaches and Parameters

This appendix presents the modeling approach and equations used to estimate environmental releases for DEHP during the use of laboratory chemicals OES. This approach utilizes the *Generic Scenario on Use of Laboratory Chemicals* (U.S. EPA, 2023b) and CDR data (U.S. EPA, 2020a) 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.
- 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 DEHP during the use of laboratory chemicals are a function of DEHP'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, DEHP 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.

D.3.1 Model Equations

Table_Apx D-3 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 D.3.2. The Monte Carlo simulation calculated the total DEHP 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 D-3. 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 D.1)	Vapor Generation Rate: F_{DEHP-L}; VP; f_{sat}; MW; R; T; V_{cont}; $RATE_{fill}$ Operating Time: Q_{DEHP_day}; V_{cont}; $RATE_{fill}$; RHO; OD; F_{DEHP-L}
Release source 2: Dust Emissions from Transferring Powders.	EPA/OPPT Generic Model to Estimate Dust Releases from Transfer/Unloading/Loading Operations of Solid Powders (Appendix D.1)	Q_{DEHP_day}; $F_{dust\_generation}$; $F_{dust\_capture}$; $F_{dust\_control}$
Release source 3: Container Cleaning Wastes.	EPA/OAQPS AP-42 Small Container Residual Model or EPA/OPPT Solid Residuals in Transport Containers Model, based on physical form (Appendix D.1)	Q_{DEHP_day}; $F_{residue\_S}$; V_{cont}; RHO; F_{DEHP-S}; F_{DEHP-L}; OD; Q_{cont_solid}; $F_{residue\_L}$
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 D.1)	Vapor Generation Rate: F_{DEHP-L}; MW; VP; $RATE_{air\_speed}$; $D_{cleaning}$; T; P Operating Time: Q_{DEHP_day}; V_{cont}; $RATE_{fill}$; RHO; OD; F_{DEHP-L}
Release source 5: Equipment Cleaning Wastes.	EPA/OPPT Multiple Process Vessel Residual Model or EPA/OPPT Solids Residuals in Transport Container Model, based on physical form (Appendix D.1)	Q_{DEHP_day}; $F_{lab\_residue\_L}$; $F_{lab\_residue\_S}$
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 D.1)	Vapor Generation Rate: F_{DEHP-L}; MW; VP; $RATE_{air\_speed}$; $D_{cleaning}$; T; P Operating Time: $OH_{cleaning}$
Release source 7: Releases During Laboratory Analysis.	EPA/OPPT Penetration Model or EPA/OPPT Mass Transfer Coefficient Model, based on air speed (Appendix D.1)	Vapor Generation Rate: F_{DEHP-L}; MW; VP; $RATE_{air\_speed}$; $D_{testing}$; T; P Operating Time: $OH_{testing}$
Release source 8: Laboratory Waste Disposal.	See Equation D-12 and Equation D-13	Q_{DEHP_day}; $F_{residue\_L}$; $F_{lab\_residue\_L}$; $F_{lab\_residue\_S}$; $F_{dust\_generation}$; $F_{residue\_S}$ Release Points 1,3,6,and 7

For liquid DEHP, release source 8 (Laboratory Waste Disposal) is calculated via a mass-balance, via the following equation:

Equation D-12.

$$Release\_perDay_{RP8-L} = \left(Q_{DEHP\_day} - Release_{perDay}{}_{RP1} - Release_{perDay}{}_{RP3} - Release_{perDay}{}_{RP6} - Release\_perDay_{RP7}\right) * \left(1 - F_{residue\_L} - F_{lab\_residue\_L}\right)$$

Where:

$Release\_perDay_{RP8-L}$	=	Liquid DEHP released for release source 8 [kg/site-day]
Q_{DEHP_day}	=	Facility throughput of DEHP (see Appendix D.3.3) [kg/site-day]
$Release\_perDay_{RP1}$	=	Liquid DEHP released for release source 1 [kg/site-day]
$Release\_perDay_{RP3}$	=	Liquid DEHP released for release source 3 [kg/site-day]
$Release\_perDay_{RP6}$	=	Liquid DEHP released for release source 6 [kg/site-day]
$Release\_perDay_{RP7}$	=	Liquid DEHP released for release source 7 [kg/site-day]
$F_{residue\_L}$	=	Fraction of DEHP remaining in transport containers (see Appendix D.3.13) [kg/kg]
$F_{lab\_residue\_L}$	=	Fraction of DEHP remaining in lab equipment (see Appendix D.3.17) [kg/kg]

For solids containing DEHP, release source 8 (Laboratory Waste Disposal) is calculated via a mass-balance, via the following equation:

Equation D-13.

$$Release\_perDay_{RP8-S} = Q_{DINP\_day} * \left(1 - F_{dust\_generation} - F_{residue\_S} - F_{lab\_residue\_S}\right)$$

Where:

$Release\_perDay_{RP8-S}$	=	Solid DEHP released for release source 8 [kg/site-day]
Q_{DINP_day}	=	Facility throughput of DEHP (see Appendix D.3.3) [kg/site-day]
$F_{dust\_generation}$	=	Fraction of DEHP lost during unloading of solid powder (see Appendix D.3.14) [kg/kg]
$F_{residue\_S}$	=	Fraction of DEHP remaining in transport containers (see Appendix D.3.13) [kg/kg]
$F_{lab\_residue\_S}$	=	Fraction of DEHP remaining in lab equipment (see Appendix D.3.17) [kg/kg]

D.3.2 Model Input Parameters

Table_Apx D-4 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.

Table_Apx D-4. 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 DEHP	PV	kg/yr	130,455	—	—	—	—	See Appendix D.3.3
Daily Facility Throughput of Solid DEHP	$Q_{stock\_site\_day\_S}$	g/site-day	255	0.003	510	255	Triangular	See Appendix D.3.3
Daily Facility Throughput of Liquid DEHP	$Q_{stock\_site\_day\_L}$	mL/site-day	2000	0.50	4000	2000	Triangular	See Appendix D.3.3
Liquid DEHP Concentration	$F_{DEHP\text{-}L}$	kg/kg	0.1	0.001	0.2	0.001	Triangular	See Appendix D.3.7
Solid DEHP Concentration	$F_{DEHP\text{-}S}$	kg/kg	0.003	—	—	—	—	See Appendix D.3.7
Operating Days	OD	days/yr	260	174	260	260	Discrete	See Appendix D.3.9
Air Speed	$RATE_{air\_speed}$	ft/min	19.7	2.56	398.03	—	Lognormal	See Appendix D.3.10
Saturation Factor	f_{sat}	dimensionless	0.5	0.5	1.45	0.5	Triangular	See Appendix D.3.11
Liquid Container Size	V_{cont}	gal	1	0.00026	1	1	Triangular	See Appendix D.3.12
Solid Container Mass	Q_{cont_solid}	kg	1	0.005	1	1	Triangular	See Appendix D.3.12
Liquid Container Loss Fraction	$F_{container\_residue\text{-}L}$	kg/kg	0.003	0.003	0.006	0.003	Triangular	See Appendix D.3.13
Solid Container Loss Fraction	$F_{container\_residue\text{-}S}$	kg/kg	0.01	—	—	—	—	See Appendix D.3.13
Fraction of chemical lost during transfer of solid powders	$F_{dust\_generation}$	kg/kg	0.005	—	—	—	—	See Appendix D.3.14
Vapor Pressure at 25C	VP	mmHg	1.42E−07	—	—	—	—	Physical property
Molecular Weight	MW	g/mol	390.57	—	—	—	—	Physical property

Input Parameter	Symbol	Unit	Deterministic Values	Uncertainty Analysis Distribution Parameters				Rationale / Basis
			Value	Lower Bound	Upper Bound	Mode	Distribution Type	
Gas Constant	R	atm-cm^3/gmol-L	82.05	—	—	—	—	Universal constant
Density of Products	RHO	kg/L	1.3256	0.69	1.3258	1.3256	Triangular	See Appendix D.3.9
Temperature	T	K	298	—	—	—	—	Process parameter
Pressure	P	atm	1	—	—	—	—	Process parameter
Small Container Fill Rate	$RATE_{fill}$	containers/h	60	—	—	—	—	See Appendix D.3.15
Diameter of Opening – Container Cleaning	$D_{cleaning}$	cm	5.08	—	—	—	—	See Appendix D.3.16
Lab Testing Duration	$OH_{testing}$	h/day	1	—	—	—	—	See Appendix D.3.6
Equipment Cleaning Duration	$OH_{cleaning}$	h/day	4	—	—	—	—	See Appendix D.3.6
Equipment Cleaning Loss Fraction–- Liquid	$F_{lab\_residue-L}$	kg/kg	0.02	—	—	—	—	See Appendix D.3.17
Equipment Cleaning Loss Fraction–- Solid	$F_{lab\_residue-S}$	kg/kg	0.01	—	—	—	—	See Appendix D.3.17

D.3.3 Throughput Parameters

The *Use of Laboratory Chemicals – Generic Scenario for Estimating Occupational Exposures and Environmental Releases* (U.S. EPA, 2023b) provides daily throughput of DEHP required for laboratory stock solutions. According to the GS, laboratory liquid use rates range from 0.5 mL up to four liters per day, and laboratory solid use rates range from 0.003 grams to 510 grams per day. Midpoints of these ranges are 2 liters/day for liquids and 255 g/day for solids. 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, 2023b). 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 midpoints as the modes.

The daily throughput of DEHP in liquid laboratory chemicals is calculated using Equation D-1414 by multiplying the daily throughput of all laboratory solutions by the concentration of DEHP in the solutions and converting volume to mass.

Equation D-14.

$$Q_{DEHP\_day} = Q_{stock\_site\_day\_L} * F_{DEHP-L} * RHO * \frac{0.001L}{mL}$$

Where:

Q_{DEHP_day}	=	Facility throughput of DEHP [kg/site-day]
$Q_{stock\_site\_day\_L}$	=	Facility annual throughput of liquid laboratory chemicals [mL/site-day]
F_{DEHP-L}	=	Concentration of DEHP in liquid laboratory chemicals (see Section D.3.7) [kg/kg]
RHO	=	Density of DEHP [kg/L]

The daily throughput of DEHP in solid laboratory chemicals is calculated using Equation D-15 by multiplying the daily throughput of all laboratory solids by the concentration of DEHP in the solids.

Equation D-15.

$$Q_{DEHP\_day} = Q_{stock\_site\_day\_S} * F_{DEHP-S} * \frac{0.001kg}{g}$$

Where:

Q_{DEHP_day}	=	Facility throughput of DEHP [kg/site-day]
$Q_{stock\_site\_day\_S}$	=	Facility annual throughput of solid laboratory chemicals [g/site-day]
F_{DEHP-S}	=	Concentration of DEHP in solid laboratory chemicals (see Section D.3.7) [kg/kg]

The annual throughput of DEHP is calculated using Equation D-16 by multiplying the daily throughput by the number of operating days. The number of operating days is determined according to Appendix D.3.9.

Equation D-16.

$$Q_{DEHP\_year} = Q_{DEHP\_day} * OD$$

Where:

Q_{DEHP_year}	=	Facility annual throughput of DEHP [kg/site-yr]
Q_{DEHP_day}	=	Facility throughput of DEHP (see Appendix D.3.3) [kg/site-day]
OD	=	Operating days (see Appendix D.3.9) [days/yr]

D.3.4 Number of Sites

Per 2020 U.S. Census Bureau data for the North American Industry Classification System (NAICS) codes identified in the *Use of Laboratory Chemicals – Generic Scenario for Estimating Occupational Exposures and Environmental Releases* (U.S. EPA, 2023b) 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 D-17.

$$N_s = \frac{PV}{Q_{DEHP\_year}}$$

Where:

N_s	=	Number of sites [sites]
PV	=	Production volume (see Appendix D.3.3) [kg/year]
Q_{DEHP_year}	=	Facility annual throughput of DEHP (see Appendix D.3.3) [kg/site-yr]

D.3.5 Number of Containers per Year

The number of liquid DEHP laboratory containers unloaded by a site per year is calculated using the following equation:

Equation D-18.

$$N_{cont\_unload\_yr} = \frac{Q_{DEHP\_year}}{F_{DEHP-L} * RHO * \left(3.79\ \frac{L}{gal}\right) * V_{cont}}$$

Where:

V_{cont}	=	Container volume (see Appendix D.3.12) [gal/container]
Q_{DEHP_year}	=	Facility annual throughput of DEHP (see Appendix D.3.3) [kg/site-yr]
RHO	=	DEHP product density [kg/L]
F_{DEHP-L}	=	Mass fraction of DEHP in liquid (see Appendix D.3.7) [kg/kg]
$N_{cont\_unload\_yr}$	=	Annual number of containers unloaded [container/site-year]

The number of laboratory containers containing solids with DEHP unloaded by a site per year is calculated using the following equation:

Equation D-19

$$N_{cont\_unload\_yr} = \frac{Q_{DEHP\_year}}{F_{DEHP-S} * Q_{cont\_solid}}$$

Where:

Q_{cont_solid}	=	Mass in container of solids (see Appendix D.3.12) [kg/container]
Q_{DEHP_year}	=	Facility annual throughput of DEHP (see Appendix D.3.3) [kg/site-yr]
F_{DEHP-S}	=	Mass fraction of DEHP in solid (see Appendix D.3.7) [kg/kg]
$N_{cont\_unload\_yr}$	=	Annual number of containers unloaded [container/site-year]

D.3.6 Operating Hours

EPA estimated operating hours or hours of duration using data provided from the *Use of Laboratory Chemicals – Generic Scenario for Estimating Occupational Exposures and Environmental Releases* (U.S. EPA, 2023b), *ChemSTEER User Guide* (U.S. EPA, 2015), 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 D-20

$$OH_{RP1/RP4} = \frac{N_{cont\_unload\_yr}}{RATE_{fill} * OD}$$

Where:

$OH_{RP1/RP4}$	=	Operating time for release points 1 and 4 [hours/site-day]
$RATE_{fill}$	=	Container fill rate (see Appendix D.3.15) [containers/hour]
$N_{cont\_unload\_yr}$	=	Annual number of containers unloaded (see Appendix D.3.5) [container/site-year]
OD	=	Operating days (see Appendix D.3.9) [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, 2015).

For product sampling (release point 7), the *ChemSTEER User Guide* (U.S. EPA, 2015) indicates a single value of one hour/day.

D.3.7 DEHP Concentration in Laboratory Chemicals

For liquid laboratory chemicals, EPA used a triangular distribution across 19 identified safety data sheets (SDSs) and set the mode equal to the mode of product concentrations (0.001 to 0.2% with a mode of 0.001% DEHP by mass). For solid laboratory chemicals, all identified products reported the same concentration of 0.3%; therefore, EPA used this value as a deterministic value as. Table_Apx D-5 provides the DEHP-containing laboratory chemicals compiled from SDS along with their concentrations of DEHP.

Table_Apx D-5. Product DEHP Concentrations for Use of Laboratory Chemicals

Product	DEHP Concentration (%)	Physical Form	Source Reference(s)
31031/606 Phthalate Esters Calibration Mix	0.2	Liquid	(Restek, 2023a)
31420 / Bis(2-ethylhexyl)Phthalate Standard	0.1	Liquid	(Restek, 2024a)
31621 / 8270 Calibration Mix #4	0.2	Liquid	(Restek, 2024b)
31845 / EPA Method 506 Phthalate and Adipate Esters	0.1	Liquid	(Restek, 2023b)
31850 / 8270 MegaMix®	0.1	Liquid	(Restek, 2019b)
31903 / CLP 04.1 B/N MegaMix Mix A (Revision 2)	0.1	Liquid	(Restek, 2023c)
33227 / EPA Method 8061A Phthalate Esters Mixture	0.1	Liquid	(Restek, 2019a)
BN Extractables – Skinner List	0.2	Liquid	(Phenova, 2017a)
Custom 8061 Phthalates Mix	0.1	Liquid	(Phenova, 2017b)
Custom 8270 Cal Mix 1	0.1	Liquid	(Phenova, 2018a)
Custom 8270 Cal Standard	0.2	Liquid	(Phenova, 2017c)
Custom Low ICAL Mix	0.1	Liquid	(Phenova, 2017d)
Custom SS 8270 Cal Mix 1	0.1	Liquid	(Phenova, 2017e)
EPA 525.2 Semivolatile Mix	0.1	Liquid	(Phenova, 2018c)
Mercox II Resin	5 – 20	Liquid	(Ladd Research, 2023)
Base/Neutrals Mix 1	0.2	Liquid	(SPEX CertiPrep LLC, 2019)
Phthalates in Poly(vinyl chloride)	0.3	Solid	(Spex CertiPrep LLC, 2017c)
Phthalates in Polyethylene Standard	0.3	Solid	(SPEX CertiPrep LLC, 2017a)
Phthalates in Polyethylene Standard w/BPA	0.3	Solid	(Spex CertiPrep LLC, 2017d)

D.3.8 DEHP Product Density

For liquid laboratory chemicals, EPA used a triangular distribution with the reported minimum (0.69 kg/L), maximum (1.33 kg/L), and mode densities (1.33 kg/L) to simulate a product density value. Table_Apx D-6 provides the DEHP-containing laboratory chemicals compiled from SDS along with their product densities.

