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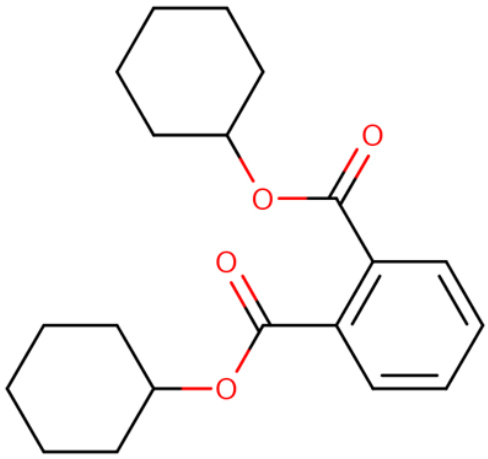
United States
Environmental Protection Agency

# Risk Evaluation for Dicyclohexyl Phthalate (DCHP)

## CASRN 84-61-7




*December 2025*

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# ACKNOWLEDGEMENTS

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**Docket**
Supporting information can be found in the public docket, Docket ID (EPA-HQ-OPPT-2018-0504).

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# EXECUTIVE SUMMARY

***Background***

EPA has evaluated the health and environmental risks of the chemical dicyclohexyl phthalate (DCHP) under section 6 of the Toxic Substances Control Act (TSCA). In this risk evaluation, the Agency has determined that DCHP presents an unreasonable risk of injury to human health under the conditions of use (COUs) driven by significant contributions to unreasonable risk due to worker exposures under two COUs. Of the 24 COUs that EPA evaluated, 2 COUs significantly contribute to the unreasonable risk of injury to workers due to acute inhalation exposures; no COUs significantly contribute to unreasonable risk to ONUs (occupational non-users), consumers, or the general population. In this risk evaluation, EPA's protective, screening level approaches demonstrated that DCHP does not present an unreasonable risk to the environment. Accordingly, no TSCA COUs significantly contribute to any unreasonable risk to the environment.

DCHP is used primarily as a plasticizer in manufacturing adhesives, paints and coatings, printing inks, plastic products, rubber products, and plastic resins. It is also used as a stabilizing agent, specifically as a phlegmatizer for dibenzoyl peroxide (BPO) and peroxide-based formulations. Other DCHP applications include industrial use of adhesives and sealants in transportation equipment and computer and electronic product manufacturing; and in commercial and consumer products, including adhesives and sealants, paints and coatings, and plastic and rubber products—all of which are COUs under TSCA. Workers may be exposed to DCHP when making these products or otherwise using DCHP in the workplace. When it is manufactured or used to make products, DCHP can be released into water, where because of its physical and chemical properties, most will end up in the sediment of lakes and rivers. If released into the air, DCHP will attach to dust particles and deposit on land or into water. Indoors, DCHP has the potential over time to be released from products and adhere to dust particles. If it does, people could inhale or ingest dust that contains DCHP.

Laboratory animal studies have been conducted with DCHP to determine whether it causes a range of non-cancer health effects on people. After reviewing the available studies, the Agency concludes that there is strong evidence that DCHP causes developmental toxicity (a non-cancer human health hazard). The most sensitive adverse developmental endpoint includes effects on the developing male reproductive system consistent with a disruption of androgen action—what is known as *phthalate syndrome*, which results from decreased fetal testicular testosterone.

EPA is including DCHP for cumulative risk assessment (CRA) along with five other phthalate chemicals that also cause effects on laboratory animals consistent with phthalate syndrome (U.S. EPA, 2023c). Notably, assessments by Health Canada, U.S. Consumer Product Safety Commission (U.S. CPSC), European Chemicals Agency (ECHA), and the Australian National Industrial Chemicals Notification and Assessment Scheme (NICNAS) have reached similar conclusions regarding the developmental effects of DCHP. They have also conducted CRAs of phthalates based on these chemicals' shared ability to cause phthalate syndrome. Furthermore, independent, expert peer reviewers endorsed EPA's proposal to conduct a CRA of phthalates under TSCA during the May 2023 meeting of the Science Advisory Committee on Chemicals (SACC; accessed December 18, 2025) because humans are co-exposed to multiple toxicologically similar phthalates that cause effects on the developing male reproductive system consistent with a disruption of androgen action and phthalate syndrome (U.S. EPA, 2023f). In this risk evaluation, the Agency evaluated cumulative exposure to phthalates for the U.S. civilian population using human biomonitoring data. Note that these phthalate exposures to the general population cannot be attributed to specific TSCA COUs or other sources. This non-attributable, cumulative phthalate exposure and risk, representing the U.S. population, was considered by EPA in its risk evaluation for DCHP. The Agency has included the phthalate CRA as part of its risk

characterization for DCHP in alignment with the 2008 National Research Council Report: *Phthalates and Cumulative Risk Assessment: The Task Ahead* (NRC, 2008). This risk evaluation describes analyses considering both DCHP exposure under the COUs as the "individual assessment" (or "single-chemical assessment") as well as analyses also considering background exposure to other phthalates[1] (*i.e.*, National Health and Nutrition Examination Survey, though DCHP is no longer included in NHANES analyses) as the "cumulative assessment."

In December 2019, EPA designated DCHP as a high-priority substance for TSCA risk evaluation and in August 2020 released the final scope of the risk evaluation (U.S. EPA, 2020b). This completed risk evaluation assesses human health risk to workers, including ONUs, consumers, and the general population exposed to environmental releases of DCHP. It also assesses risk to the environment. Manufacturers report DCHP production volumes through the Chemical Data Reporting (CDR) rule under CAS Registry Number (CASRN) 84-61-7. The production volume for DCHP was between 500,000 and 1,000,000 pounds (lb) in 2019 based on the 2020 CDR data (EPA describes production volumes as a range to protect confidential business information or CBI). Review of preliminary 2024 CDR data shows that that total production volumes for the years 2020 to 2023 are similar to the previously reported range from 2020 CDR. The Agency has evaluated DCHP across its TSCA COUs, ranging from manufacture to disposal.

Past assessments of DCHP from other government agencies that addressed a broad range of uses, which may have included both TSCA and uses not subject to TSCA, have concluded that DCHP does not pose risk to human health or the environment based on its concentration in products and the environment. Notably, both the U.S. CPSC's and Health Canada's risk assessments included consideration of exposure from children's products as well as from other sources such as personal care products, diet, consumer products, and the environment. However, these past assessments did not specifically consider exposure to workers. In this assessment, EPA has reached the same general conclusions of those assessments with regard to risk to consumers and the general population—with the exception of where it evaluated and has identified risks to workers with some manufacturing and processing uses of DCHP.

In this assessment, EPA evaluated risks resulting from exposure to DCHP from facilities that use, manufacture, or process DCHP under industrial and/or commercial COUs and DCHP-containing products resulting from such manufacture and processing. Human or environmental exposure to DCHP through uses that are not subject to TSCA (*e.g.*, use in cosmetics, medical devices, food contact materials) were not specifically evaluated by the Agency in reaching its determination of unreasonable risk to injury of human health. This is because these uses are excluded from TSCA's definition of chemical substance under TSCA section 3(2)(B). Thus, though EPA is determining in this risk evaluation that two specific TSCA COUs significantly contribute to its unreasonable risk finding for DCHP, this determination cannot be extrapolated to form conclusions about uses of DCHP that are not subject to TSCA, and that EPA did not evaluate.