Table_Apx D-6. Product DEHP Densities for Use of Laboratory Chemicals

Product	DEHP Product Density (kg/L)	Source Reference(s)
31031/606 Phthalate Esters Calibration Mix	0.791–0.792	(Restek, 2023a)

Product	DEHP Product Density (kg/L)	Source Reference(s)
31420 / Bis(2-ethylhexyl)Phthalate Standard	1.3254–1.3258	(Restek, 2024a)
31621 / 8270 Calibration Mix #4	1.3254–1.3258	(Restek, 2024b)
31845 / EPA Method 506 Phthalate and Adipate Esters	0.69	(Restek, 2023b)
31850 / 8270 MegaMix®	1.3254–1.3258	(Restek, 2019b)
31903 / CLP 04.1 B/N MegaMix Mix A (Revision 2)	1.3254–1.3258	(Restek, 2023c)
33227 / EPA Method 8061A Phthalate Esters Mixture	0.672	(Restek, 2019a)
Mercox II Resin	0.943	(Ladd Research, 2023)

D.3.9 Operating Days

EPA modeled the operating days per year using a discrete distribution with a low-end of 174 days/yr and a high-end of 260 days/yr based on the *Use of Laboratory Chemicals – Generic Scenario for Estimating Occupational Exposures and Environmental Releases* based on a working duration of 8 to 12 hours/day (U.S. EPA, 2023b).

D.3.10 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 dataset 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.

D.3.11 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 (U.S. EPA, 1991b). The CEB Manual indicates that saturation concentration for bottom filling was expected to be about 0.5 (U.S. EPA, 1991b). 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 (U.S. EPA, 1991b). 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, 2015).

D.3.12 Container Size

EPA identified laboratory chemicals packaged in small containers no larger than one gallon in size (liquids) or one kg in quantity (solids). The *Use of Laboratory Chemicals – Generic Scenario for Estimating Occupational Exposures and Environmental Releases* (U.S. EPA, 2023b) states that, in the absence of site-specific information, a default liquid volume of one gal and a default solid quantity of one kg may be used. Laboratory products containing DEHP showed container sizes less than one gallon or one kg. Based on reported liquid containers, EPA used a lower bound of 0.00026 gallons for liquids and 0.005 kg for solids. Therefore, EPA built a triangular distribution for liquid volumes with a lower bound of 0.00026 gallons, and an upper bound and mode of one gallon. EPA similarly built a triangular distribution for solid quantities with a lower bound and mode of 0.005 kg, and an upper bound of one kg.

D.3.13 Container Loss Fractions

For small liquid containers, EPA used the *EPA/OPPT Small Container Residual Model* to estimate residual releases from liquid container cleaning. The *EPA/OPPT Small Container Residual Model*, as detailed in the *ChemSTEER User Guide* (U.S. EPA, 2015) provides recommends a default central tendency loss fraction of 0.3 percent and a high-end loss fraction of 0.6 percent. 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.

For solid containers, EPA used the *EPA/OPPT Solid Residuals in Transport Containers Model* to estimate residual releases from solid container cleaning. The *EPA/OPPT Solid Residuals in Transport Containers Model*, as detailed in the *ChemSTEER User Guide* (U.S. EPA, 2015) provides an overall loss fraction of one percent from container cleaning.

D.3.14 Dust Generation Loss Fraction

The *EPA/OPPT Generic Model to Estimate Dust Releases from Transfer/Unloading/Loading Operations of Solid Powders* (Dust Release Model) was used to estimate loss fractions of solids from releases of dust to the environment (U.S. EPA, 2021b). EPA used a triangular distribution for both dust capture efficiency as well as dust control efficiency based on data presented in the Dust Release Model. The dust capture efficiency has a lower bound of 0 kg/kg with an upper bound of 1 kg/kg and a mode of 0.963 kg/kg. The dust control efficiency has a lower bound of 0 kg/kg with an upper bound of 1 kg/kg and a mode of 0.79 kg/kg.

D.3.15 Small Container Fill Rate

The *ChemSTEER User Guide* (U.S. EPA, 2015) provides a typical fill rate of 60 containers per hour for containers with less than 20 gallons of liquid.

D.3.16 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, 2015).

D.3.17 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, 2015) provides an overall loss fraction of two percent from equipment cleaning.

For solids, used the *EPA/OPPT Solid Residuals in Transport Containers Model* to estimate the releases from equipment cleaning. The *EPA/OPPT Solid Residuals in Transport Containers Model*, as detailed in the *ChemSTEER User Guide* (U.S. EPA, 2015) provides an overall loss fraction of one percent from equipment cleaning.

D.4 Use of Automotive Care Products

This appendix presents the modeling approach and equations used to estimate environmental releases for DEHP during the use of automotive care products OES. This approach utilizes the *Methodology Review Document for Automotive Detailing Products* (U.S. EPA, 2022b) combined with Monte Carlo simulation (a type of stochastic simulation).

Based on the Methodology Review Document (MRD), EPA identified the following release sources from use of automotive care products:

- Release source 1: Transfer Operation Losses to Air from Unloading Automotive Care Products.
- Release source 2: Dust Emissions from Unloading Solid Products.
- Release source 3: Container Residue Losses.
- Release source 4: Open Surface Losses to Air During Container Cleaning.
- Release source 5: Releases During Product Application.

Environmental releases for DEHP during the use of automotive care products are a function of DEHP'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, DEHP concentrations, air speed, saturation factor, container size, and loss fractions. 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.

D.4.1 Model Equations

Table_Apx D-7 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 automotive care products 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 D.4.2. The Monte Carlo simulation calculated the total DEHP 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 D-7. Models and Variables Applied for Release Sources in the Use of Automotive Care Products OES

Release Source	Model(s) Applied	Variables Used
Release source 1: Transfer Operation Losses to Air from Unloading Automotive Care Products.	*EPA/OAQPS AP-42 Loading Model* (Appendix D.1)	Vapor Generation Rate: F_{DEHP}; VP; f_{sat}; MW; R; T; V_{cont}; $RATE_{fill}$ Operating Time: $Q_{DEHP_{day}}$; V_{cont}; $RATE_{fill}$; RHO; OD; F_{DEHP}
Release source 2: Dust Emissions from Unloading Solid Product.	*N/A – Not assessed; Only identified DEHP-containing automotive care product in paste/liquid form. Solid forms of product not assessed.*	N/A – DEHP present solely in liquid formulations
Release source 3: Container Residue Losses.	*EPA/OAQPS AP-42 Small Container Residual Model* (Appendix D.1)	$Q_{DEHP_{day}}$; $F_{container\_residue}$; V_{cont}; RHO; F_{DEHP}; OD;
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 D.1)	Vapor Generation Rate: F_{DEHP}; MW; VP; $RATE_{air\_speed}$; $D_{cleaning}$; T; P Operating Time: $Q_{DEHP_{day}}$; V_{cont}; $RATE_{fill}$; RHO; OD; F_{DEHP}
Release source 5: Releases During Product Application.	See Equation D-12	$Q_{DEHP_{day}}$; $F_{container\_residue}$;

For DEHP, release source 5 (Releases During Product Application) is calculated via a mass-balance, via the following equation:

Equation D-21.

$$Release\_perDay_{RP5} = \left(Q_{DEHP_{day}}\right) * \left(1 - F_{container\_residue}\right)$$

Where:

$Release\_perDay_{RP5}$ = DEHP released for release source 5[kg/site-day]
$Q_{DEHP_{day},adj}$ = Facility throughput of DEHP (see Appendix D.4.3) [kg/site-day]
$F_{container\_residue}$ = Fraction of DEHP remaining in transport containers (see Appendix D.3.13) [kg/kg]

D.4.2 Model Input Parameters

Table_Apx D-8 summarizes the model parameters and their values for the Use of Automotive Care Products Monte Carlo simulation. Additional explanations of EPA's selection of the distributions for each parameter are provided after this table.

Table_Apx D-8. Summary of Parameter Values and Distributions Used in the Use of Automotive Care Products 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 DEHP	PV	kg/yr	130,455	—	—	—	—	See Appendix D.4.3
Use Rate of Automotive Detailing Product per Car	$Q_{product\_car}$	oz/car	2	1	16	2	Triangular	See Appendix D.4.3
Annual Number of Cars Detailed	$N_{car\_site\text{-}yr}$	cars/site-year	2,191	1,610	3,212	2,191	Triangular	See Appendix D.4.9
DEHP Automotive Care Product Concentration	F_{DEHP}	kg/kg	1.00E−03	1.00E−05	0.05	1.10E−03	Triangular	See Appendix D.4.7
Operating Days	OD	days/yr	260	174	260	260	Discrete	See Appendix D.4.8
Air Speed	$RATE_{air\_speed}$	ft/min	19.7	2.56	398	—	Lognormal	See Appendix D.4.11
Saturation Factor	f_{sat}	dimensionless	0.5	0.5	1.45	0.5	Triangular	See Appendix D.4.12
Container Volume	V_{cont}	gal	1	0.11993	1	1	Triangular	See Appendix D.4.13
Container Mass	Q_{cont}	kg	1	0.454	5	1	Triangular	See Appendix D.4.13
Fraction of DEHP remaining in Container as residue	$F_{container\_residue}$	kg/kg	3E−03	3E−04	6E−03	3E−03	Triangular	See Appendix D.4.14
Maximum Identified Number of Sites	Ns_{max}	sites	147,152	—	—	—	—	See Appendix D.4.4
Vapor Pressure at 25 °C	VP	mmHg	1.42E−07	—	—	—	—	Physical property
Molecular Weight	MW	g/mol	390.57	—	—	—	—	Physical property
Gas Constant	R	atm-cm^3/gmol-L	82.05	—	—	—	—	Universal constant
Temperature	T	K	298	—	—	—	—	Process parameter
Pressure	P	atm	1	—	—	—	—	Process parameter
Unloading Rate	$RATE_{fill}$	containers/hour	60	—	—	—	—	See Appendix D.4.15
Diameter of Opening – Container Cleaning	$D_{cleaning}$	cm	5.08	—	—	—	—	See Appendix D.4.16

D.4.3 Throughput Parameters

There were no reports of used of DEHP in automotive care products in CDR. Therefore, EPA estimated the total PV of DEHP in automotive care products 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 DEHP to CDR, regardless of assigned OES. EPA assumed that sites that claimed their PV as confidential business information (CBI) used 25,000 pounds of DEHP-containing automotive care products annually. The total PV for this OES was 130,455 kg/year.

Table_Apx D-9. Production Volume Estimation for Use of Automotive Care Products

Site Name	Site Location	Reported Production Volume (lb/year)	Threshold Limit Used	Production Volume Added to Total (lb/year)
Alac International Inc.	New York, NY	112,875	5%	5,644
AllChem Industries	Gainesville, FL	35,280	5%	1,764
Brenntag Mid-South Inc.	Henderson, KY	172,096	5%	8,605
ChemSpec, Ltd.	Uniontown, OH	131,456	5%	6,573
Eastman Chemical	Kingsport, TN	CBI	25,000	25,000
Formosa Global Solutions	Livingston, NJ	480,453	5%	24,023
GJ Chemical Co. Inc.	Newark, NJ	573,312	25,000	25,000
Harwick Standard Distribution Corp.	Akron, OH	105,623	5%	5,281
Industrial Chemicals Inc.	Vestavia Hills, AL	257,484	5%	12,874
LG Chem America Inc.	Atlanta, GA	CBI	25,000	25,000
M.A. Global Resources Inc.	Apex, NC	89,825	5%	4,491
Alphagary Corp.	Leominster, MA	214,378	5%	10,719
Alphagary Corp.	Pineville, NC	3,230,008	25,000	25,000
Momentive Performance Materials	Waterford, NY	2,985	5%	149
R.E. Carroll, Inc.	Trenton, NJ	308,844	5%	15,442
Shrieve Chemical Company, LLC	Spring, TX	CBI	25,000	25,000
The Chemical Company	Jamestown, RI	CBI	25,000	25,000
Tribute Energy, Inc.	Houston, TX	4,276,967	25,000	25,000
Univar Solutions	The Woodlands, TX	305,516	5%	15,276
Connell Bros. Co.	San Francisco, CA	35,274	5%	1,764

The *Commercial Use of Automotive Detailing Products - Generic Scenario for Estimating Occupational Exposures and Environmental Releases Methodology Review Document* (U.S. EPA, 2022b) provides annual number of car detailed which is used to calculate the annual throughput of DEHP in automotive care products. According to the MRD, the number of cars detailed a year range from 1,610 cars up to 3,212 cars per year, with the mode of this range of 2,191 cars per year. For each car detailed, the MRD provided a range of product applied to each car of one oz per car to 16 oz per car. The midpoint of this range was two oz per car. For this scenario, EPA initially assigned a triangular distribution for the annual number of cars detailed and amount of product applied per car with upper and lower bounds corresponding to the high- and low-end values, and the midpoints as the modes.

The annual throughput of automotive care products is calculated using Equation D-22 by multiplying the annual number of cars detailed per site by the use rate of detailing product per car and converting from volume to mass.

Equation D-22.

$$Q_{product-site-yr} = N_{car-site-yr} * Q_{prod-car} * \frac{0.03L}{oz} * \frac{1kg}{L}$$

Where:

$Q_{product-site-yr}$	=	Annual facility throughput of automotive care product [kg/site-year]
$N_{car-site-yr}$	=	Annual number of cars detailed [car/site-year]
$Q_{prod-car}$	=	Use rate of automotive detailing product per car [oz/car]

The annual throughput of DEHP is calculated using Equation D-23 by multiplying the annual throughput of all automotive care products by the concentration of DEHP in the product.

Equation D-23.

$$Q_{DEHP-site-yr} = Q_{product-site-yr} * F_{DEHP}$$

Where:

$Q_{DEHP-site-yr}$	=	Annual facility throughput of DEHP [kg/site-year]
$Q_{product-site-yr}$	=	Annual facility throughput of automotive care product [kg/site-year]
F_{DEHP}	=	Mass fraction of DEHP in automotive care products (see Appendix D.4.7) [kg/kg]

The daily throughput of DEHP is calculated using Equation D-24 by dividing the annual DEHP throughput by the number of operating days. The number of operating days is determined according to Appendix D.4.8.

Equation D-24.

$$Q_{DEHP-site-day} = \frac{Q_{DEHP-site-yr}}{OD}$$

Where:

$Q_{DEHP-site-day}$	=	Facility throughput of DEHP [kg/site-day]
$Q_{DEHP-site-yr}$	=	Annual facility throughput of DEHP [kg/site-day]
OD	=	Operating days (see Appendix D.4.8) [days/yr]

D.4.4 Number of Sites

For the NAICS codes identified in the *Commercial Use of Automotive Detailing Products - Generic Scenario for Estimating Occupational Exposures and Environmental Releases Methodology Review Document* there are 147,152 automotive detailing sites (U.S. EPA, 2022b). 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 D-25.

$$N_s = \frac{PV}{Q_{DEHP-site-yr}}$$

Where:

N_s	=	Number of sites [sites]
PV	=	Production volume (see Appendix D.4.3) [kg/year]
$Q_{DEHP-site-year}$	=	Facility annual throughput of DEHP (see Appendix D.4.3) [kg/site-yr]

D.4.5 Number of Containers per Year

The number of DEHP automotive care product containers unloaded by a site per year is calculated using the following equation:

Equation D-26.

$$N_{cont\_unload\_yr} = \frac{Q_{DEHP-site-day} * OD}{F_{DEHP} * Q_{cont}}$$

Where:

Q_{cont}	=	Container mass (see Appendix D.4.13) [kg/container]
$Q_{DEHP-site-day}$	=	Facility throughput of DEHP (see Appendix D.4.3) [kg/site-day]
OD	=	Operating days (see Appendix D.4.8) [days/yr]
F_{DEHP}	=	Mass fraction of DEHP in automotive care products [kg/kg] (see Appendix D.4.7)
$N_{cont\_unload\_yr}$	=	Annual number of containers unloaded [container/site-year]

D.4.6 Operating Hours

EPA estimated operating hours or hours of duration using data provided from the *Commercial Use of Automotive Detailing Products - Generic Scenario for Estimating Occupational Exposures and Environmental Releases Methodology Review Document* (U.S. EPA, 2022b), *ChemSTEER User Guide* (U.S. EPA, 2015), and/or through calculation from other parameters. Release points with operating hours provided from these sources include unloading and container cleaning.

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 D-27.

$$OH_{RP1/RP4} = \frac{N_{cont\_unload\_yr}}{RATE_{fill} * OD}$$

Where:

$OH_{RP1/RP4}$	=	Operating time for release points 1 and 4 [hours/site-day]
$RATE_{fill}$	=	Container fill rate (see Appendix D.4.15) [containers/hour]

$N_{cont\_unload\_yr}$	=	Annual number of containers unloaded (see Appendix D.4.5) [container/site-year]
OD	=	Operating days (see Appendix D.4.8) [days/site-year]

D.4.7 DEHP Concentration in Automotive Care Products

EPA used the concentration range of seven identified SDSs or published health assessment, with the mode of range represented by the mean of all products. EPA modeled the DEHP concentration in automotive care products using a triangular distribution with a low-end of 0.001 percent and a high-end of 5 percent with a mode of 0.11 percent. Table_Apx D-10 provides the DEHP-containing automotive care products compiled from SDS or health assessment along with their concentrations of DEHP.

Table_Apx D-10. Product DEHP Concentrations for Use of Automotive Care Products

Product	DEHP Concentration (%)	Source Reference(s)
Red Glazing Putty 1# Tube	1–5%	(Quest Automotive Products, 2015)
3M One-Step Rust Converter, PN 3513	1–5%	(Danish EPA, 2010)
Unknown, Vinyl Make-up	0.02%	(Danish EPA, 2010)
Unknown, Vinyl Make-up	0.11–0.14%	(Danish EPA, 2010)
Unknown, Glass Cleaners	0.0011–0.002%	(Danish EPA, 2010)
Unknown, Fabric Waterproofing	0.08–0.09%	(Danish EPA, 2010)
Unknown, Glass Cleaners	0.13%	(Danish EPA, 2010)

D.4.8 Operating Days

EPA modeled the operating days per year using a discrete distribution with a low-end of 174 days/yr and a high-end of 260 days/yr and mode of 260 days/yr based on the *Commercial Use of Automotive Detailing Products - Generic Scenario for Estimating Occupational Exposures and Environmental Releases Methodology Review Document* (U.S. EPA, 2022b).

D.4.9 Annual Number of Cars Detailed per Site

EPA modeled the annual number of cars detailed per year using a triangular distribution with a low-end of 1,610 days/yr and a high-end of 3,212 days/yr and mode of 2,191 days/yr based on the *Commercial Use of Automotive Detailing Products - Generic Scenario for Estimating Occupational Exposures and Environmental Releases Methodology Review Document* (U.S. EPA, 2022b).

D.4.10 Use Rate of Automotive Care Product per Car

EPA modeled the use rate of automotive car product per car using a triangular distribution with a low-end of one oz/car and a high-end of 16 oz/car and mode of 2 oz/car representing the median of known use rates, based on the *Commercial Use of Automotive Detailing Products - Generic Scenario for Estimating Occupational Exposures and Environmental Releases Methodology Review Document* (U.S. EPA, 2022b).

D.4.11 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 dataset 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.

D.4.12 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 (U.S. EPA, 1991b). The CEB Manual indicates that saturation concentration for bottom filling was expected to be about 0.5 (U.S. EPA, 1991b). 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 (U.S. EPA, 1991b). 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, 2015).

D.4.13 Container Size

EPA identified automotive care products packaged in small containers no smaller than 0.454 kg in quantity. EPA assumed, in the absence of site-specific or product-specific information, a default quantity of one kg and an upper bound of 5 kg, based on the range of container sizes in the *ChemSTEER User Guide* (U.S. EPA, 2015) for small containers. Therefore, EPA built a triangular distribution with a lower bound of 0.454 kg, an upper bound of five kg, and mode of one kg. All products were identified in a liquid or paste form; therefore, EPA assessed all releases in liquid form assuming a product density of one kg/L based on the *Commercial Use of Automotive Detailing Products - Generic Scenario for Estimating Occupational Exposures and Environmental Releases Methodology Review Document* (U.S. EPA, 2022b).

D.4.14 Container Loss Fractions

For small containers, 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 Small Container Residual Model*. For unloading drums by pouring 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 0.03 percent to 0.79 percent and an average of 0.32 percent. The *EPA/OPPT Small Container Residual Model* from the *ChemSTEER User Guide* (U.S. EPA, 2015) recommends a default central tendency loss fraction of 0.3 percent and a high-end loss fraction of 0.6 percent.

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, 2015). 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 pouring.

D.4.15 Small Container Fill Rate

The *ChemSTEER User Guide* (U.S. EPA, 2015) provides a typical fill rate of 60 containers per hour for containers with less than 20 gallons of liquid.

D.4.16 Diameter 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, 2015).

D.5 Inhalation Exposure to Respirable Particulates Model Approach and Parameters

The *Generic Model for Central Tendency and High-End Inhalation Exposure to Total and Respirable Particulates Not Otherwise Regulated (PNOR)* (U.S. EPA, 2021b) estimates worker inhalation exposure to respirable solid particulates using personal breathing zone (PBZ) Particulate, Not Otherwise Regulated (PNOR) monitoring data from the Occupational Safety and Health Administration's (OSHA) Chemical Exposure Health Data (CEHD) dataset. The CEHD data provides PNOR exposures as 8-hour time-weighted averages (TWAs) by assuming exposures outside the sampling time are zero, and the data also include facility NAICS code information for each data point. To estimate particulate exposures for relevant OESs, EPA used the 50th and 95th percentiles of respirable PNOR values for applicable NAICS codes as the central tendency and high-end exposure estimates, respectively.

Due to lack of data on the concentration of DEHP in the particulates, EPA assumed DEHP is present in particulates at the same mass fraction as in the bulk solid material, whether that is a plastic product or another solid article. Therefore, EPA calculates the 8-hour TWA exposure to DEHP present in dust and particulates using the following equation:

Equation D-28.

$$C_{DEHP,8hr-TWA} = C_{PNOR,8hr-TWA} \times F_{DEHP}$$

Where:

$C_{DCHP,8hr-TWA}$	=	8-hour TWA exposure to DEHP [mg/m^3]
$C_{PNOR,8hr-TWA}$	=	8-hour TWA exposure to PNOR [mg/m^3]
F_{DEHP}	=	Mass fraction of DEHP in PNOR [mg/mg]

Table_Apx D-11 provides a summary of the OESs assessed using the *Generic Model for Central Tendency and High-End Inhalation Exposure to Total and Respirable Particulates Not Otherwise Regulated (PNOR)* (U.S. EPA, 2021b) along with the associated NAICS code, PNOR 8-hour TWA exposures, DEHP mass fraction, and DEHP 8-hour TWA exposures assessed for each OES.

Table_Apx D-11. Summary of DEHP Exposure Estimates for OESs Using the Generic Model for Exposure to PNOR

Occupational Exposure Scenario (OES)	NAICS Code Assessed	Respirable PNOR 8-h TWA from Model (mg/m³)		DEHP Mass Fraction Assessed	DEHP 8-h TWA (mg/m³)	
		Central Tendency	High-End		Central Tendency	High-End
Textile finishing	313–314 – Textile Manufacturing	0.36	5	8.6E−06	3.1E−06	4.3E−05
Waste handling, treatment, and disposal	56 – Administrative and Support and Waste Management and Remediation Services	0.24	3.5	0.44	0.11	1.5

D.6 Spray Exposure Model Approach and Parameters

This section presents the modeling approach, and equations used to estimate occupational exposures for DEHP during the diffusion bonding OES as well as the application of paints, coatings, adhesives and sealants OES. This approach utilizes the Automotive Refinishing Spray Coating Mist Inhalation Model from the ESD on Coating Application via Spray-Painting in the Automotive Refinishing Industry (OECD, 2011a). The model estimates worker inhalation exposure based on the concentration of the chemical of interest in the nonvolatile portion of the sprayed product and the concentration of over sprayed mist/particles. The model is based on PBZ monitoring data for mists during automotive refinishing. EPA used the 50th and 95th percentile mist concentration along with the concentration of DEHP in the diffusion bonding products to estimate the central tendency and high-end inhalation exposures, respectively.

D.6.1 Model Design Equations

The Automotive Refinishing Spray Coating Mist Inhalation Model calculates the 8-hour TWA exposure to DEHP present in mist and particulates using the following equation:

Equation D-29.

$$C_{DEHP,8hr-TWA} = \frac{C_{mist} \times F_{DEHP\_solids} \times ED}{8\ hours}$$

Where:

$C_{DEHP,8hr-TWA}$	=	8-hour TWA inhalation exposure to DEHP (mg/m³)
C_{mist}	=	Over sprayed product mist concentration in the air within worker's breathing zone (mg/m³)
F_{DEHP_solids}	=	Mass fraction of DEHP in the non-volatile portion of the spray ($mg_{DEHP}/mg_{nonvolatile\ components}$)
ED	=	Exposure Duration (h)

D.6.2 Model Parameters

Table_Apx D-12 summarizes the input model parameters and their values for the Automotive Refinishing Spray Coating Mist Inhalation Model. Additional explanations of EPA's selection of the values for each parameter are provided after this table.

Table_Apx D-12. Summary of Parameter Values Used in the Spray Inhalation Model

OES	Input Parameter	Symbol	Unit	Parameter Value		Rationale/ Basis
				Central Tendency	High-End	
Diffusion bonding & application of paints, coatings, adhesives, and sealants	Concentration of Mist	C_{mist}	mg/m^3	3.38	22.1	See Appendix D.6.2.1
Diffusion bonding	DEHP Concentration in Product	F_{DEHP_prod}	kg/kg	0.05	0.09	See Appendix D.6.2.2
Application of paints, coatings, adhesives, and sealants	DEHP Concentration in Product	F_{DEHP_prod}	kg/kg	0.045	0.70	See Appendix D.6.2.2
Diffusion bonding & application of paints, coatings, adhesives, and sealants	Concentration of Nonvolatile Solids in the Spray Product[2]	F_{solids_prod}	kg/kg	0.5	0.25	See Appendix D.6.2.3
Diffusion bonding	DEHP Concentration of Nonvolatile Components (Calculated)	F_{DEHP_solids}	mg/mg	0.10	0.36	See Appendix D.6.2.4
Application of paints, coatings, adhesives, and sealants	DEHP Concentration of Nonvolatile Components (Calculated)	F_{DEHP_solids}	mg/mg	09	1.00	See Appendix D.6.2.4
Diffusion bonding	Exposure Duration	ED	hour	8		See Appendix D.6.2.5

D.6.2.1 Concentration of Mist

EPA utilized coating mist concentrations within spray booths obtained through a search of available OSHA In-Depth Surveys of the Automotive Refinishing Shop Industry and other relevant studies, as published in the ESD on Coating Application via Spray-Painting in the Automotive Refinishing Industry (OECD, 2011a). The data are divided into various combinations of spray booth types (*e.g.*, downdraft and crossdraft) and spray gun types (*e.g.*, conventional, high-volume low-pressure). EPA expects there to be a variety of facility types and substrates being coated such that a variety of spray booth and spray gun combinations may be used to apply the products. Due to this, EPA used mist concentrations from all scenarios for this parameter. The scenarios included combinations of crossdraft and downdraft booths with either conventional spray guns or HVLP spray guns. Central tendency and high-end scenario parameters represent the 50th and 95th percentile mist concentrations, respectively. The central tendency mist concentration was 3.38 mg/m^3 and the high-end concentration was 22.1 mg/m^3.

[2] The high-end input parameter value for Concentration of Nonvolatile Solids in the spray product is less than the concentration used in the central tendency calculation. The reason for this is that it results in DEHP being a larger percentage of the solids fraction and thus a higher DEHP exposure concentration.

D.6.2.2 DEHP Product Concentration

EPA compiled DEHP concentration information from the SDSs of diffusion bonding products containing DEHP (see Appendix A for a full list of products). EPA used material SDSs to develop a DEHP concentration distribution for the use of diffusion bonding products. Since both product SDS sheets listed a concentration of less than 10 percent DEHP, the assumed product concentration range was 1 to 9 percent. Based on this range, a high-end of 0.09 kg/kg was used with a central tendency of 0.05 kg/kg for DEHP product concentration.

EPA compiled DEHP concentration information from the SDSs of paints, coatings, adhesives, and sealants containing DEHP (see Appendix J for a full list of products). EPA used SDSs to develop a DEHP concentration distribution for the application of paints, coatings, adhesives, and sealants. Based on the SDS data, a high-end concentration of 0.70 kg/kg and central tendency concentration of 0.045 kg/kg were assessed.

D.6.2.3 Concentration of Nonvolatile Solids in the Spray Product

The ESD on Coating Application via Spray-Painting in the Automotive Refinishing Industry cites data from Volume 6 of the *Kirk-Othmer Encyclopedia of Chemical Technology* stating that nonvolatile solids in a spray paint or coating product can range from 0.15 to 0.50 kg/kg (OECD, 2011a; Bryant, 1993). EPA used the ESD recommended value of 0.50 kg/kg and the upper bound of the underlying distribution of 0.25 kg/kg for the central tendency and high-end parameters, respectively (OECD, 2011a).

D.6.2.4 DEHP Concentration in Nonvolatile Components

The mass fraction of DEHP in the nonvolatile portion of the sprayed product is calculated using the following equation:

Equation D-30.

$$F_{DEHP\_solids} = \frac{F_{DEHP\_prod}}{F_{solids\_prod}}$$

Where:

F_{DEHP_solids}	=	Mass fraction of DEHP in the nonvolatile portion of the sprayed product ($kg_{DEHP}/kg_{nonvolatile\ components}$)
F_{DEHP_prod}	=	Mass fraction of DEHP in the diffusion bonding product, spray-applied ($kg_{DEHP}/kg_{sprayed\ product}$)
F_{solids_prod}	=	Mass fraction of nonvolatile components within the sprayed product ($kg_{nonvolatile\ components}/kg_{sprayed\ product}$)

The results of this equation were a central tendency DEHP concentration of 0.10 and a high-end concentration of 0.70 for diffusion bonding, and a central tendency DEHP concentration of 0.09 and a high-end concentration of 1.00 for the application of paints, coatings, adhesives, and sealants.

D.6.2.5 Exposure Duration

EPA did not identify DEHP-specific data on spray application duration. Due to this, the exposure duration was assessed at a full eight-hour shift. There is some uncertainty in the full shift assumption since workers may have other activities (*e.g.*, container unloading and cleaning) during their shift. Additionally, those activities may result in exposures to DEHP vapors. An eight-hour duration for spraying is used and assumed to be protective of any contribution to exposures from vapors.

Appendix E CONSIDERATION OF ENGINEERING CONTROLS AND PERSONAL PROTECTIVE EQUIPMENT

The Occupational Safety and Health Administration (OSHA) and the National Institute for Occupational Safety and Health (NIOSH) recommend employers utilize the hierarchy of controls to address hazardous exposures in the workplace. The hierarchy of controls strategy outlines, in descending order of priority, the use of elimination, substitution, engineering controls, administrative controls, and lastly personal protective equipment (PPE). The hierarchy of controls prioritizes the most effective measures first which is to 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 (*e.g.*, source enclosure, local exhaust ventilation systems), followed by administrative controls (*e.g.*, do not open machine doors when running), or changes in work practices (*e.g.*, maintenance plan to check equipment to ensure no leaks) to reduce exposure potential. Administrative controls are policies and procedures instituted and overseen by the employer to limit worker exposures. Under Standard 1910.1000, OSHA requires the use of engineering or administrative controls to bring exposures to the levels permitted under the air contaminants standard. The respirators do not replace engineering controls and they are implemented in addition to feasible engineering controls (29 CFR 1910.134(a)(1). The PPE (*e.g.*, respirators, gloves) could be used 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. EPA's estimates of occupational exposure presented in this document do not assume the use of engineering controls or PPE; however, the effect of respiratory and dermal protection factors on EPA's occupational exposure estimates can be explored in *Risk Evaluation for Di-ethylhexyl Phthalate, Supplemental Information File: Risk Calculator for Occupational Exposures.*

E.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, provide respirators that are applicable and suitable for the purpose intended. Engineering and administrative controls must be implemented whenever employees are exposed above the Permissible Exposure Limit (PEL). If engineering and administrative controls do not reduce exposures to below the PEL, respirators must be worn. Respirator selection provisions are provided in part 1910.134(d) and require that appropriate respirators are selected based on the respiratory hazard(s) to which the worker will be exposed and workplace and user factors that affect respirator performance and reliability. Assigned protection factors (APFs) are provided in Table 1 under part 1910.134(d)(3)(i)(A) (see below in Table_Apx E-1) and refer to the level of respiratory protection that a respirator or class of respirators could provide to employees when the employer implements a continuing, effective respiratory protection program. 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 that meet these criteria may include air-purifying respirators with organic vapor cartridges. Respirators must meet or exceed the required level of protection listed in Table_Apx

E-1. Based on the APF, inhalation exposures may be reduced by a factor of 5 to 10,000 if respirators are properly worn and fitted.