***Determining Unreasonable Risk to Human Health***

In TSCA existing chemical risk evaluations, EPA must determine whether a chemical substance does or does not present unreasonable risk of injury to health or the environment, under the COUs. The unreasonable risk must be consistent with the best available science. The Agency, in making the finding of *presents unreasonable risk to human health*, considers risk-related factors as described in its risk evaluation framework rule (40 CFR part 702). Risk-related factors beyond the levels of DCHP that can

[1] The six phthalates in the cumulative assessment include butyl benzyl phthalate (BBP), dibutyl phthalate (DBP), DCHP, diethylhexyl phthalate (DEHP), diisobutyl phthalate (DIBP), and diisononyl phthalate (DINP).

cause specific health effects include but are not limited to the type of health effect under consideration, the reversibility of the health effect being evaluated, exposure-related considerations (*e.g.*, duration, magnitude, frequency of exposure), population exposed (including any potentially exposed or susceptible subpopulations), and EPA's confidence in the information used to inform the hazard and exposure values. These considerations must be included as part of a pragmatic and holistic evaluation of hazard and exposure to DCHP. If an estimate of risk for a specific scenario is below the standard risk benchmarks, then the formal determination of whether those risks significantly contribute to the unreasonable risk of DCHP under TSCA must be both case-by-case and context driven.

EPA evaluated the risks to people from being exposed to DCHP at work, indoors, and outdoors. In its human health evaluation, the Agency used a combination of screening level and more refined approaches to assess how people might be exposed to DCHP through breathing or ingesting dust or other particulates as well as through skin contact. EPA also released a cumulative risk technical support document (TSD) including DCHP and five other phthalates that all cause the same health effect—phthalate syndrome (U.S. EPA, 2025ai). The CRA takes into consideration differences in the ability of each phthalate to cause effects on the developing male reproductive system. Use of this "relative potency" across all the phthalates EPA reviewed that cause phthalate syndrome provides a more robust risk assessment of DCHP as well as a common basis for adding risk across the six phthalates included in the CRA TSD. Thus, risks are characterized for occupational and consumer exposures to DCHP—alone as well as in conjunction with the measured cumulative phthalate exposure that is experienced by the U.S. population and that cannot be attributed to a specific use.

In determining whether DCHP presents an unreasonable risk of injury to human health, EPA considered the following potentially exposed and susceptible subpopulations (PESS) in its assessment: females of reproductive age, pregnant women, infants, children and adolescents, people who frequently use consumer products and/or articles containing high concentrations of DCHP, people exposed to DCHP in the workplace, people in close proximity to releasing facilities (including fenceline communities), and Tribes and subsistence fishers whose diets include large amounts of fish. These subpopulations are PESS because some have greater exposure to DCHP per body weight (*e.g.*, infants, children, adolescents) while others may experience exposure from multiple sources or higher exposures than others. EPA's robust screening analysis finds that exposure of consumers and the general population to DCHP does not significantly contribute to unreasonable risk of injury to human health. However, the Agency identified two COUs where occupational exposure for workers through inhalation significantly contributes to the unreasonable risk of injury to human health.

***Determining Unreasonable Risk to the Environment***

In determining whether DCHP presents an unreasonable risk of injury to the environment, EPA considered the following groups of organisms in its assessment: aquatic vertebrates, aquatic invertebrates, algae, and terrestrial mammals. The Agency weighed the scientific evidence to determine confidence levels in underlying datasets and risk estimates for the environment.

Based on the risk evaluation for DCHP—including the environmental hazards to assessed populations, chemical properties of DCHP (*e.g.*, solid physical state, tendency to partition to organic matter over water, limited water solubility), low potential for exposure, and consideration of uncertainties—EPA did not identify significant contributions to unreasonable risk of injury to the environment for DCHP under any COU.

***Summary, Considerations, and Next Steps***

EPA has determined that the following COUs, significantly contribute to unreasonable risk of injury to human health to workers from acute inhalation exposures:

- Industrial use – paints and coatings; and
- Commercial use – paints and coatings.

The acute inhalation exposure to workers is the primary route contributing to the aggregate and cumulative exposure for workers.[2]

EPA has determined that the following COUs do *not* significantly contribute to the unreasonable risk:

- Manufacturing – domestic manufacturing;
- Manufacturing – importing;
- Processing – incorporation into formulation, mixture, or reaction product – adhesive and sealant chemicals in adhesive manufacturing;
- Processing – incorporation into formulation, mixture, or reaction product – plasticizer (adhesive manufacturing; paint and coating manufacturing; and printing ink manufacturing);
- Processing – incorporation into formulation, mixture, or reaction product – stabilizing agent (adhesive manufacturing; asphalt paving, roofing, and coating materials manufacturing; and paints and coating manufacturing);
- Processing – incorporation into article – plasticizer in plastics product manufacturing and rubber product manufacturing;
- Processing – repackaging (*e.g.*, laboratory chemicals);
- Processing – recycling;
- Distribution in commerce;
- Industrial use – adhesives and sealants (*e.g.*, computer and electronic product manufacturing; transportation equipment manufacturing);
- Industrial use – finishing agent – cellulose film production;
- Industrial use – inks, toner, and colorant products (*e.g.*, screen printing ink);
- Industrial use – other articles with routine direct contact during normal use including rubber articles; plastic articles (hard) (*e.g.*, transportation equipment manufacturing);
- Commercial use – adhesives and sealants;
- Commercial use – building/construction materials not covered elsewhere;
- Commercial use – inks, toner, and colorant products (*e.g.*, screen printing ink);
- Commercial use – laboratory chemicals;
- Commercial use – other articles with routine direct contact during normal use including rubber articles; plastic articles (hard);
- Consumer use – adhesives and sealants;
- Consumer use – other articles with routine direct contact during normal use including rubber articles; plastic articles (hard);
- Consumer use – other consumer articles that contain dicyclohexyl phthalate from: inks, toner, and colorants; paints and coatings; adhesives and sealants (*e.g.*, paper products, textiles, products using cellulose film, etc.); and

[2] The Agency conducted analyses on aggregate exposures and cumulative risks. Aggregate exposure analyses consider effects on populations that are exposed to DCHP via multiple routes (*e.g.*, dermal contact, ingestion, inhalation). Cumulative risk refers to human health risks related to exposures to multiple chemicals with similar effects (*i.e.*, aggregate + NHANES = cumulative). See Section 4.4 for more information.

- Disposal.

There were no COUs that significantly contribute to unreasonable risk for ONUs, consumers, the general population, or the environment.

This risk evaluation was released for public comment and peer reviewed by the SACC in August 2025. It takes into consideration input from the public and recommendations received from the SACC. In this risk evaluation, EPA has determined that DCHP presents an unreasonable risk of injury to human health driven by significant contributions to unreasonable risk to workers for two COUs under TSCA. As a next step, EPA will initiate risk management for DCHP by applying one or more of the requirements under TSCA section 6(a) to the extent necessary so that DCHP no longer presents an unreasonable risk. The Agency expects risk management requirements to focus on those COUs that significantly contribute to the determination of unreasonable risk of DCHP. As the acute inhalation risk presented in the single chemical analysis is the driver of the significant contributions to unreasonable risk, EPA's risk management will focus on the significant contributions to risk presented in the single chemical analysis of DCHP.

# 1 INTRODUCTION

EPA has evaluated dicyclohexyl phthalate (DCHP) under section 6(b) of the Toxic Substances Control Act (TSCA). DCHP is primarily used as a plasticizer in polyvinyl chloride (PVC) in consumer, commercial, and industrial applications—though it is also used in adhesives, sealants, paints, coatings, rubbers, and non-PVC plastics as well as for other applications. Section 1.1 summarizes the scope of the DCHP risk evaluation and provides information on production volume and a life cycle diagram (LCD). Section 1.2 describes the conditions of use (COUs) and conceptual models used for DCHP. Section 1.3 provides an overview of the populations (including subpopulations) and durations of exposure assessed. Lastly, Section 1.4 presents the organization of the remainder of the risk evaluation.

Figure 1-1 describes the major inputs, phases, and outputs/components of the TSCA risk evaluation process (accessed December 18, 2025), from scoping to releasing the final risk evaluation.

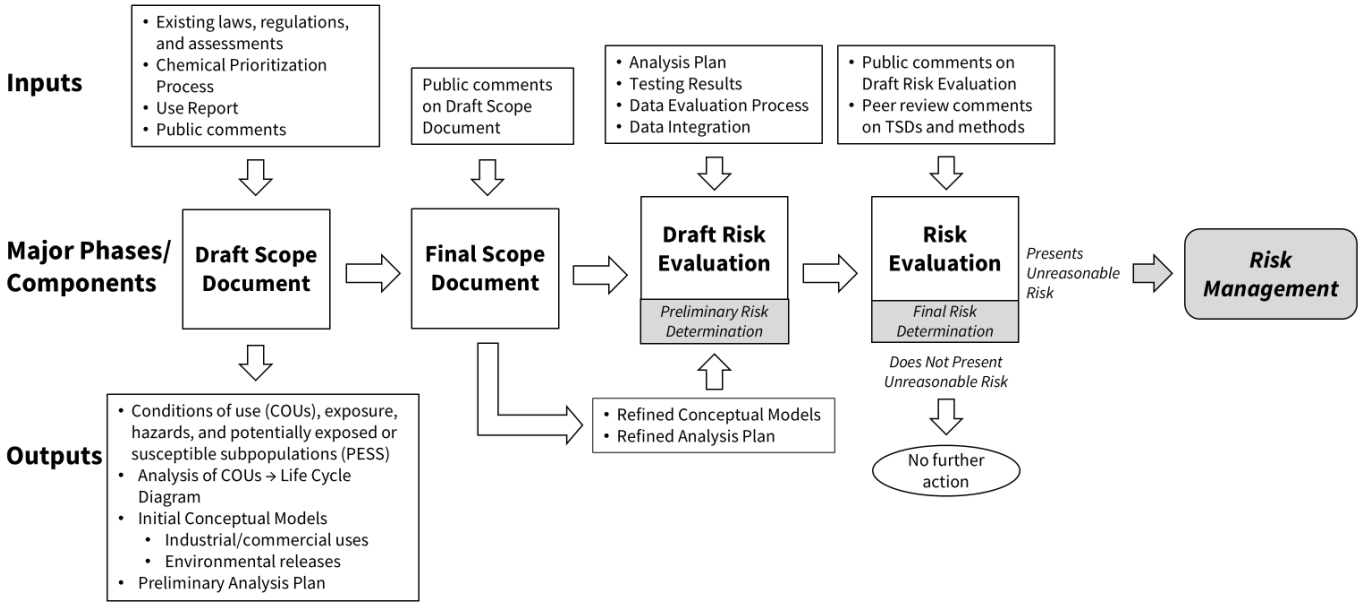


**Figure 1-1. TSCA Existing Chemical Risk Evaluation Process**

## 1.1 Scope of the Risk Evaluation

EPA evaluated risk to humans and the environment for DCHP. Specifically for human populations, the Agency evaluated risk to workers and occupational non-users (ONUs) via inhalation routes; risk to workers via dermal routes; risk to ONUs via dermal routes for occupational exposure scenarios (OESs) in mists and dusts; risk to consumers via inhalation, dermal, and oral routes; and risk to bystanders via the inhalation route. Additionally, EPA considered the following potentially exposed or susceptible subpopulations (PESS) in its assessment: females of reproductive age, pregnant women, infants, children and adolescents, people who frequently use consumer products and/or articles containing high-concentrations of DCHP, people exposed to DCHP in the workplace, and Tribal and subsistence fishers whose diets include large amounts of fish. As described further in Section 4.1.3, EPA assessed risks to the general population, including considerations for fenceline populations, from environmental releases using a screening level analysis, which considered risk from exposure to DCHP via oral ingestion of surface water, drinking water, fish, and soil from air to soil deposition. For environmental populations, EPA evaluated risk to aquatic species via water, sediment, and air as well as risk to terrestrial species via air, soil, sediment, and water.

Consistent with EPA's *Draft Proposed Approach for Cumulative Risk Assessment (CRA) of High-Priority Phthalates and a Manufacturer-Requested Phthalate under the Toxic Substances Control Act* (U.S. EPA, 2023c), the Agency has also authored a cumulative risk technical support document (TSD) of DCHP and five other toxicologically similar phthalates (butyl benzyl phthalate [BBP], dibutyl phthalate [DBP], diethylhexyl phthalate [DEHP], diisobutyl phthalate [DIBP], and diisononyl phthalate [DINP]). These phthalates are also being evaluated under TSCA based on a common toxicological endpoint; that is, *phthalate syndrome*, which results from decreased fetal testicular testosterone (U.S. EPA, 2025ai). The cumulative analysis takes into consideration differences in phthalate potency to cause effects on the developing male reproductive system. Use of relative potency across the phthalates provides a common basis for adding risk across the cumulative chemicals.

Numerous other regulatory agencies—Health Canada, U.S. Consumer Product Safety Commission (U.S. CPSC), European Chemicals Agency (ECHA), and the Australian National Industrial Chemicals Notification and Assessment Scheme (NICNAS)—have assessed phthalates for cumulative risk. Furthermore, EPA's proposal to conduct a CRA of phthalates under TSCA was endorsed by the Science Advisory Committee on Chemicals (SACC) as the best available science because humans are co-exposed to multiple toxicologically similar phthalates that cause effects on the developing male reproductive system consistent with a disruption of androgen action and phthalate syndrome (U.S. EPA, 2025ae, 2023f). As described further in Sections 4.4.4 and 4.4.5, cumulative risk considerations focus on acute duration exposures to the most susceptible subpopulations: female workers and consumers of reproductive age (16–49 years) as well as male infants and male children (3–15 years) exposed to consumer products and articles.

The DCHP risk evaluation includes a series of technical support documents (TSDs). Each TSD support document contains subassessments that inform adjacent, "downstream" TSDs (and supplemental files). A basic diagram showing the layout and relationship of these assessments is provided below in Figure 1-2. High-level summaries of each relevant assessment/TSD are presented in this risk evaluation. Detailed information for each TSD can be found in the corresponding documents. Appendix C incudes a list and citations for all TSDs and supplemental files included in this DCHP risk evaluation.

All DCHP TSDs leveraged the data and information sources already identified in the *Final Scope of the Risk Evaluation for Dicyclohexyl Phthalate (1,2-Benzenedicarboxylic acid, 1,2-dicyclohexyl ester); CASRN 84-61-7* (also referred to as "final scope document" or "final scope") (U.S. EPA, 2020b). The Office of Pollution Prevention and Toxics (OPPT) conducted a comprehensive search for "reasonably available information" to identify relevant DCHP data for use in the risk evaluation. The approach used to identify specific relevant risk assessment information was discipline-specific and is detailed in *Systematic Review Protocol for Dicyclohexyl Phthalate (DCHP)* (U.S. EPA, 2025ah), or as otherwise noted in the relevant TSDs.