For atmospheres that are immediately dangerous to life and health, workers must use a full facepiece pressure demand self-contained breathing apparatus (SCBA) certified by NIOSH for a minimum service life of 30 minutes or a combination full facepiece pressure demand supplied-air respirator (SAR) with auxiliary self-contained air supply. Respirators that are provided only for escape from an atmosphere that is immediately dangerous to life and health must be NIOSH-certified for escape from the atmosphere in which they will be used.

Table_Apx E-1. 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)					

E.2 Glove 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 part 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 protection factors (PFs) 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.

Gloves only offer barrier protection until the chemical breaks through the glove material. Using a conceptual model, Cherrie (Cherrie et al., 2004) proposed a glove workplace protection factor: the ratio of estimated uptake through the hands without gloves to the estimated uptake though the hands while wearing gloves: this protection factor is driven by flux and thus varies with time. The European Centre for Ecotoxicology and Toxicology of Chemicals Targeted Risk Assessment (ECETOC TRA) model represents the protection factor of gloves as a fixed, APF equal to 5, 10, or 20 (Marquart et al., 2017) where, similar to the APF for respiratory protection, the inverse of the protection factor is the fraction of the chemical that penetrates the glove. It should be noted that the described PFs are not based on experimental values or field investigations of PPE effectiveness, but rather professional judgments used in the development of the ECETOC TRA model. EPA did not identify reasonably available information on PPE usage to corroborate the PFs used in this model.

As indicated in Table_Apx E-2, use of protection factors above 1 is recommended only for glove materials that have been tested for permeation against the 1,1-dichloroethane-containing liquids associated with the condition of use. EPA has not found information that would indicate specific activity training (*e.g.*, procedure for glove removal and disposal) for tasks where dermal exposure can be expected to occur in a majority of sites in industrial only occupational exposure scenarios (OESs), so the PF of 20 would usually not be expected to be achieved.

Table_Apx E-2. Glove Protection Factors for Different Dermal Protection Strategies from ECETOC TRA v3

Dermal Protection Characteristics	Affected User Group	Indicated Efficiency (%)	Protection Factor (PF)
a. Any glove / gauntlet without permeation data and without employee training	Both industrial and professional users	0	1
b. Gloves with available permeation data indicating that the material of construction offers good protection for the substance		80	5
c. Chemically resistant gloves (*i.e.*, as *b* above) with "basic" employee training		90	10
d. Chemically resistant gloves in combination with specific activity training (*e.g.*, procedure for glove removal and disposal) for tasks where dermal exposure can be expected to occur	Industrial users only	95	20

Appendix F PROCEDURES FOR MAPPING FACILITIES FROM STANDARD ENGINEERING SOURCES TO OESs SCENARIOS AND COUs

F.1 Conditions of Use and Occupational Exposure Scenarios

Condition of Use (COU)

Toxic Substances Control Act (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 F-1. Therefore, a COU is defined as a combination of life cycle stage, category, and subcategory. EPA identifies COUs for chemicals during the scoping phase; this process is not discussed in this document.

Occupational Exposure Scenario (OES)

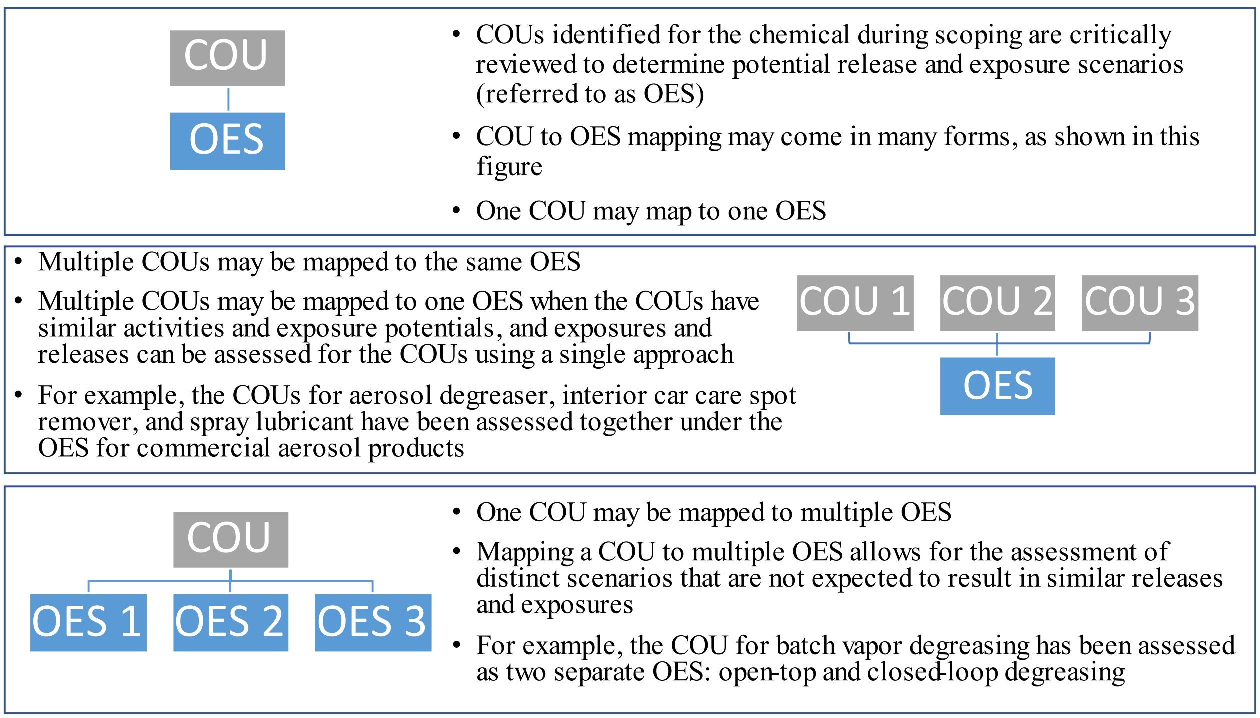
Thus far, EPA has not adopted a standardized definition for OES. The purpose of an OES is to group or segment COUs for assessment of releases and exposures based on similarity of the operations and data availability for each COU. For example, EPA may assess a group of multiple COUs together as one OES 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, EPA would not group them into the same OES. This is depicted in Figure_Apx F-1.

For chemicals undergoing risk evaluation, EPA maps each industrial and commercial COU to one or more OES 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. EPA identify OES 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 OES occur early in the risk evaluation process and are not in scope of this document. This section is intended to just provide background context on COUs and OES.

Table_Apx F-1. Example Condition of Use Table with Mapped Occupational Exposure Scenarios

Condition of Use (COU)			Occupational Exposure Scenario (OES)
Life Cycle Stage	**Category[a]**	**Subcategory**	
Manufacturing	Domestic manufacturing	Domestic manufacturing	Manufacturing
	Import	Import	Repackaging
Processing	As a reactant	Rubber product manufacturing	Rubber manufacturing
	Incorporation into formulation, mixture, or reaction product	Plastic material and resin manufacturing	Plastic converting
		Plastic product manufacturing	
	Repackaging	Other functional use in wholesale retail trade	Repackaging
	Etc.		

[a] Categories reflect CDR codes and broadly represent the industrial and/or commercial settings of the COU.
[b] The subcategories reflect more specific COUs.



Figure_Apx F-1. Condition of Use to Occupational Exposure Scenario Mapping Options

F.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:

- 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 will establish reporting requirements, including changes to CDR, to collect information that better meets data needs for the TSCA existing chemical program. The rule will have reporting requirements tiered to specific stages of existing chemical assessments (*e.g.*, prioritization, risk evaluation) and harmonized to the Organisation for Economic Co-operation and Development (OECD) risk assessment framework, which will 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 nonpoint 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 for 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. Therefore, they are not discussed further in this document.

Mapping procedures for the above sources are discussed in detail in the subsequent sections; however, Table_Apx F-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. 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 F-2 have specific reporting requirements that include flags for the type of processes that occur at the site.

Assessors should be sure that a facility that reports to multiple databases/sources is consistently mapped to the same OES, as applicable. This is not applicable if the facility reports separately for different areas/processes of their facility (*e.g.*, a large chemical plant may report one block of unit operations separate from another such that they have different OES).

Table_Apx F-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 four 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 sub-uses 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: 2023	- Reporters must select from specific uses (*e.g.*, manufacture, import, processing) and sub-uses (*e.g.*, 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	- Source Classification Codes (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 TRI 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 - National Pollutant Discharge Elimination System (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 Enforcement and Compliance History Online (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 (*e.g.*, remediation general permit).

Source	Reported Information Useful for Mapping OES/COU	Reporting Frequency	Notes
OSHA	- NAICS or SIC codes	- OSHA conducts monitoring as-needed for site investigations - Monitoring data are available in CEHD when the investigation and any subsequent litigation cases are closed - Latest year in CEHD with data: 2021	- CEHD includes data from 1984 and forward.
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: 2023	- NIOSH HHEs generally include narrative descriptions of facility processes and worker activities, with specific information on how the chemical being monitored for is used.
[a] Facilities may report using a Form A if the annual reportable release amount of the chemical did not exceed 500 pounds for the reporting year, and the amounts manufactured, or processed, or otherwise used did not exceed 1 million pounds for that year.			

F.3 OES Mapping Procedures

This section contains procedures for mapping facilities to OES for each source discussed in Appendix F.2.

F.3.1 Chemical Data Reporting

The only facilities required to report to CDR are those that manufacture or import specific chemicals at or above a specified threshold.[3] 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.

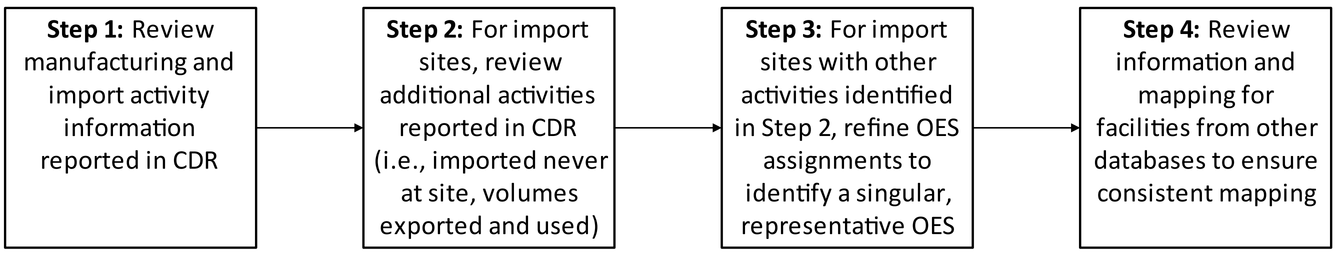
CDR, under TSCA, requires manufacturers (including importers) to provide EPA with information on the production and use of chemicals in commerce. These facilities must report to CDR every four years. For risk evaluations conducted under the amended TSCA, EPA has primarily used 2016 and 2020 CDR. The procedures in this document are appliable 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 appliable. These procedures should be applicable to future CDR, depending on changes to reporting requirements. When the TDR rule is implemented, 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;

[3] The 2020 CDR reporting instructions, including descriptions on the information required to be reported, can be found at: https://www.epa.gov/chemical-data-reporting/instructions-reporting-2020-tsca-chemical-data-reporting.

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 F-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, Appendix F.5.1 shows step-by-step examples for using the mapping procedures to determine the OES for three example CDR reporting facilities.



Figure_Apx F-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.
    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 vs. 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 4.

   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]).

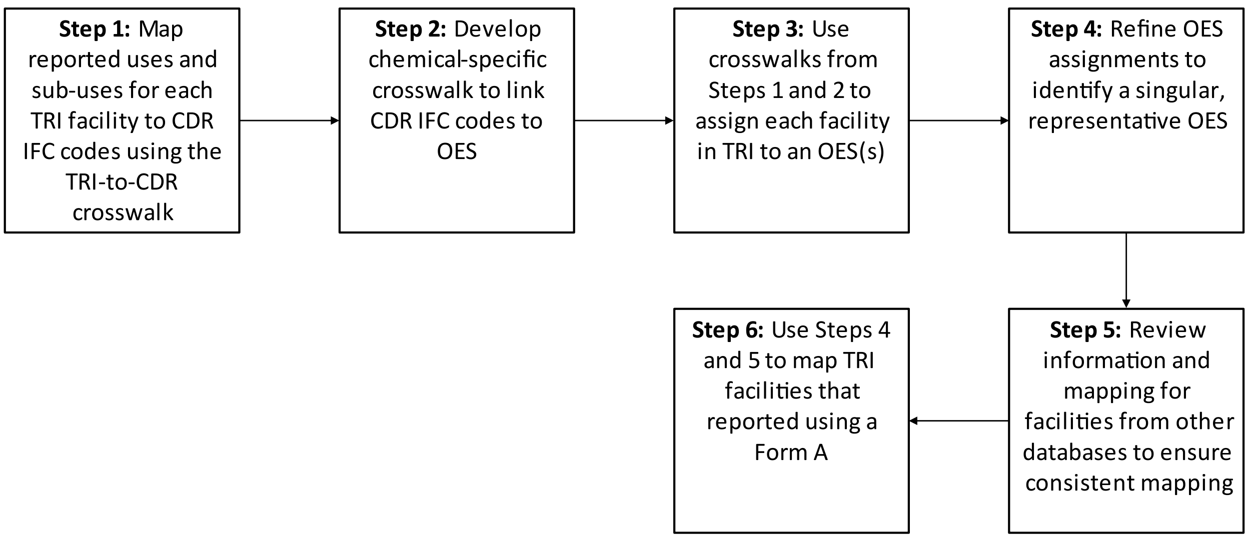
4. Review Information from Other Databases: Other databases/sources (such as TRI, NEI, and DMR) should be checked to see if the facility has reported to these. If so, the OES determined from the mapping procedures for those databases (discussed in other sections of this document) should also be used. 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.

Based on the information available in CDR, EPA expects that, for most chemicals, 100% of the sites reporting to CDR can feasibly be mapped to an OES.

F.3.2 Toxics Release Inventory

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 or greater) 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 F-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, Appendix F.5.2 shows step-by-step examples for using the mapping procedures to determine the OES for three example TRI reporting facilities.



Figure_Apx F-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 (see Appendix F.6). 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 (like the example provided in Table_Apx F-1) to the list of 2016 CDR IFC codes in the CDR reporting instructions.[4] 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,

[4] 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

n-Methylpyrrolidone, carbon tetrachloride, perchloroethylene, trichloroethylene, and 1,4-dioxane).

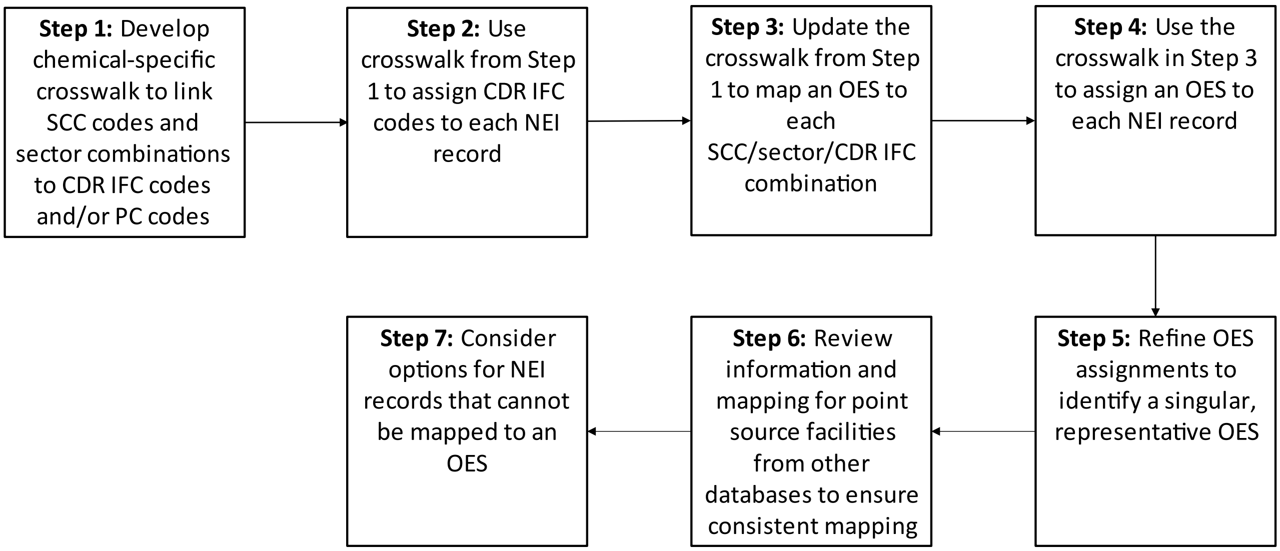
3. Assign OES: Each TRI facility is then mapped to one or more OES using the CDR IFC codes assigned to each facility in Step 1 and the CDR IFC code-to-OES crosswalk developed in Step 2.
4. Refine OES Assignments: If a facility maps to more than one OES in Step 3, a single primary OES must be selected 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 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 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 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.
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.

Given the information available in TRI, EPA expects that, for most chemicals, 100% of the sites reporting to TRI can feasibly be mapped to an OES.

F.3.3 National Emissions Inventory

The NEI is a compilation of air emissions of criteria pollutants, criteria precursors, and hazardous air pollutants from point and nonpoint 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 one to three years, depending upon the size of the source. Nonpoint estimates are typically developed by state personnel.

Figure_Apx F-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, Appendix F.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.



Figure_Apx F-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 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 as discussed in Appendix F.1.
4. Use CDR Crosswalks to Assign OES: The chemical-specific CDR crosswalks developed in Steps 1 through 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 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 b.
        - 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).

6. 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.

7. 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:

   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.

   b. Contacting the facility for clarification on the use of the chemical. Information Collection Request (ICR) requirements also apply when contacting 10 or more facilities. Note that information requests such as these may require an ICR if 10 or more entities are contacted.[5]

F.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

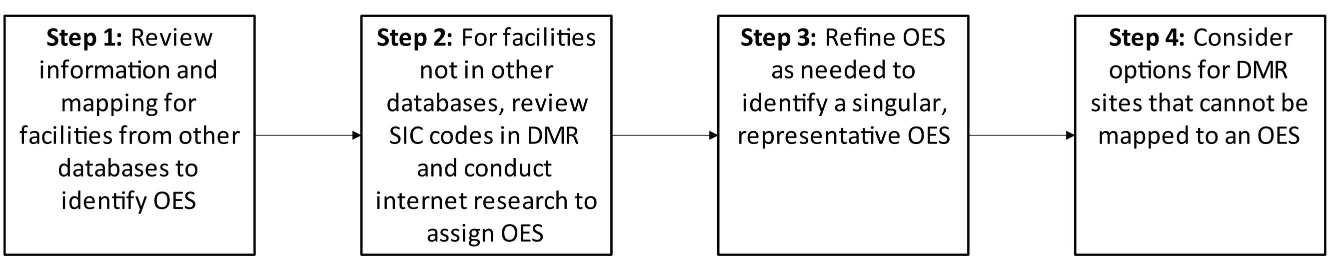
[5] More on Information Collection Requests can be found at: https://www.epa.gov/icr/icr-basics

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) commonly found within that industry.[6] 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.[7]
- 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 F-5 depicts the steps that should be followed to map DMR reporting sites to OES. Each step is explained in the text below the figure. Additionally, Appendix F.5.4 shows step-by-step examples for using the mapping procedures to determine the OES for two example DMR reporting facilities.



Figure_Apx F-5. OES Mapping Procedures for DMR

[6] A list of the industries for which EPA has promulgated effluent guidelines is available at: https://www.epa.gov/eg/industrial-effluent-guidelines#existing

[7] 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.

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 OES: 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 cross walked 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 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.[8] 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.

[8] Information on individual and general NPDES permits can be found at: https://www.epa.gov/npdes/npdes-permit-basics

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.

    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.

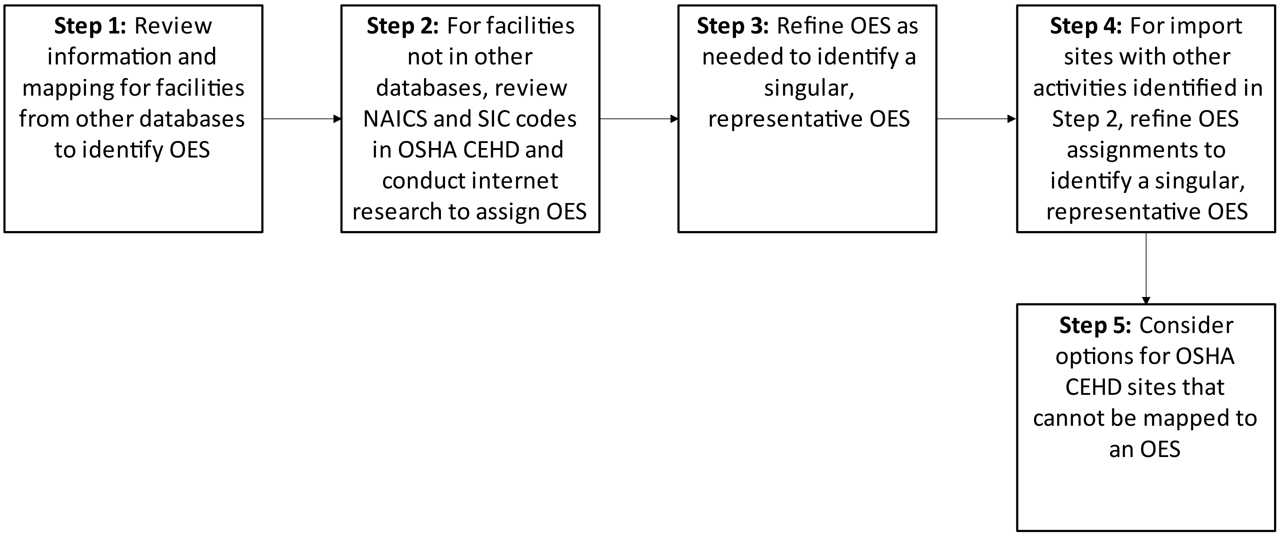
    c. Contacting the facility for clarification on the use of the chemical. ICR requirements also apply when contacting 10 or more facilities.

F.3.5 Occupational Safety and Health Administration Chemical and Exposure 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.[9] 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 F-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, Appendix F.5.5 shows step-by-step examples for using the mapping procedures to determine the OES for two example OSHA CEHD facilities.

[9] More information on OSHA CEHD can be found at: https://www.osha.gov/opengov/health-samples



Figure_Apx F-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 (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 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 are 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.

F.3.6 National Institute for Occupational Safety and Health (NIOSH) 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.[10] 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.

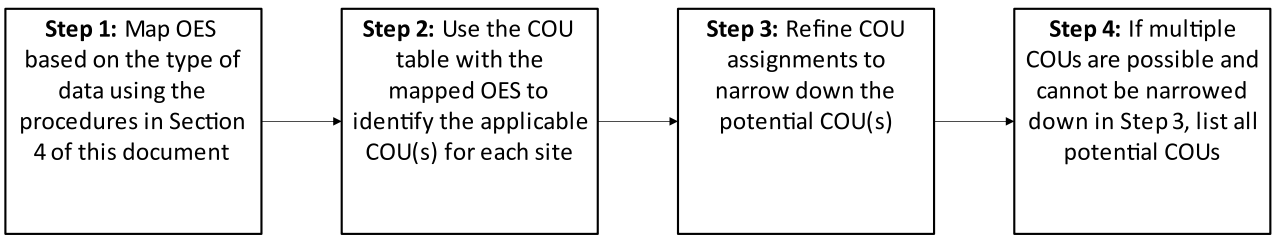
To map a facility that is the subject of a NIOSH HHE, the information in the HHE report should be used. Specifically, the HHE report typically includes general process information for the facility, information on how the chemical is used, worker activities, and the facility's SIC code. This information 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 percent of these facilities can be mapped to an OES. Additionally, Appendix F.5.6 shows two examples of how to map NIOSH HHE facilities to OES.

[10] More information about NIOSH HHEs is available at: https://www.cdc.gov/niosh/hhe/about.html

F.4 COU Mapping Procedures

As discussed in Appendix F.1, there is not always a one-to-one mapping between COUs and OES.

Figure_Apx F-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 F.3. Each step is explained in the text below the figure. Additionally, Appendix F.5.7 shows step-by-step examples for using the mapping procedures to determine the COU for three example facilities.



Figure_Apx F-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. <u>Map the Facility to an OES</u>: 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 Appendix F.3).
2. <u>Use the COU Table with Mapped OES to Assign COUs</u>: At the point of the risk evaluation process where EPA is mapping data from standard sources to OES and COU, EPA has already mapped OES to each of the COUs from the scope document, as shown in Table_Apx F-1. This crosswalk between COUs and OES should be used to identify the COU(s) for the facility using the OES mapped per Appendix F.3.
3. <u>Refine the COU Assignment</u>: 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 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 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.

F.5 Example Case Studies

This section contains step-by-step examples of how to implement the OES and COU mapping procedures listed in Appendices F.3 and F.4 to determine OES for facilities that report to standard engineering sources.

F.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 Appendix F.3.1. Specifically, this section includes examples for three example sites that reported to 2020 CDR for DEHP. 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 F-3 summarizes the information gathered from 2020 CDR for the three example sites for this step.

Table_Apx F-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	Not known or reasonably ascertainable	Not needed.	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.

1. 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. Table_Apx F-4 summarizes the information gathered from 2020 CDR for the three example sites for this step.

Table_Apx F-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	No	0	0	Cannot be determined in Step 2: Proceed with Step 3.

2. 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. Table_Apx F-5 summarizes the information gathered from 2020 CDR for the three example sites for this step.

Table_Apx F-5. Step 3 for CDR Mapping Example Facilities

Facility Name	Step 3a: NAICS	Step3b: 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	424690, Other Chemical and Allied Products Merchant Wholesalers	Processing-Repackaging	Research indicates the facility is a sells chemical and does not indicate how DEHP is used.	N/A	Using information from step 3, this site maps to the Repackaging OES.
Facility C	424690, Other Chemical and Allied Products Merchant Wholesalers	Processing-Repackaging	Research indicates the facility is a sells chemical and does not indicate how DEHP is used.	N/A	Using information from step 3, this site maps to the Repackaging OES.

F.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 Appendix F.3.2. Specifically, this appendix includes examples for three example sites that reported to TRI for the chemical 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 F-6, along with the 2016 CDR IFC codes mapped using Appendix A.

Table_Apx F-6. 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 in Appendix. The categories and subcategories of COUs typically match the IFC code category. See Table_Apx F-7 for the completed crosswalk for 1,2-dichloroethane.

Table_Apx F-7. Step 2 for TRI Mapping Example Facilities

COU and OES from Published Scope Document				Mapping		
Life Cycle Stage	Category	Subcategory	Occupational Exposure Scenario	2020 CDR IFC Code	2020 CDR IFC Code Name	Rationale
Manufacturing	Domestic manufacturing	Domestic manufacturing	Manufacturing	None	None	Per Appendix F.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 Appendix F.5.1, there is no corresponding CDR code for this COU/OES.

COU and OES from Published Scope Document				Mapping		
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
	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
		Vapor degreasing (TBD)				
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 Appendix F.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				

COU and OES from Published Scope Document				Mapping		
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 Appendix F.5.1, there is no corresponding CDR code for this COU/OES.

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 F-8 includes the potential OES for each example facility per this step.

Table_Apx F-8. 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-e. Table_Apx F-9 summarizes the information gathered for the three example sites for this step.

Table_Apx F-9. 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 F-10 summarizes the information gathered from other databases for the three example sites for this step.

Table_Apx F-10. Step 5 for TRI Mapping Example Facilities

Facility Name	Step 4: 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.	Since no additional information was determined in Step 5, the site maps to the Repackaging OES per Step 4d.

F.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 Appendix F.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 (nonpoint 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 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 shown in Table_Apx F-11 and Table_Apx F-12. Note that theses 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.
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 F-13 for Facility G (point source) and Example H (nonpoint source).
3. 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 F-7 (TRI Step 2) links CDR codes to COUs and OES and is used in this example.
4. Use CDR Crosswalks to Assign OES: 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 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 F-14 for completed Step 4 for the example facilities
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 in Steps 5a-b. See Table_Apx F-15 for Facility G (point source) and Example H (nonpoint source).

6. 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 nonpoint source Example H.
7. 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 percent 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.

Table_Apx F-11. Step 1a for NEI Mapping Example Facilities

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.

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 F-12. 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

Table_Apx F-13. 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

Table_Apx F-14. 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)	Since 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.

Table_Apx F-15. Step 5 for NEI Mapping Example Facilities

Facility Name	Sector	Step 5a: Additional Point Source Information	Step 5b: Additional Nonpoint 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.

F.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 Appendix F.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.
2. Assign OES: If the facility does not report to other databases, the reported SIC code from DMR and internet research should be used to map the facility to an OES, per Steps 2a and 2b. See Table_Apx F-16 for completed Step 2 for the example facilities.
3. Refine OES: If the specific OES still cannot be determined using the information in Step 2, information in Steps 3a-d 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 F-17 for completed Step 3 for the example facilities

Table_Apx F-16. 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, Table_Apx F-7) and internet research.

Table_Apx F-17. Step 3 for DMR Mapping Example Facilities

Facility Name	Step 3a: NPDES Permit Number	Step 3b: Finding the NPDES Permit	Step 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 in Table_Apx F-7 cover remediation.	Since 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.			

F.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 Appendix F.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.
2. 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 F-18 for completed Step 2 for the example facilities.

Table_Apx F-18. 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 in Table_Apx F-7, 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 Waste handling, disposal, treatment, and recycling OES, based on information from internet research.

3. 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 F-19 for completed Step 3 for the example facilities.

Table_Apx F-19. 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.		

F.5.6 NIOSH HHE Mapping Examples

This section includes examples of how to implement the OES mapping procedures listed in Appendix F.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. 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 F-7), 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. 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 F-7), the use of 1,2-dichloroethane as a reactant falls under the Processing as a Reactant OES.

As discussed in Appendix F.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.

F.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 Appendix F.4. Specifically, this appendix uses the same example facilities (Facility D, Facility E, and Facility F) for the TRI examples in Appendix F.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 Appendix F.3). This mapping was completed in completed in Appendix F.5.2 and is summarized in Table_Apx F-20.

Table_Apx F-20. 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

2. Use the COU Table with Mapped OES to Assign COUs: At the point of the risk evaluation process where EPA is mapping data from standard sources to OES and COU, EPA has already mapped OES to each of the COUs from the scope document. This crosswalk between COUs and OES, which is in Table_Apx F-7, for the example facilities should be used to identify the COU(s). See Table_Apx F-21 for completed Step 2 for the example facilities.

Table_Apx F-21. Step 2 for COU Mapping Example Facilities

<table>
<tr><th>Facility Name</th><th>OES Determination from Appendix A.2</th><th>Step 2: Mapped COUs</th></tr>
<tr><td>Facility D</td><td>Processing as a reactant</td><td>Using the COU to OES crosswalk previously developed (Table_Apx F-7), the COUs that map to this OES are:
<table>
<tr><th>Life Cycle Stage</th><th>Category</th><th>Subcategory</th></tr>
<tr><td rowspan="3">Processing</td><td rowspan="3">Processing–as a reactant</td><td>Intermediate in petrochemical manufacturing</td></tr>
<tr><td>Plastic material and resin manufacturing</td></tr>
<tr><td>All other basic organic chemical manufacturing</td></tr>
</table></td></tr>
<tr><td>Facility E</td><td>Functional fluids (closed systems)</td><td>Using the COU to OES crosswalk previously developed (Table_Apx F-7), only one COU maps to this OES:
<table>
<tr><th>Life Cycle Stage</th><th>Category</th><th>Subcategory</th></tr>
<tr><td>Industrial use</td><td>Functional fluids (closed systems)</td><td>Engine coolant additive</td></tr>
</table></td></tr>
<tr><td>Facility F</td><td>Repackaging</td><td>Using the COU to OES crosswalk previously developed (Table_Apx F-7), only one COU maps to this OES:
<table>
<tr><th>Life Cycle Stage</th><th>Category</th><th>Subcategory</th></tr>
<tr><td>Repackaging</td><td>Repackaging</td><td>Repackaging</td></tr>
</table></td></tr>
</table>

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-b. See Table_Apx F-22 for completed Step 3 for the example facilities.