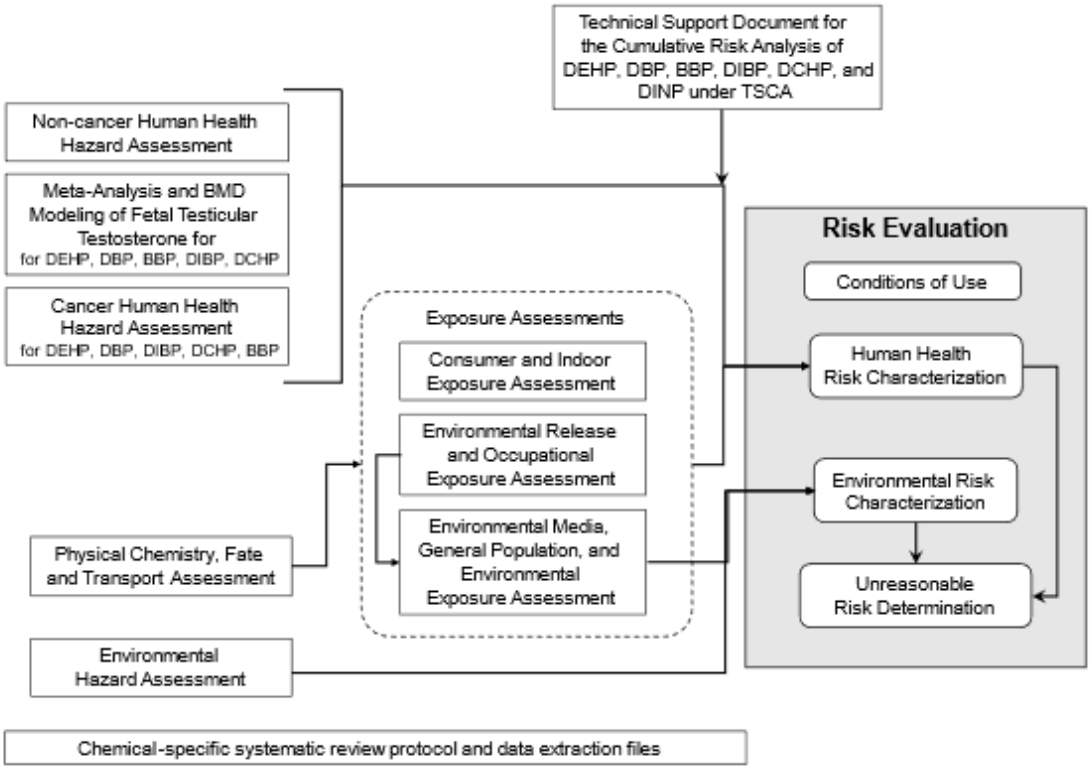


**Figure 1-2. Risk Evaluation Document Summary Map**

### 1.1.1 Life Cycle and Production Volume

The LCD shown in Figure 1-3 depicts the COUs assessed in this risk evaluation, during various life cycle stages, including manufacturing, processing, distribution, use (industrial, commercial, consumer), and disposal. The LCD has been updated since its inclusion in the final scope, with consolidated and/or expanded processing and use steps. A complete list of updates and explanations of the updates made to COUs for DCHP from the final scope document to this risk evaluation is provided in Appendix D. The information in the LCD is grouped according to the Chemical Data Reporting (CDR) processing codes and use categories (including functional use codes for industrial uses and product categories for industrial and commercial uses). The CDR Rule under TSCA section 8(a) (see 40 CFR part 711) requires certain U.S. manufacturers (including importers) to provide EPA with information on the chemicals they manufacture or import into the United States.

EPA included descriptions of the industrial, commercial, and consumer use categories identified from the 2020 CDR in the LCD (Figure 1-3) (U.S. EPA, 2020a). The descriptions provide a brief overview of the use category; the *Environmental Release and Occupational Exposure Assessment for Dicyclohexyl Phthalate* (U.S. EPA, 2025s) contains more detailed descriptions (*e.g.*, process descriptions, worker activities, process flow diagrams, equipment illustrations) for each manufacturing, processing, use, and disposal category.

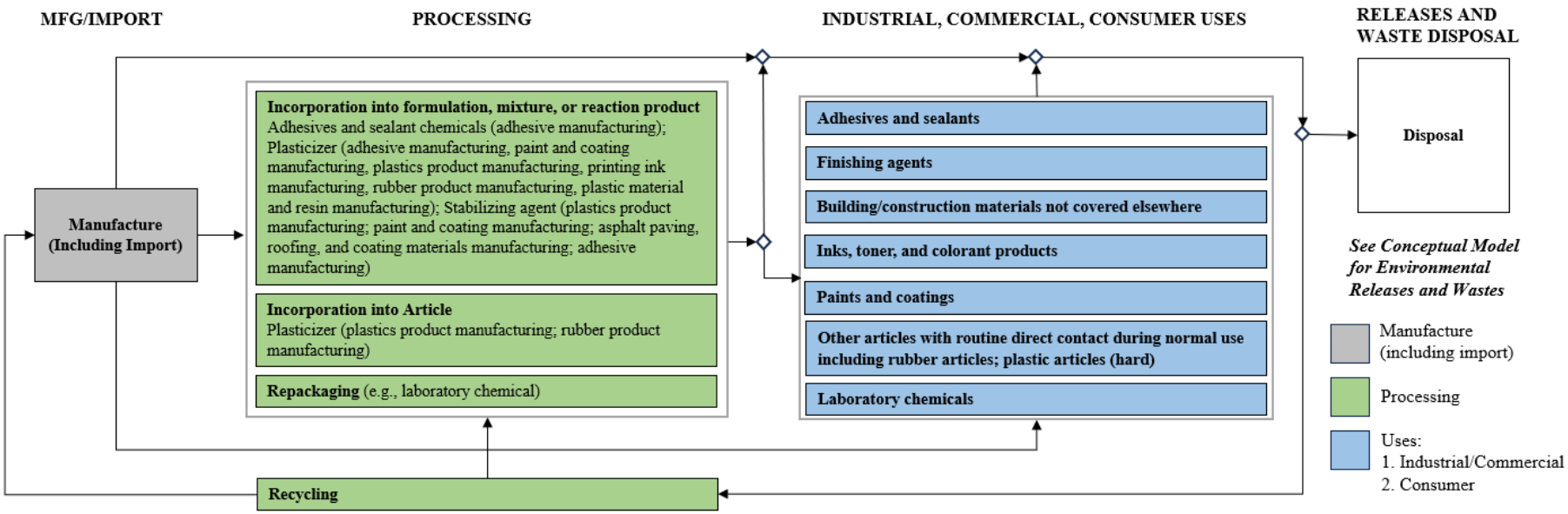


**Figure 1-3. DCHP Life Cycle Diagram**

See Table 1-1 for categories and subcategories of COUs. Activities related to distribution (*e.g.*, loading, unloading) were considered throughout the DCHP life cycle, as well as qualitatively through a single distribution scenario.