Table_Apx F-22. 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	The facility is a large chemical	The COU subcategory for "Plastic material and resin manufacturing" can be eliminated.

Facility Name	Step 3a: NAICS Code	Step 3b: Internet Research	COU Determination
	Transportation	manufacturing plant.	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 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. Since 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 F-23. Since a COU consists of a life cycle stage, category, and subcategory, all three should be presented in this step.

Table_Apx F-23. 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

F.6 TRI to CDR Use Mapping Crosswalk

Table_Apx F-24 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 F-24 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 should be used with Table_Apx F-24.

Table_Apx F-24. 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

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.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 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

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
						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.
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

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
						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.e.*, 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.e.*, 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.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

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
						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.
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

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
						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.
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

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
						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 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, and peroxydisulfuric acid salts.

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
						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 thermoset 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.e.*, 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.

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.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.e.*, 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

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
						that only relabel or redistribute the reportable chemical substance without removing the chemical substance from the container in which it is received or purchased.
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 (*e.g.*, 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

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
						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	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.

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.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.
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

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
						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 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 (*e.g.*, chlorine, hypochlorite, N-chloro compounds and chlorine dioxide); and peroxygen bleaching agents (*e.g.*, 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.

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
						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 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).

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.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 anti-freezes 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.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 (*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	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

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
						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	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 (*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	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,

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
						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.
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

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
						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 oxidative process which degrades the color system. Examples generally fall into one of two groups: chlorine containing bleaching agents (*e.g.*, chlorine, hypochlorites, N-chloro compounds and chlorine dioxide); and peroxygen bleaching agents (*e.g.*, hydrogen peroxide, potassium permanganate, and sodium perborate).

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	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 (*e.g.*, chlorine, hypochlorites, N-chloro compounds and chlorine dioxide); and peroxygen bleaching agents (*e.g.*, hydrogen peroxide, potassium permanganate, and sodium perborate).
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,

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
						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 (*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.

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 anti-freezes 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.

Appendix G ESTIMATING DAILY WASTEWATER DISCHARGES FROM DISCHARGE MONITORING REPORTS AND TOXICS RELEASE INVENTORY DATA

This section provides steps and examples for estimating daily wastewater discharges from industrial and commercial facilities manufacturing, processing, or using chemicals undergoing risk evaluation under the Toxics Substances Control Act (TSCA). Wastewater discharges are reported either via Discharge Monitoring Reports (DMRs) under the National Pollutant Discharge Elimination System (NPDES) or the Toxics Release Inventory (TRI).

Estimation Methods are provided:

- Average Daily Wastewater Discharge Rate (kg/site-day) and
- Trends over 5 years for a facility including the Maximum, Median, and Most Recent annual 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.

G.1 Collecting and Mapping Wastewater Discharge Data to Conditions of Use and Occupational Exposure Scenarios

The first step in estimating daily releases is obtaining and mapping the relevant data to the conditions of use (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 Risk Evaluation to further define the COUs into more specific occupational exposure scenarios (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 five 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 two months, quarterly). TRI data are only reported annually for the previous calendar year and is typically released in July (*i.e.*, 2020 TRI data are 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 five 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.

G.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. Section 2.3.2 of this report describes approach for estimating number of days.

G.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/yr have been completed, the next steps in the analysis are to make estimates of 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 (see Appendix G.2 for approach to estimating operating days/year).

This approach can be used for both direct discharges to surface water and indirect discharges to publicly owned treatment works (POTW) or non-POTW wastewater treatment (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. EPA determines if a receiving POTW or non-POTW WWT in TRI overlaps with DMR facilities based on the receiving facilities FRS ID.

G.4 Trends in Wastewater Discharge Data: 5 Year Data Characterization

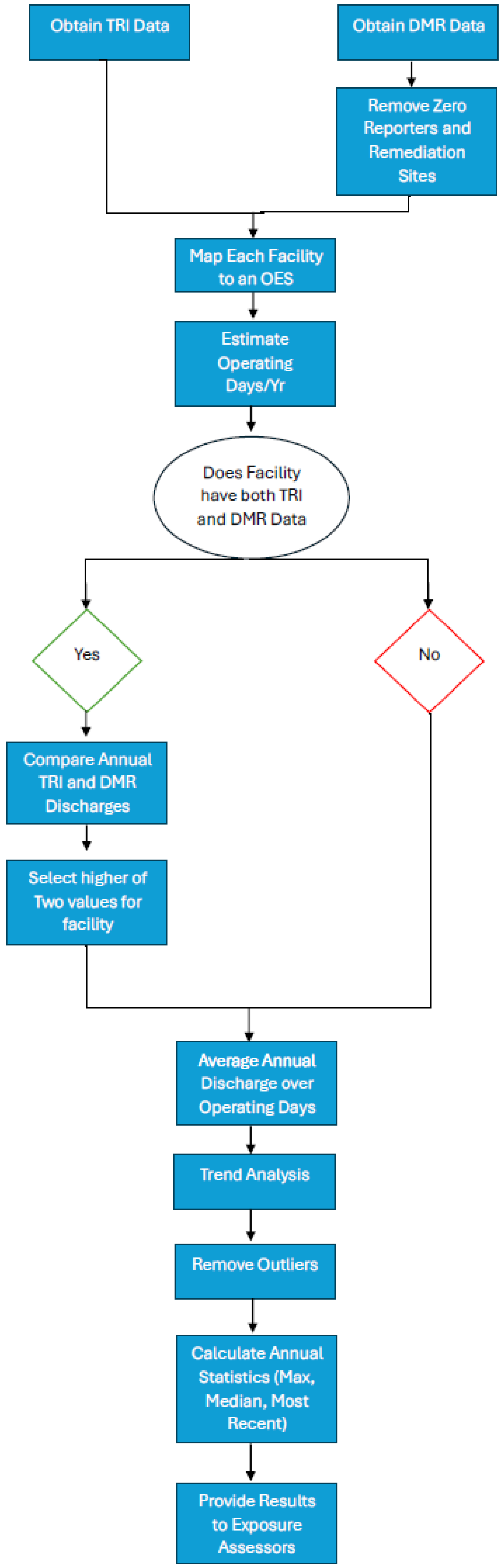
Wastewater discharge data may vary from year to year for a facility due to factors including the economy. A trend of the releases from each facility can be used to characterize results and develop a range of potential discharges from each site. A 5-year period will be used for this analysis. Prior to calculating the five-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 <25th percentile − 1.5IQR or values >75th percentile + 1.5IQR would be considered outliers.

After any outliers are removed, the five-year maximum, median, and most recent (if different than the maximum) annual discharge and associated daily discharge (using the method in Appendix G.3 should be determined for each facility.

G.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 G-1 below, helps visualize the process for estimating daily discharges.



Figure_Apx G-1. Decision Tree for Wastewater Discharge Estimates Using TRI and DMR Data

G.5 Example Facilities

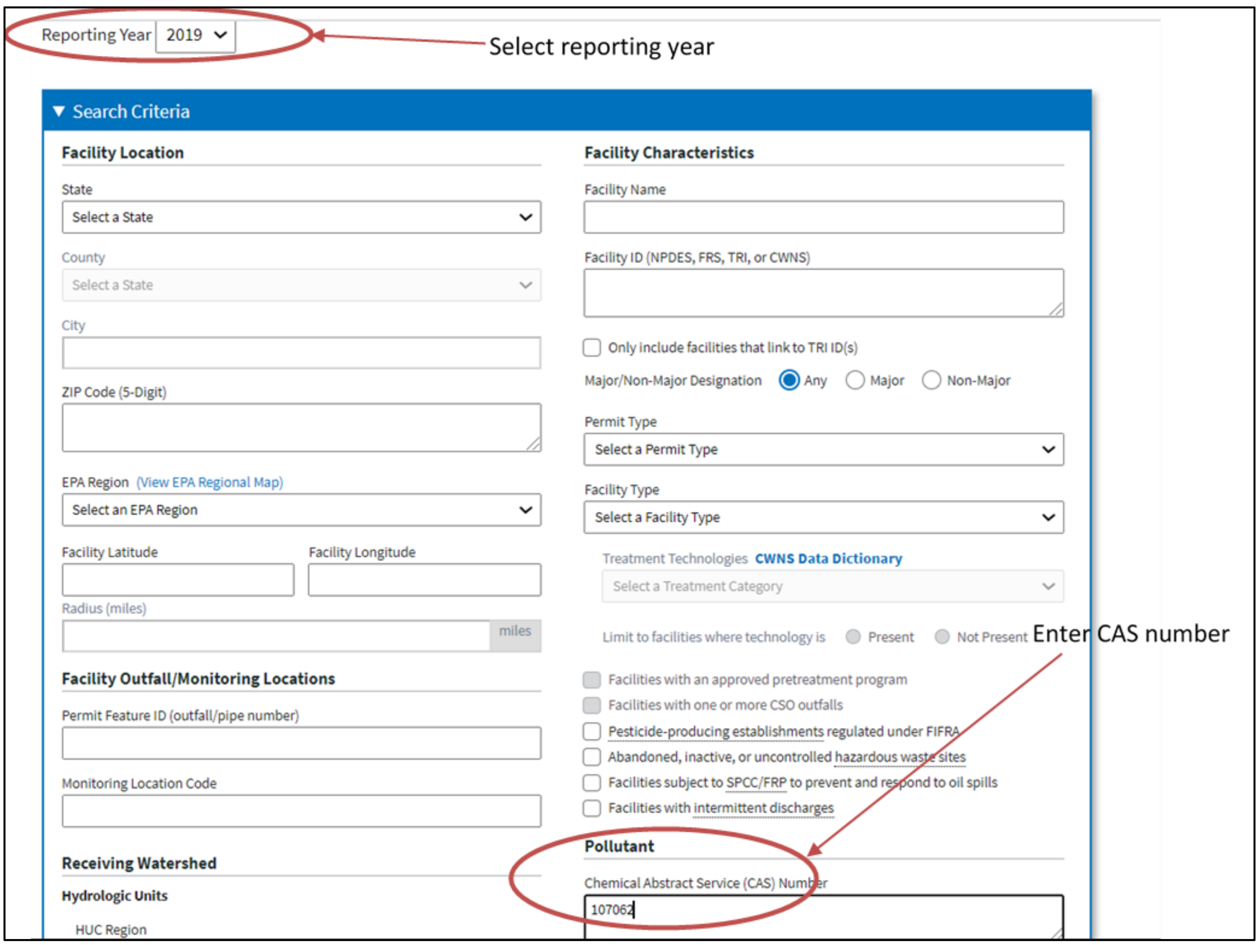
This section illustrates how to calculate average daily discharges for situations where a facility has both TRI and DMR data and where a facility only has TRI data. The examples provided are for two facilities reporting for DEHP:

1. Teknor Apex Tennessee Company in Haywood, TN: reports both DMR and TRI; and
2. Teknor Apex Co in City of Industry, CA: reports to TRI only.

For purposes of this example, only a single year for each database is presented.

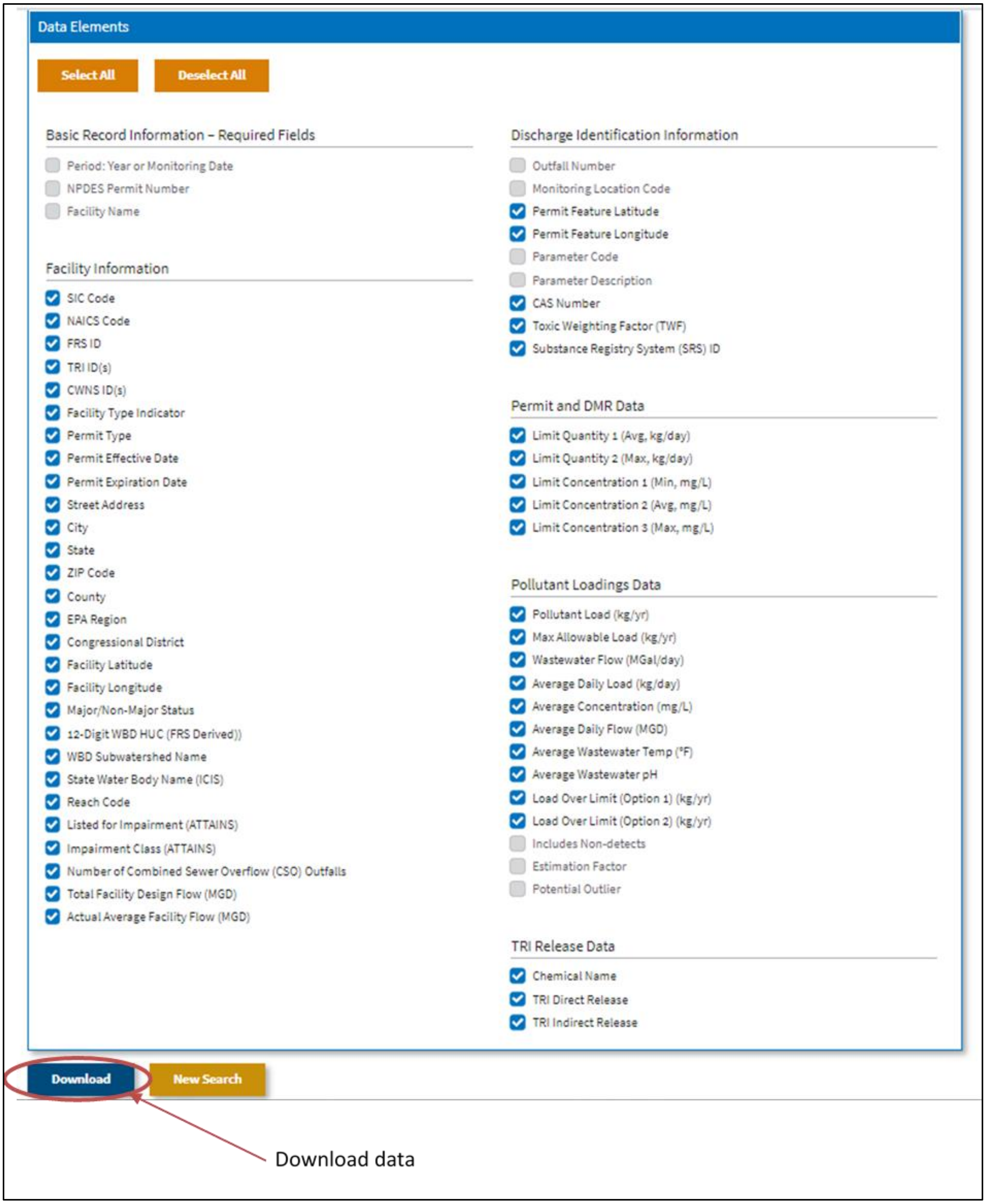
Obtaining DMR Data

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, select the reporting year of interest and then enter a chemical CAS number as shown in Figure_Apx G-2.



Figure_Apx G-2. Loading Tool – Data Query

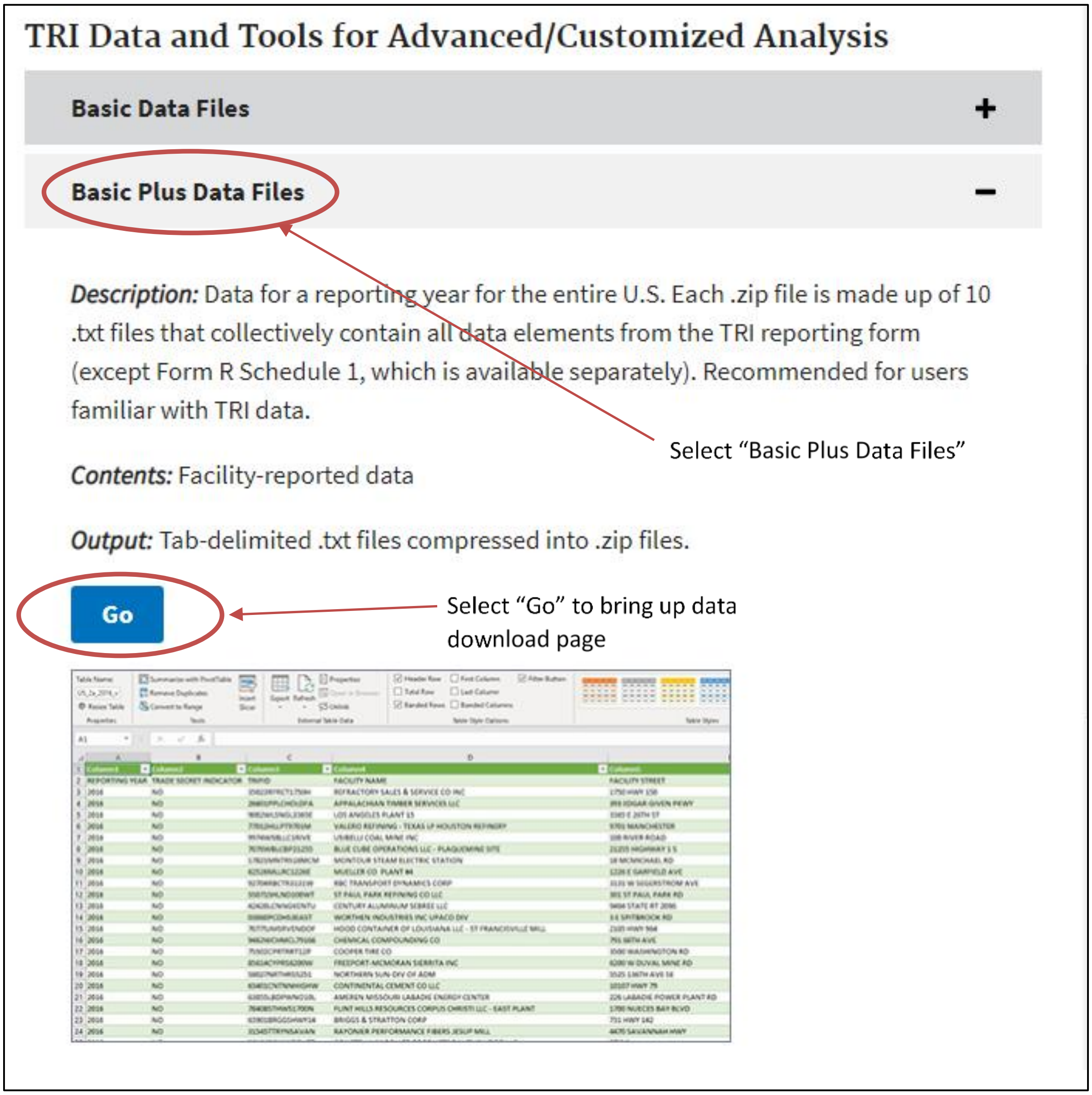
After clicking submit, the Loading Tool will present a list of data elements that can be selected or deselected for the query. By default, all data elements will be selected and for this methodology, it is suggested to leave that unchanged to ensure all relevant data fields are downloaded. The user should then click “download”, as shown in Figure_Apx G-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.



Figure_Apx G-3. Loading Tool – Download Facility Discharges from Query Results

Obtaining TRI Data

TRI data are 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. These data can be obtained by going to the following website: https://www.epa.gov/toxics-release-inventory-tri-program/tri-data-and-tools, selecting “Basic Plus Data Files”, then “Go” as shown in Figure_Apx G-4.

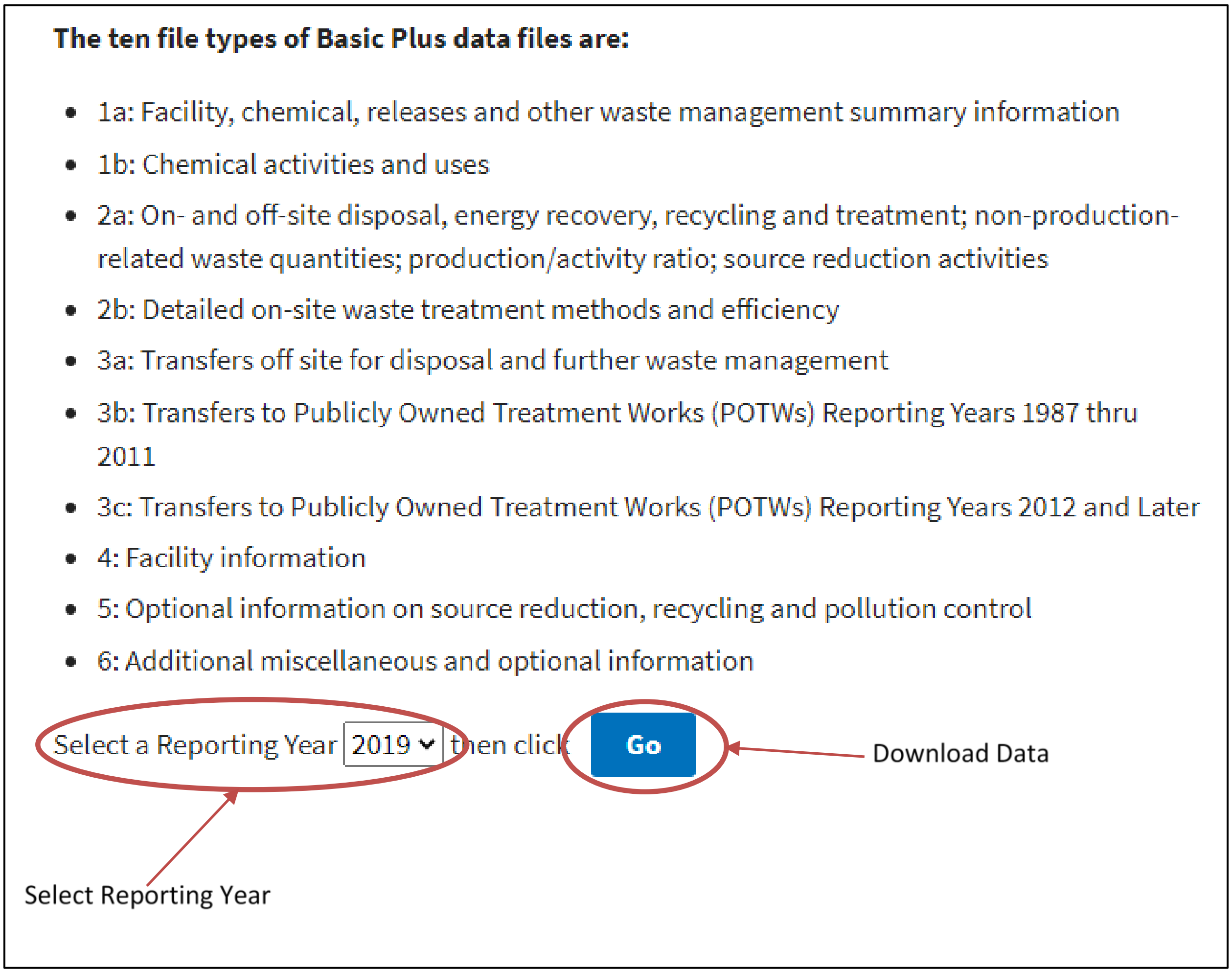


Figure_Apx G-4. Accessing Basic Plus Data Files[a]

[a] Guides for accessing, downloading, and importing the Basic Plus Data files can be found on EPA’s website.

The subsequent webpage can then be used to select the reporting year of interest and download the data files as shown in Figure_Apx G-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.[11] Table_Apx G-1 provides a list of key data fields and which Basic Plus data file they can be obtained from.

[11] 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 document.



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 G-5. TRI – Downloading Basic Data Plus Files

Table_Apx G-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

TRI Basic Plus Data File	Field Name
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
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

TRI Basic Plus Data File	Field Name
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
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

TRI Basic Plus Data File	Field Name
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
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

TRI Basic Plus Data File	Field Name
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
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

TRI Basic Plus Data File	Field Name
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
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

TRI Basic Plus Data File	Field Name
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
US_3c_[Year]	6. ELEMENTAL METAL INCLUDED
US_3c_[Year]	8. CLASSIFICATION

TRI Basic Plus Data File	Field Name
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

TRI Basic Plus Data File	Field Name
US_3c_[Year]	81. QUANTITY TRANSFERRED
US_3c_[Year]	82. BASIS OF ESTIMATE
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. EXPERIMENTTAL AND ESTIMATED TREATMENT
US_3c_[Year]	105. EXPERIMENTTAL 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 DMR and reported North American Industry Classification System (NAICS) codes of Custom Compounding of Purchased Resins (325991). Therefore, they are mapped to the Plastic compounding OES. Based on the revised Plastic compounding GS, each facility is assumed to operate 246 days/year (U.S. EPA, 2021d).

Annual Facility Discharges

Annual facility discharges can be obtained directly from the Loading Tool and TRI data file downloads for each facility. The 2020 annual discharges for the two facilities in this example are provided in Table_Apx G-2.

Table_Apx G-2. Example Facilities' 2020 Annual Discharges

Facility	Annual Surface Water Discharge from Loading Tool (kg)	Annual Reported Discharge from TRI (kg)
Teknor Apex Tennessee Company, TN	0.60 kg	0.91 kg to surface water 6.8 kg to POTW 0 kg to non-POTW WWT
Teknor Apex Co, CA	N/A: No DMR data for this facility	1.8 kg to surface water 3.2 kg to POTW 0 kg to non-POTW WWT

Average Daily Discharges

To calculate average daily discharges at each facility, the annual discharge, separated by type of reception (*i.e.*, surface water, POTW, non-POTW WWT) is averaged over the number of operating as shown in the calculations below:

$$ADR = \frac{YR}{OD}$$

Where:

ADR = Average daily discharge (kg/day)
YR = Annual discharge (kg/year)
OD = Operating days (days/year)

For Teknor Apex Tennessee Company the annual discharge of 0.60 kg/year is averaged over 246 days/year (operating days for plastic compounding) to calculate the daily discharge using DMR as:

$$ADR = \frac{YR}{OD} = \frac{0.60\ kg/yr}{246\ days/yr} = 0.002\ kg/day$$

For Teknor Apex Tennessee Company the average daily discharge for surface water using TRI is calculated as the 0.91 kg/year annual discharge over 246 days/year, as shown below:

$$ADR = \frac{YR}{OD} = \frac{0.91\ kg/yr}{246\ days/yr} = 0.003\ kg/day$$

For Teknor Apex Tennessee Company, the average daily discharge for transfer to POTW using TRI is calculated as 6.8 kg/yr annual discharge over 246 days/yr, as shown below:

$$ADR = \frac{YR}{OD} = \frac{6.8\ kg/yr}{246\ days/yr} = 0.028\ kg/day$$

Similarly, for Teknor Apex Co, the average daily discharge for surface water is calculated as the annual discharge of 1.8 kg/year over 246 days/year:

$$ADR = \frac{YR}{OD} = \frac{1.8\ kg/yr}{246\ days/yr} = 0.007\ kg/day$$

Finally, for Teknor Apex Tennessee Company, the average daily discharge for transfer to POTW using

TRI is calculated as 3.2 kg/yr annual discharge over 246 days/yr, as shown below:

$$ADR = \frac{YR}{OD} = \frac{3.2\ kg/yr}{246\ days/yr} = 0.013\ kg/day$$

Appendix H GUIDANCE FOR USING THE NATIONAL EMISSIONS INVENTORY AND TOXIC RELEASE INVENTORY FOR ESTIMATING AIR RELEASES

This section provides guidance for using EPA's National Emissions Inventory (NEI) and Toxics Release Inventory (TRI) data to estimate air releases for certain chemicals undergoing risk evaluation under the Toxic Substances Control Act (TSCA). These estimates will be used as inputs to air modeling for the purposes of estimating ambient air concentrations.

H.1 Background

EPA's NEI and TRI programs require individual facilities, as well as state, local, and tribal (SLT) Air Agencies, to report information on airborne chemical releases to the EPA. While 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 occupational exposure scenarios (OES).

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 document provides an approach for using NEI data, in combination with TRI data, to estimate air emissions.

H.2 Obtaining Air Emissions Data

H.2.1 Obtaining NEI Data

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.[12] The zipped point source data files are extremely large and require specialized database experience to query and manipulate. As an alternative, EPA's Emissions Inventory System (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 Microsoft (MS) Excel (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.,* North American Industry Classification System [NAICS] code).

H.2.2 Obtaining TRI Data

TRI data may be downloaded from EPA's public TRI Program, TRI Data and Tools website.[13] Once the csv file(s) has (have) been downloaded, the data are filtered by the chemical of interest using the CAS number and/or chemical name. Relevant NEI data fields include reporting year, facility identifying

[12] https://www.epa.gov/air-emissions-inventories/2017-national-emissions-inventory-nei-data#datas
[13] https://www.epa.gov/toxics-release-inventory-tri-program/tri-data-and-tools

information (*e.g.*, name, address, FRS ID, and TRIFID), chemical information (chemical name, CAS), primary NAICS codes, fugitive air releases, and stack air releases.

H.3 Mapping NEI and TRI DATA to Occupational Exposure Scenarios

Once TRI and NEI data are obtained, the next step is to map the data to OESs. For procedures for mapping facilities from TRI and NEI to OES, refer to Appendix F.

H.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.

H.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), although 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 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 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.

H.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.[14] Other sources of release duration and pattern information include GSs and Emission Scenario Documents (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

[14] Note that the NEI operating hours fields are not populated for all NEI entries.

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 GS/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 GS/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 GS/ESDs, are another source of information for release duration. Often, release duration information from literature sources 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 these 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 are 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 GS/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 GS/ESDs) sometimes, but 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 GS/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), EPA 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 as: Days/yr = hours per year ÷ hours per day.
    b. If hours per year and/or hours per day are not reported, calculate days per year as: Days/yr = Days per week x weeks per year
2. *Facility-specific use rates:* If information on facility-specific use rates is available, estimate days/yr using one of the following approaches:

    a. If facilities have known or estimated average daily use rates, calculate the days/yr as: Days/yr = Estimated Annual Use Rate for the Site (kg/yr) ÷ average daily use rate from sites with available data (kg/day).

   b. If sites without days/yr data do not have known or estimated average daily use rates, use the average number of days/yr 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/yr should be used. This assumes the plant runs 7 day/week and 50 week/yr (with two 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/yr should be used. This assumes the plant manufactures the chemical 5 days/week and 50 weeks/yr (with two weeks down for turnaround).

6. *Processing as reactant (intermediate use) in the manufacture of commodity chemical*s: As noted above, the manufacture of commodity chemicals is assumed to occur 350 days/yr such that the use of a chemical as a reactant to manufacture a commodity chemical will also occur 350 days/yr.

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/yr 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/yr 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/yr for the chemical industry. However, in instances where the OES uses a low volume of the chemical of interest, 250 days/yr can be used as a lower estimate for the days/yr.

9. *All Other OESs:* Regardless of facility operating schedule, other OES are unlikely to use the chemical of interest every day. Therefore, a value of 250 days/yr should be used for these OESs.

Estimating Number of Operating Days for Area Sources

For area sources, EPA will also estimate operating days per year using information such as NEI operating data for major source facilities within the same OES, general information about the OES, and values from literature. Facility operating days per year will be used to calculate daily emissions from the NEI and TRI annual emissions data, as:

Daily emissions (kg/day) = Annual emissions (kg/yr) ÷ Operating days per year (days/yr)

Appendix I PRODUCTS CONTAINING DEHP

This section includes a sample of products containing DEHP. This is not a comprehensive list of products containing DEHP. In addition, some manufacturers may appear over-represented in this table. This may mean that they are more likely to disclose product ingredients online than other manufacturers but does not imply anything about the use of the chemical compared to other manufacturers in this sector.