The production volume for CASRN 84-61-7 in 2019 was between 500,000 and 1,000,000 pounds (lb) in 2019 based on the 2020 CDR data. EPA describes production volumes as a range to protect production volume data claimed as confidential business information (CBI). For the 2020 CDR cycle, collected data included the company name, volume of each chemical manufactured/imported, the number of workers at each site, and information on whether the chemical was used in the commercial, industrial, and/or consumer sector(s). Review of preliminary 2024 CDR data shows that that total production volume for the years 2020-2023 are similar to the previously reported range from 2020 CDR.

In the 2020 CDR, two sites reported production of DCHP. LANXESS reported a production volume of 17,290 lb for the 2019 CDR reporting year. The remaining site, Vertellus LLC, reported their production volumes as confidential business information (CBI) but also reported an export volume of 410,849 lb for 2019 and that 10 percent of their production volume was used as a plasticizer in adhesive manufacturing. EPA assumed that this site had no uses of DCHP that are included under the reporting threshold and that 410,849 lb represented 90 percent of their total production volume. Therefore, the Agency calculated the total manufactured production volume from the site as 456,499 lb (410,849 ÷ 0.9 = 456,499 lb or 207,064 kg). EPA used this data and the number of reporting import sites to estimate an average import volume per site.

## 1.2 Conditions of Use Included in the Risk Evaluation

The final scope document (U.S. EPA, 2020b) identified and described the life cycle stages, categories, and subcategories that comprise TSCA COUs that EPA planned to consider in the risk evaluation. All COUs for DCHP included in this risk evaluation are reflected in the LCD (Figure 1-3) and conceptual models (Section 1.2.1). Table 1-1 below presents all COUs for DCHP.

In this risk evaluation, EPA made updates to the COUs listed in the final scope (U.S. EPA, 2020b). A complete list of updates and explanations of the updates made to COUs for DCHP from the final scope document to this risk evaluation is provided in Appendix D.

**Table 1-1. Categories and Subcategories of Use and Corresponding Exposure Scenario in the Risk Evaluation for DCHP**

| Life Cycle Stage[a] | Category[b] | Subcategory[c] | Reference(s) |
|---|---|---|---|
| Manufacturing | Domestic manufacturing | Domestic manufacturing | (U.S. EPA, 2020a, 2019a) |
| | Importing | Importing | (U.S. EPA, 2020a, 2019a) |
| Processing | Processing – incorporation into formulation, mixture, or reaction product | Adhesive and sealant chemicals in:<br>– Adhesive manufacturing | (U.S. EPA, 2019a) |
| | | Plasticizer in:<br>– Adhesive manufacturing<br>– Paint and coating manufacturing<br>– Plastic material and resin manufacturing<br>– Plastics product manufacturing<br>– Printing ink manufacturing<br>– Rubber product manufacturing | (U.S. EPA, 2020a; ACA, 2019; AIA, 2019; Carboline, 2019a, b; MEMA, 2019; U.S. EPA, 2019a, d) |
| | | Stabilizing agent in:<br>– Adhesive manufacturing | (U.S. EPA, 2024d; Nouryon Chemicals LLC, 2020; U.S. |

| Life Cycle Stage[a] | Category[b] | Subcategory[c] | Reference(s) |
|---|---|---|---|
| Processing | Processing – incorporation into formulation, mixture, or reaction product | – Asphalt paving, roofing, and coating materials manufacturing<br>– Paint and coating manufacturing<br>– Plastics product manufacturing | EPA, 2020a; AIA, 2019; U.S. EPA, 2019c) |
| | Processing – incorporation into article | Plasticizer in:<br>– Plastics product manufacturing<br>– Rubber product manufacturing | (AIA, 2019; MEMA, 2019; U.S. EPA, 2019a) |
| | Repackaging | Repackaging (*e.g.*, laboratory chemical) | (U.S. EPA, 2020d) |
| | Recycling | Recycling | (CPSC, 2015) |
| Distribution in Commerce | Distribution in commerce | Distribution in commerce | |
| Industrial Use | Adhesives and sealants | Adhesives and sealants (*e.g.*, computer and electronic product manufacturing; transportation equipment manufacturing) | (Henkel, 2024; AIA, 2019; Henkel, 2019; MEMA, 2019; Henkel, 2017) |
| | Finishing agent | Cellulose film production | (U.S. EPA, 2020c; Earthjustice, 2019) |
| | Inks, toner, and colorant products | Inks, toner, and colorant products (*e.g.*, screen printing ink) | (LANXESS, 2021; U.S. EPA, 2021c, 2019e; Gans Ink and Supply, 2018) |
| | Paints and coatings | Paints and coatings | (Carboline, 2019a, b; U.S. EPA, 2019d) |
| | Other articles with routine direct contact during normal use including rubber articles; plastic articles (hard) | Other articles with routine direct contact during normal use including rubber articles; plastic articles (hard) (*e.g.*, transportation equipment manufacturing) | (AIA, 2019; MEMA, 2019) |
| Commercial Use | Adhesives and sealants | Adhesives and sealants | (Midwest Technology Products, 2024; MKT, 2023b; Permatex, 2021; Lord Corporation, 2020; AIA, 2019; MEMA, 2019; MKT, 2018; Lord Corporation, 2017; Ford Motor Company, 2015) |
| | Building/construction materials not covered elsewhere | Building/construction materials not covered elsewhere | (LANXESS, 2021; U.S. EPA, 2019a) |
| | Inks, toner, and colorant products | Inks, toner, and colorant products (*e.g.*, screen printing ink) | (LANXESS, 2021; U.S. EPA, 2021c, 2019e; Gans Ink and Supply, 2018) |
| | Laboratory chemicals | Laboratory chemicals | (Restek Corp, 2024; Sigma-Aldrich, 2024a, b; NASA, 2020; U.S. EPA, 2020d; SPEX CertiPrep, 2019) |

| Life Cycle Stage[a] | Category[b] | Subcategory[c] | Reference(s) |
|---|---|---|---|
| Commercial Use | Paints and coatings | Paints and coatings | (CETCO, 2024; Carboline, 2019a, b; Euclid Chemical Company, 2019a, b; U.S. EPA, 2019d; CETCO, 2018a; Euclid Chemical Company, 2018; HYDRO-GARD, 2017a, b) |
| | Other articles with routine direct contact during normal use including rubber articles; plastic articles (hard) | Other articles with routine direct contact during normal use including rubber articles; plastic articles (hard) | (U.S. EPA, 2020a; AIA, 2019; MEMA, 2019; U.S. EPA, 2019a) |
| Consumer Use | Adhesives and sealants | Adhesives and sealants | (DeWALT, 2024a; Lord Corporation, 2024; Midwest Technology Products, 2024; MKT, 2024; Permatex, 2024, 2021; DeWALT, 2020; MKT, 2018; Lord Corporation, 2017) |
| | Other articles with routine direct contact during normal use including rubber articles; plastic articles (hard) | Other articles with routine direct contact during normal use including rubber articles; plastic articles (hard) | (U.S. EPA, 2020a; AIA, 2019; MEMA, 2019; U.S. EPA, 2019a) |
| | Other | Other consumer articles that contain dicyclohexyl phthalate from: inks, toner, and colorants; paints and coatings; adhesives and sealants (*e.g.*, paper products, textiles, products using cellulose film, etc.) | (HYDRO-GARD, 2024; Hallstar, 2022; LANXESS, 2021; U.S. EPA, 2020c; Earthjustice, 2019; MEMA, 2019; U.S. EPA, 2019e; Gans Ink and Supply, 2018; HYDRO-GARD, 2017a, b; CPSC, 2015) |
| Disposal | Disposal | Disposal | |

[a] Life Cycle Stage Use Definitions (40 CFR 711.3)
- "Industrial use" means use at a site at which 1 or more chemicals or mixtures are manufactured (including imported) or processed.
- "Commercial Use" means the use of a chemical or a mixture containing a chemical (including as part of an article) in a commercial enterprise providing saleable goods or services.
- "Consumer use" means the use of a chemical or a mixture containing a chemical (including as part of an article, such as furniture or clothing) when sold to or made available to consumers for their use.
- Although EPA has identified both industrial and commercial uses here for purposes of distinguishing scenarios in this document, the Agency interprets the authority over "any manner or method of commercial use" under TSCA section 6(a)(5) to reach both.