Table_Apx I-1. Products Containing DEHP

Occupational Exposure Scenario (OES)	Product	Manufacturer	DEHP Concentration	Source
Application of paints, coatings, adhesives, and sealants	Modified Asphalt	Valero Marketing & Supply Company and Affiliates	< 0.1%, unspecified	(Valero Marketing and Supply Company, 2014)
Fabrication of final product from articles	BriteLine Banner	Ultraflex Systems	10 – 20%, by weight	(Ultraflex Systems, 2018)
Application of paints, coatings, adhesives, and sealants	3M Scotchcast Poly Plus (Colors)	3M	0.1 – 1.0%, unspecified	(3M, 2018)
Application of paints, coatings, adhesives, and sealants	MC-SHIELDCOAT 100	Wasser Corporation	1 – 5%, unspecified	(Wasser Corporation, 2021b)
Application of paints, coatings, adhesives, and sealants	Rock-It® Adhesive	Tremco U.S. Roofing	7 – 13%, by weight	(Tremco U.S. Roofing, 2018)
Application of paints, coatings, adhesives, and sealants	TREMPROOF 250 GC-R-LV 5 GAL	Tremco Incorporated	< 1.0%, by weight	(Tremco Incorporated, 2018)
Incorporation into formulation, mixture, or reaction product	Polyflex 411A Iso-Catalyst	Wasser Corporation	5 – 10%, by weight	(Wasser Corporation, 2021a)
Use of dyes and pigments, and fixing agents	Universal C/P Beach, Cotton, Eggshell Cream, Lt Cream, Mint, Parchment, Super White	Tremco U.S. Sealants, Tremco Canadian Sealants	0.1 – 1%, by weight	(Tremco Canadian Sealants, 2015a, b) (Tremco U.S. Sealants, 2015a, b, c, d, e)

Occupational Exposure Scenario (OES)	Product	Manufacturer	DEHP Concentration	Source
Use of dyes and pigments, and fixing agents	Universal C/P Sunset Yellow	Tremco U.S. Sealants	0.1 − <0.3%, by weight	(Tremco U.S. Sealants, 2016)
Application of paints, coatings, adhesives, and sealants	Duro Dyne Durolon Fabric	Duro Dyne Corporation	1 − 5%, by weight	(Duro Dyne Corporation, 2014)
Incorporation into formulation, mixture, or reaction product	High Density Cork	Tekstur	Unknown	(Tekstur)
Incorporation into formulation, mixture, or reaction product	WECU Soundless / WECU Soundless+	WE Cork, Inc.	Unknown	(WE Cork Inc., 2018)
Incorporation into formulation, mixture, or reaction product	DOP DLD Drum	HB Chemical	72%, by weight	(HB Chemical, 2015a)
Incorporation into formulation, mixture, or reaction product	HB C-90D	HB Chemical	7.0 − 13.0%, unspecified	(HB Chemical, 2019)
Plastic compounding	Anaconda Type MTC Blk 1- 1/4	ANAMET Electrical Inc.	0.000 − 7.583%, by weight	(ANAMET Electrical Inc., 2012)
Plastic compounding	3M™ Economy Vinyl Electrical Tape 1400, 1400C	3M	7 − 10%, by weight	(3M, 2011)
Rubber manufacturing	CIRCALOK 6410 A	LORD Corporation	5 – 10%, unspecified	(Lord Corporation, 2020)
Rubber manufacturing	CIRCALOK 6410 B	LORD Corporation	65 – 70%, unspecified	(Lord Corporation, 2021)
Incorporation into formulation, mixture, or reaction product	Pronto Putty	The Valspar Corporation	3-5%, by weight	(Valspar, 2019)
Incorporation into formulation,	Stopyt Product: Regular	Morgan Advanced	< 10%, by weight	(Morgan Advanced Materials, 2016b)

Occupational Exposure Scenario (OES)	Product	Manufacturer	DEHP Concentration	Source
mixture, or reaction product		Materials - Wesgo Metals®		
Incorporation into formulation, mixture, or reaction product	Chocolate Fragrance Oil	Wellington Fragrance	> 80%, unspecified	(Wellington Fragrance, 2014)
Use of automotive care products	Red Glazing Putty 1# Tube	Quest Automotive Products	1 − <5%, unspecified	(Quest Automotive Products, 2015)
Use of laboratory chemicals	31420 / Bis(2-ethylhexyl) Phthalate Standard	Restek Corporation	0.1%, unspecified	(Restek, 2024a)
Use of laboratory chemicals	31621 / 8270 Calibration Mix #4	Restek Corporation	0.2%, unspecified	(Restek, 2024b)
Use of laboratory chemicals	31845 / EPA Method 506 Phthalate and Adipate Esters	Restek Corporation	0.1%, unspecified	(Restek, 2023b)
Use of laboratory chemicals	31850 / 8270 MegaMix®	Restek Corporation	0.1%, unspecified	(Restek, 2019b)
Use of laboratory chemicals	31903 / CLP 04.1 B/N MegaMix Mix A (Revision 2)	Restek Corporation	0.1%, unspecified	(Restek, 2023c)
Use of laboratory chemicals	33227 / EPA Method 8061A Phthalate Esters Mixture	Restek Corporation	0.1%, unspecified	(Restek, 2019a)
Use of laboratory chemicals	bis(2-Ethylhexyl)phthalate in PE	SPEX CertiPrep LLC	0.1%, unspecified	(SPEX CertiPrep LLC, 2023)
Use of laboratory chemicals	BN Extractables – Skinner List	Phenova	0.2%, unspecified	(Phenova, 2017a)
Use of laboratory chemicals	Custom 8061 Phthalates Mix	Phenova	0.1%, unspecified	(Phenova, 2017b)

Occupational Exposure Scenario (OES)	Product	Manufacturer	DEHP Concentration	Source
Use of laboratory chemicals	Custom 8270 Cal Mix 1	Phenova	0.1%, unspecified	(Phenova, 2018a)
Use of laboratory chemicals	Custom 8270 Cal Standard	Phenova	0.2%, unspecified	(Phenova, 2017c)
Use of laboratory chemicals	Custom 8270 Plus Cal Mix	Phenova	Laboratory chemical	(Phenova, 2017d)
Use of laboratory chemicals	Custom Low ICAL Mix	Phenova	0.1%, unspecified	(Phenova, 2017e)
Use of laboratory chemicals	Custom SS 8270 Cal Mix 1	Phenova	0.1%, unspecified	(Phenova, 2018b)
Use of laboratory chemicals	Dioctyl phthalate	Sigma Aldrich	90 − 100%, unspecified	(Sigma Aldrich, 2024)
Use of laboratory chemicals	EPA 525.2 Semivolatile Mix	Phenova	0.1%, unspecified	(Phenova, 2018c)
Use of laboratory chemicals	HALOETHERS & PHTHALATES	SPEX CertiPrep LLC	0.2%, unspecified	(SPEX CertiPrep LLC, 2016)
Use of laboratory chemicals	Mercox II Resin	Ladd Research	5 − 20%, unspecified	(Ladd Research, 2023)
Use of laboratory chemicals	Base/Neutrals Mix 1	SPEX CertiPrep LLC	0.2%, unspecified	(SPEX CertiPrep LLC, 2019)
Use of laboratory chemicals	Phthalate Standard	SPEX CertiPrep LLC	0.1%, unspecified	(Spex CertiPrep LLC, 2017b)
Use of laboratory chemicals	Phthalates in Poly(vinyl chloride)	SPEX CertiPrep LLC	0.3%, unspecified	(Spex CertiPrep LLC, 2017c)
Use of laboratory chemicals	Phthalates in Polyethylene Standard	SPEX CertiPrep LLC	0.3%, unspecified	(SPEX CertiPrep LLC, 2017a)
Use of laboratory chemicals	Phthalates in Polyethylene Standard w/BPA	SPEX CertiPrep LLC	0.3%, unspecified	(Spex CertiPrep LLC, 2017d)
Incorporation into formulation, mixture, or reaction product	Champ-LubeTM 20 Plus	Athena Champion	Unknown	(Athena Champion, 2013)

Occupational Exposure Scenario (OES)	Product	Manufacturer	DEHP Concentration	Source
Incorporation into formulation, mixture, or reaction product	Octoil	Inland Vacuum Industries	100%, by volume	(Inland Vacuum Industries, 2005)
Application of paints, coatings, adhesives, and sealants	MC-Luster 100 White	Wasser Corporation	1 – 5%, by weight	(Wasser Corporation, 2009)
Application of paints, coatings, adhesives, and sealants	SB WHT 150 VOC HWVW1	Ennis-Flint	0.1 – 1.0%, by weight	(Ennis-Flint, 2015)
Incorporation into formulation, mixture, or reaction product	ROCKWOOL ® Intumescent Pipe Wraps	Rockwool Limited	Unknown	(Rockwool, 2017)
Plastic compounding	DIOCTYL PHTHALATE	Spectrum Chemical Mfg. Corp	100%, by weight	(Spectrum Chemical Mfg. Corp., 2015)
Plastic compounding	DOP	Focus Chemical, Inc.	100%, by weight	(Focus Chemical Inc., 2016)
Plastic compounding	DOP	HB Chemical	100%, by weight	(HB Chemical, 2014)
Plastic compounding	Synplast mixed phthalate	HB Chemical	30 – 60%, by weight	(HB Chemical, 2015c)
Plastic compounding	Dioctyl Phthalate	Comet Chemical Company Ltd.	100%, by weight	(Comet Chemical Company Ltd., 2016)
Rubber manufacturing	PSI PolyClay Canes and PSI PolyClay Bricks	Penn State Industries	≤ 2.5%, unspecified	(Penn State Industries, 2016)
Rubber manufacturing	PMC-744 Part A	Smooth-On Inc.	1 – 5%, by weight	(Smooth-On Inc., 2007a)
Rubber manufacturing	Renew UR 40 Part A	Renew	0 – 5%, by weight	(Renew, 2008)
Rubber manufacturing	ReoflexTM Series Part A	Smooth-On Inc.	1 – 5%, by weight	(Smooth-On Inc., 2007b)
Rubber manufacturing	VytaFlexTM Series Part A	Smooth-On Inc.	5%, by weight	(Smooth-On Inc., 2008)

Occupational Exposure Scenario (OES)	Product	Manufacturer	DEHP Concentration	Source
Application of paints, coatings, adhesives, and sealants	BAD 6012 Rust Resistant Gray Primer	Raabe Corporation	<5%, by weight	(Raabe Corporation, 1995)
Application of paints, coatings, adhesives, and sealants	Rapid Dry Multi-Surface Gray Primer	Pacific Coast Lacquer	<1%, unspecified	(Axalta, 2021)
Plastic compounding	ENDUR ® NBR Rollers	Rogers Corporation	<5%, unspecified	(Rogers Corporation, 2020)
Plastic converting	Flexible Polyvinyl Chloride	Adams Plastics L.P.	>28%, by weight	(Adams Plastics LP, 2016)
Plastic converting	01 Compound Flexible PVC	TMI International LLC	10 − 30%, unspecified	(TMI International LLC, 2014)
Rubber manufacturing	Millathane CM Premilled	TSE Industries Inc.	<0.1%, by weight	(TSE Industries Inc., 2015)
Application of paints, coatings, adhesives, and sealants	BD Loop Goop	Royal Adhesives and Sealants Canada Ltd.	2.5 − 10%, unspecified	(Royal Adhesives and Sealants Canada Ltd., 2019)
Application of paints, coatings, adhesives, and sealants	SCOFIELD® CureSeal 350	Sika Corporation	≥0.1 − <1%, unspecified	(Sika, 2018)
Application of paints, coatings, adhesives, and sealants	Eagle Paver Sealer	Eagle I.F.P. Company	0.1 − 0.2%, by weight	(Eagle I.F.P. Company, 2015)
Application of paints, coatings, adhesives, and sealants	Cure Seal 100 Plus	Clemons Concrete Coatings	0.1 − 0.2%, by weight	(Clemons Concrete Coatings, 2018)
Application of paints, coatings, adhesives, and sealants	Eagle Supreme Seal & Eagle Gloss Coat	Eagle I.F.P. Company	0.15%, by weight	(Eagle, 2015)
Application of paints, coatings, adhesives, and sealants	TRU SEAL	Nike-Tech Inc.	5 − 10%, unspecified	(Nike-Tech Inc., 2015)

Occupational Exposure Scenario (OES)	Product	Manufacturer	DEHP Concentration	Source
Application of paints, coatings, adhesives, and sealants	Black Stamp-Ever stamp, Blue Stamp-Ever stamp, Green Stamp-Ever Stamp, Red Stamp-Ever stamp	Identity Group	< 0.2%, by weight	(Identity Group, 2016a, b, c, d)
Plastic compounding	VINOPRENE 647	HB Chemical	38 − 44%, by weight	(HB Chemical, 2015b)
Plastic compounding	3M™ Vinyl Tape 764, 766, 767, & 3903	3M	10 − 30%, by weight	(3M Company, 2010)
Plastic compounding	Prime WPC/Prime Essentials/Prime SPC	Carlton Hardwood Flooring	< 4%, unspecified	(Carlton Hardwood Flooring, NA)

Appendix J LIST OF SUPPLEMENTAL DOCUMENTS

A list of the supplemental documents that are mentioned in the *Environmental Release and Occupational Exposure Assessment for Diethylhexyl Phthalate (DEHP)* and a brief description of each of these documents is given below. These supplemental documents are available in Docket EPA-HQ-OPPT-2018-0433.

1. *Environmental Releases to Wastewater for Diethylhexyl Phthalate (DEHP). This spreadsheet contains calculations of the wastewater releases of DEHP to the environment that are associated with each OES that has DMR and/or TRI data available.*
2. *Environmental Releases to Air for Diethylhexyl Phthalate (DEHP). This spreadsheet contains calculations of the air releases of DEHP to the environment that are associated with each OES that has NEI and/or TRI data available.*
3. *Environmental Releases to Land for Diethylhexyl Phthalate (DEHP). This spreadsheet contains calculations of the land releases of DEHP to the environment that are associated with each OES that has TRI data available.*
4. *Occupational Inhalation Exposure Data for Diethylhexyl Phthalate (DEHP). This spreadsheet contains occupational exposures to DEHP that are associated with each OES that has literature data available.*
5. *Occupational Dermal Exposure Modeling Results for Diethylhexyl Phthalate (DEHP). This spreadsheet contains model equations, parameter values, and the results of the deterministic calculations of the worker dermal exposures to DEHP that are associated with each OES.*
6. *Occupational Risk Calculator for Diethylhexyl Phthalate (DEHP). This spreadsheet contains model equations, parameter values, and the results of risk determination from inhalation and dermal Exposures* (U.S. EPA, 2025e).
7. *Data Extraction for Environmental Release and Occupational Exposure for Diethylhexyl Phthalate (DEHP). This spreadsheet contains summarized literature data for general facility information, environmental releases, and occupational exposures to DEHP.*
8. *Occupational Inhalation Exposures from Application of Paints, Coatings, Adhesives, and Sealants for Diethylhexyl Phthalate (DEHP). This spreadsheet contains model equations, parameter values and the results of the probabilistic (stochastic) calculations of the occupational exposures of DEHP to workers that are associated with the Application of Paints, Coatings, Adhesives, and Sealants OES.*
9. *Occupational Inhalation Exposures from Textile Finishing for Diethylhexyl Phthalate (DEHP). This spreadsheet contains model equations, parameter values and the results of the probabilistic (stochastic) calculations of the occupational exposures of DEHP to workers that are associated with the Textile Finishing OES.*
10. *Occupational Exposures from Formulations for Diffusion Bonding for Diethylhexyl Phthalate (DEHP). This spreadsheet contains model equations, parameter values and the results of the probabilistic (stochastic) calculations of the occupational exposures of DEHP to workers that are associated with the Formulations for Diffusion Bonding OES.*
11. *Environmental Releases from Use of Laboratory Chemicals for Diethylhexyl Phthalate (DEHP). This spreadsheet contains model equations, parameter values and the results of the probabilistic (stochastic) calculations of the releases of DEHP to the environment that are associated with the Use of Laboratory Chemicals OES.*

12. *Environmental Releases from Use of Automotive Care Products for Diethylhexyl Phthalate (DEHP). This spreadsheet contains model equations, parameter values and the results of the probabilistic (stochastic) calculations of the releases of DEHP to the environment that are associated with the Use of Automotive Care Products OES.*
13. *Environmental Releases from Use of Hydraulic Fracturing for Diethylhexyl Phthalate (DEHP). This spreadsheet contains model equations, parameter values and the results of the probabilistic (stochastic) calculations of the releases of DEHP to the environment that are associated with the Use of Hydraulic Fracturing OES.*
14. *Occupational Exposures from Waste Handling for Diethylhexyl Phthalate (DEHP). This spreadsheet contains model equations, parameter values and the results of the probabilistic (stochastic) calculations of the occupational exposures of DEHP to workers that are associated with the Waste Handling OES.*