[b] These categories of COUs appear in the LCD and broadly represent COUs of DCHP in industrial and/or commercial settings.

[c] These subcategories reflect more specific COUs of DCHP.

[d] The consumer COU of "Toys, playground, and sporting equipment" was removed and not included in DCHP's final scoping document. The U.S. CPSC Chronic Hazard Advisory Panel (CHAP) report from 2014 (CPSC, 2014) that states, "DCHP is currently not found in children's toys or child care articles, and it is not widely found in the environment" (page 117); the preamble of the 2017 CPSC final rule titled "Prohibition of Children's Toys and Child Care Articles Containing Specified Phthalates," which explains that ". . . the CPSC staff has not detected DCHP in toys and child care articles during routine compliance testing thus far. . ." (CPSC, 2017); As a result, EPA has no reasonably available information demonstrating that the consumer use of DCHP in toys is intended, known, or reasonably foreseen, and has not included it in the analysis for this risk evaluation of DCHP.

### 1.2.1 Conceptual Models

The conceptual model in Figure 1-4 presents the exposure pathways, exposure routes, and hazards to human populations from industrial and commercial activities and uses of DCHP. There is potential for exposure to workers and/or ONUs via inhalation and via dermal contact. The conceptual model also includes potential ONU dermal exposure to DCHP in mists and dusts deposited on surfaces. EPA evaluated activities resulting in exposures associated with distribution in commerce (*e.g.*, loading, unloading) throughout the various life cycle stages and COUs (*e.g.*, Manufacturing, Processing, Industrial use, Commercial use, and Disposal).

Figure 1-5 presents the conceptual model for consumer activities and uses, Figure 1-6 presents general population exposure pathways and hazards for environmental releases and wastes, and Figure 1-7 presents the conceptual model for ecological exposures and hazards from environmental releases and wastes.

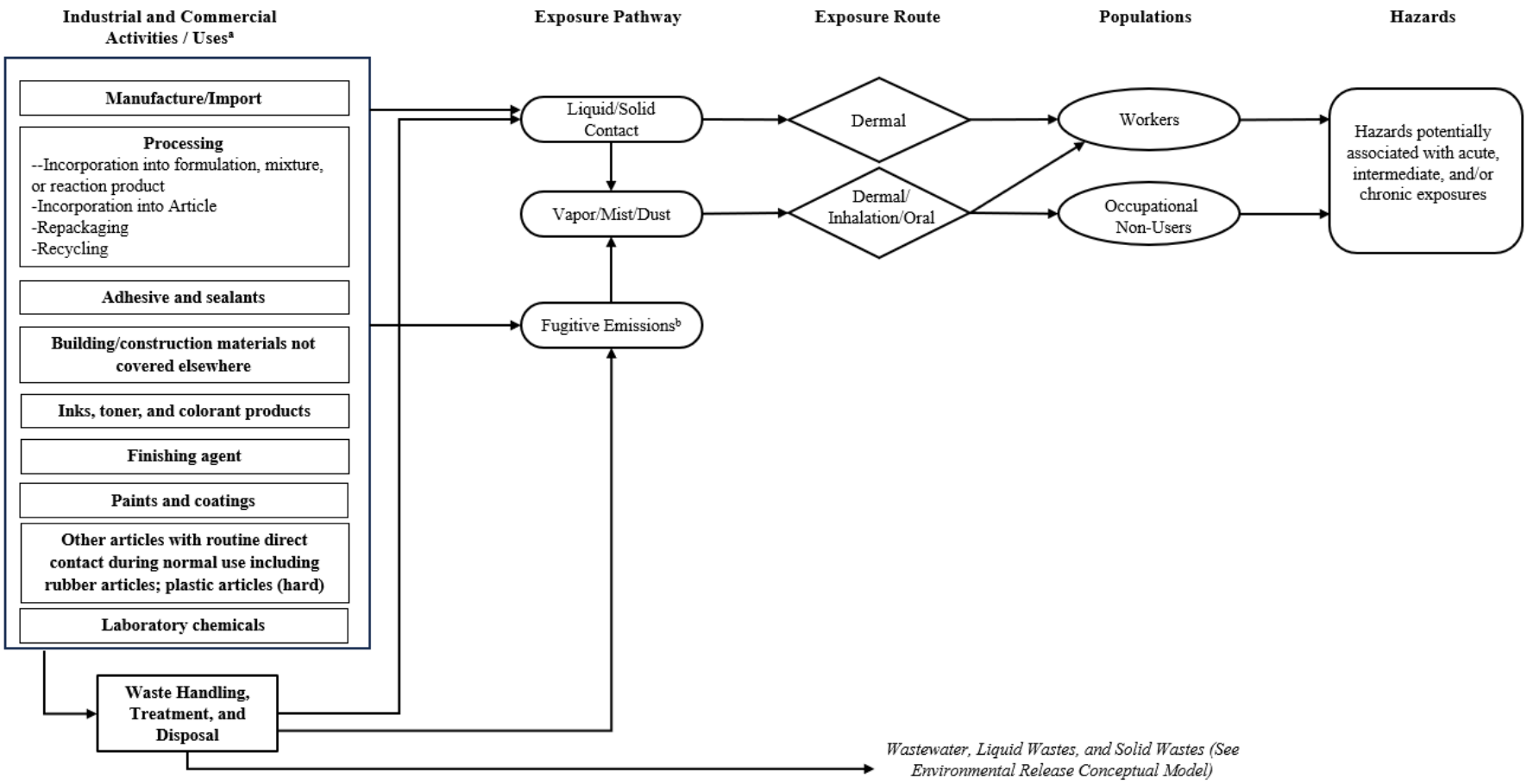


**Figure 1-4. DCHP Conceptual Model for Industrial and Commercial Activities and Uses: Potential Exposure and Hazards**

[a] Some products are used in both commercial and consumer applications. See Table 1-1 for categories and subcategories of COUs.

[b] Fugitive air emissions are emissions that are not routed through a stack and include fugitive equipment leaks from valves, pump seals, flanges, compressors, sampling connections and open-ended lines; evaporative losses from surface impoundment and spills; and releases from building ventilation systems.

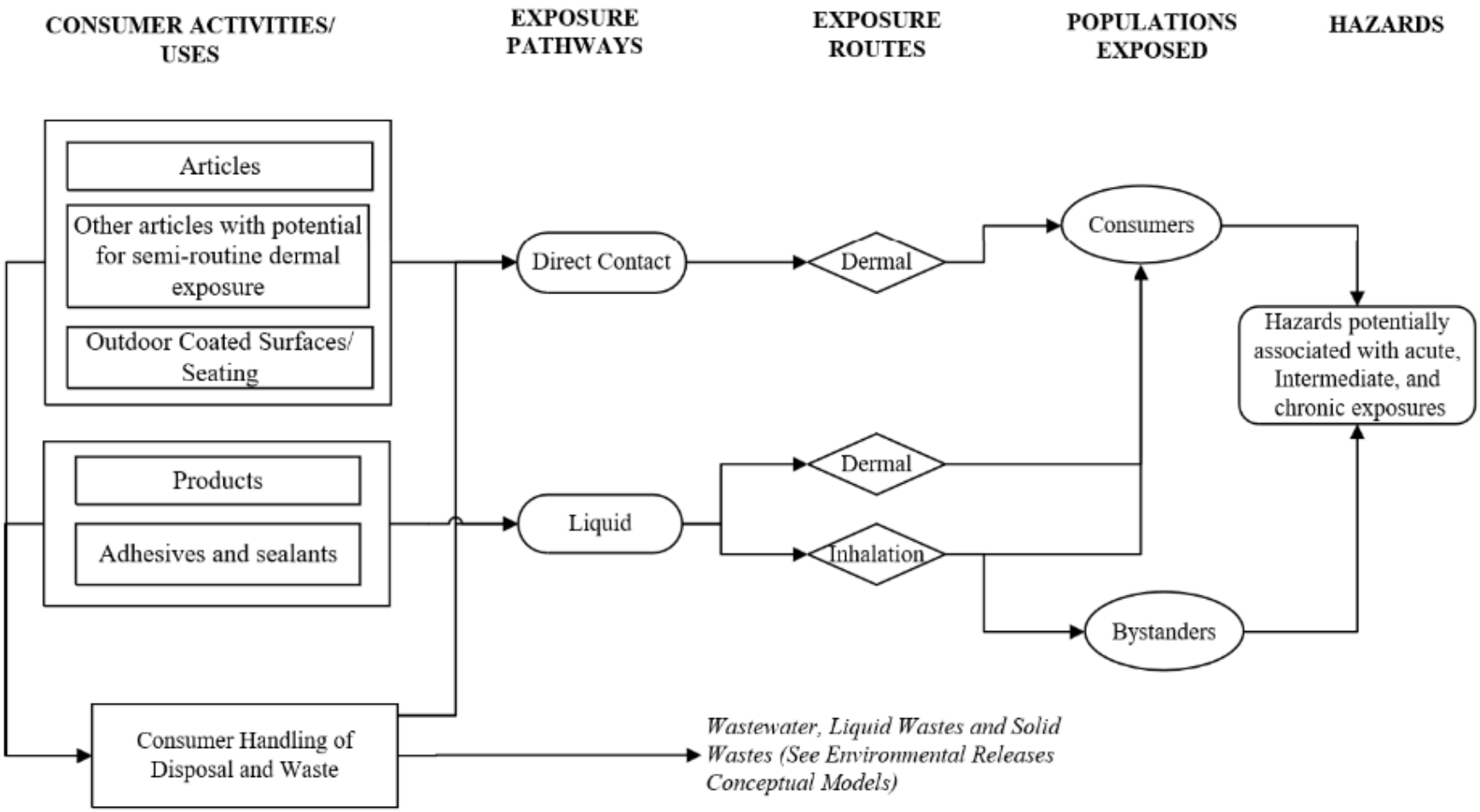


**Figure 1-5. DCHP Conceptual Model for Consumer Activities and Uses: Potential Exposures and Hazards**
The conceptual model presents the exposure pathways, exposure routes, and hazards to human populations from consumer activities and uses of DCHP.

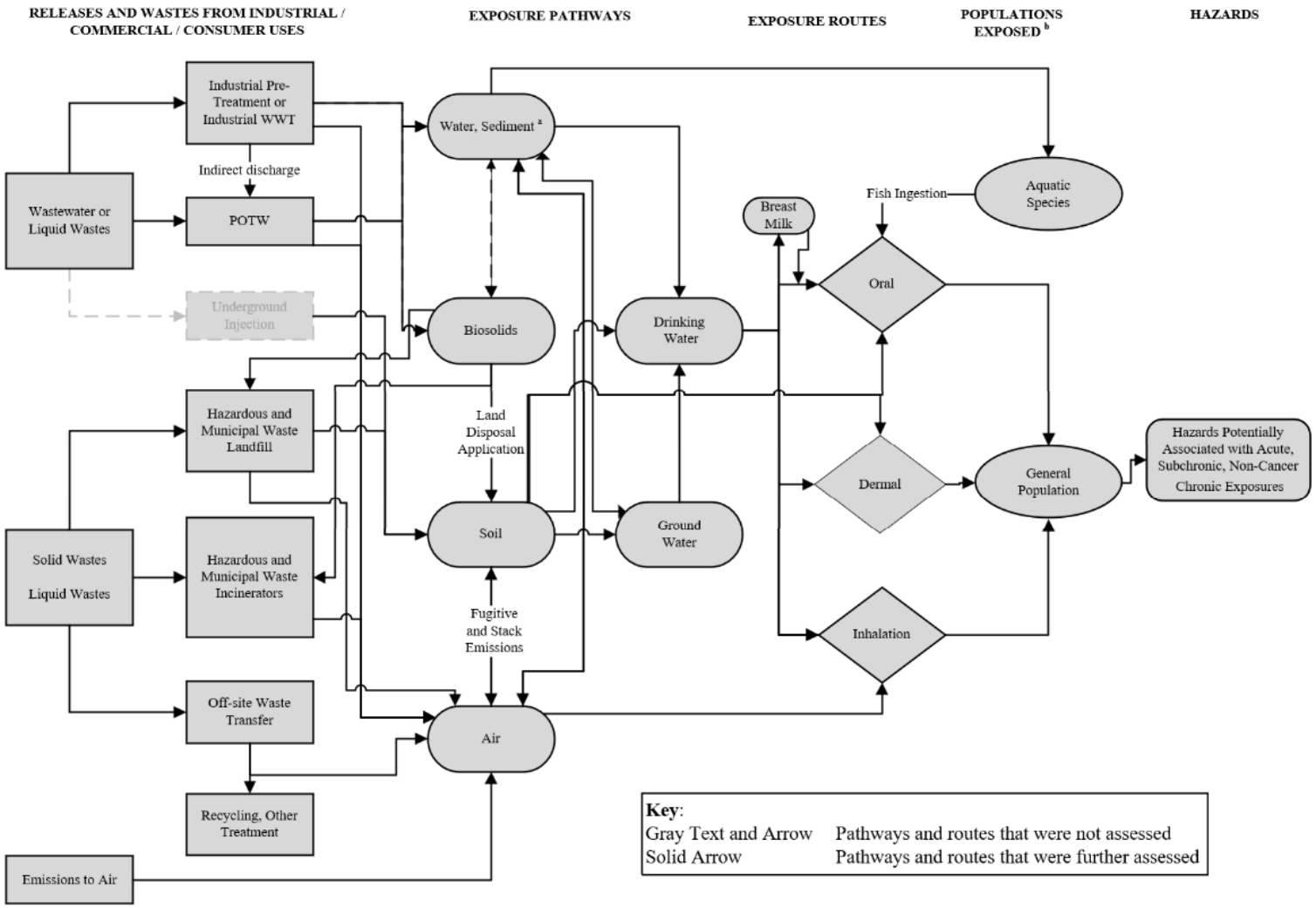


**Figure 1-6. DCHP Conceptual Model for Environmental Releases and Wastes: General Population Hazards**

The conceptual model presents the exposure pathways, exposure routes, and hazards to human populations from releases and wastes from industrial, commercial, and/or consumer uses of DCHP.

[a] Industrial wastewater or liquid wastes may be treated on-site and then released to surface water (direct discharge), or pretreated and released to publicly owned treatment works (POTWs) (indirect discharge). For consumer uses, such wastes may be released directly to POTWs. Drinking water will undergo further treatment in drinking water treatment plant. Groundwater may also be a source of drinking water. Inhalation from drinking water may occur via showering.

[b] Populations assessed include PESS.

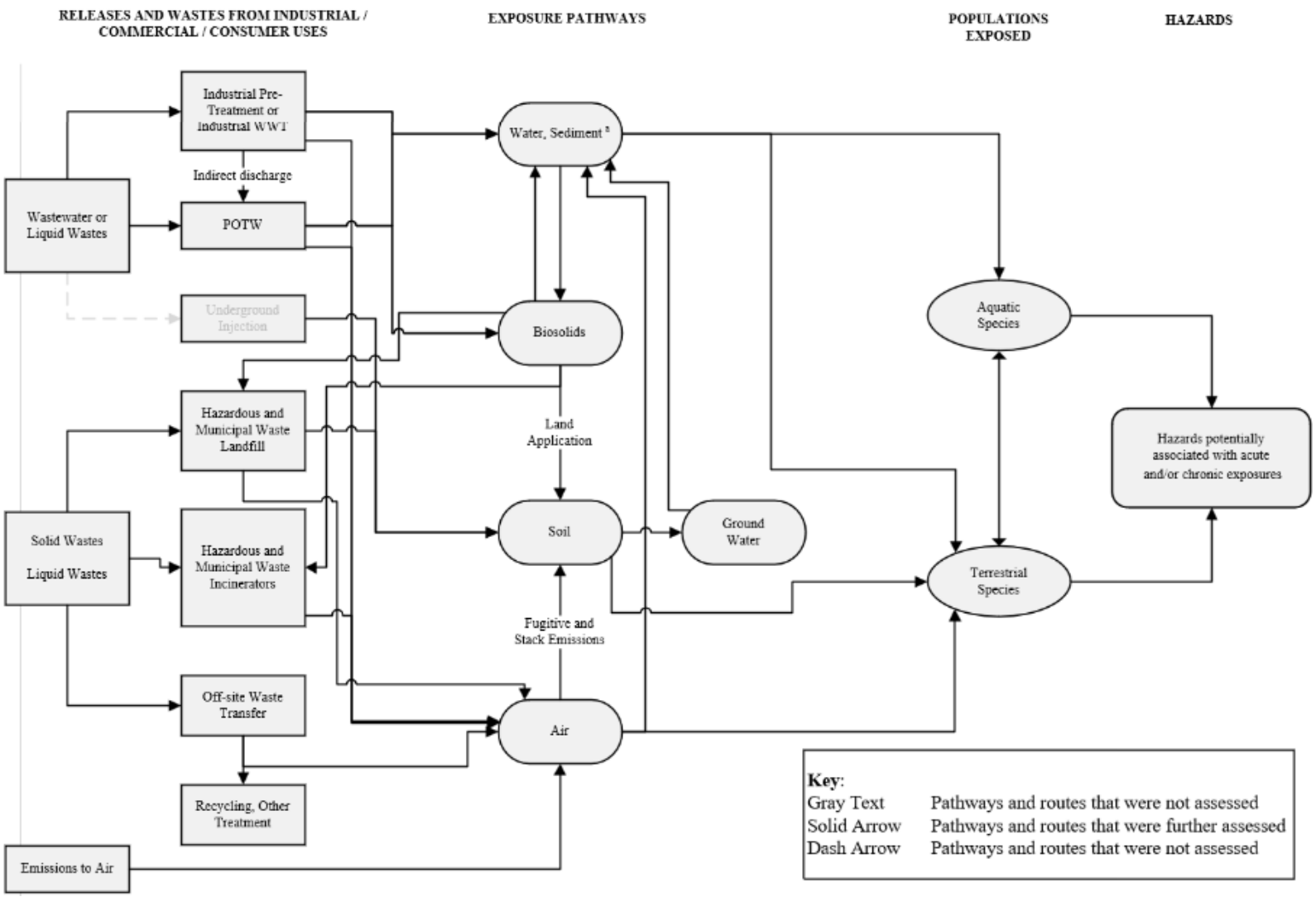


**Figure 1-7. DCHP Conceptual Model for Environmental Releases and Wastes: Ecological Exposures and Hazards**

The conceptual model presents the exposure pathways, exposure routes, and hazards to human populations from releases and wastes from industrial, commercial, and/or consumer uses of DCHP.

[a] Industrial wastewater or liquid wastes may be treated on-site and then released to surface water (direct discharge), or pretreated and released to POTWs (indirect discharge). For consumer uses, such wastes may be released directly to POTWs. Drinking water will undergo further treatment in drinking water treatment plant. Groundwater may also be a source of drinking water. Inhalation from drinking water may occur via showering.

## 1.3 Populations and Durations of Exposure Assessed

Based on the conceptual models presented in Section 1.2.1, EPA evaluated risk to humans and the environment. Environmental risks were evaluated for acute and chronic exposure scenarios for aquatic and terrestrial species, as appropriate. Human health risks associated with exposure to DCHP were evaluated for acute, intermediate, and chronic exposure scenarios, as applicable based on reasonably available exposure and hazard data as well as the relevant populations for each. Human populations assessed include the following:

- Workers, including average adults and females of reproductive age
- ONUs, including average adults
- Consumers, including infants (<1 year), toddlers (1–2 years), children (3–5 and 6–10 years), young teens (11–15 years), teenagers (16–20 years), and adults (21+ years)
- Bystanders, including infants (<1 year), toddlers (1–2 years), and children (3–5 and 6–10 years), young teens (11–15 years), teenagers (16–20 years), and adults (21+ years)
- General population, including infants (<1 year), toddlers (1–5 years), children (6–10 years), youth (11–15 and 16–20 years), and adults (21+ years)

Note that the age groups for consumers, bystanders, and general population are different because each life stage used unique exposure factors (*e.g.*, mouthing, drinking water ingestion, fish consumption rates). These exposure factors are provided in EPA's *Exposure Factors Handbook: 2011 Edition* (U.S. EPA, 2011b).

Consistent with its *Draft Proposed Approach for Cumulative Risk Assessment (CRA) of High-Priority Phthalates and a Manufacturer-Requested Phthalate under the Toxic Substances Control Act* (U.S. EPA, 2023c), EPA is focusing its phthalate CRA on populations most relevant to the common hazard endpoint (*i.e.*, reduced fetal testicular testosterone)—specifically females of reproductive age and male infants and male children. This approach emphasizes a common health effect for sensitive subpopulations; however, additional health endpoints are identified for broader populations and described in the individual non-cancer human health hazard assessments for DCHP (U.S. EPA, 2025x), DEHP (U.S. EPA, 2025y), DBP (U.S. EPA, 2025w), BBP (U.S. EPA, 2025v), DIBP (U.S. EPA, 2025z), and DINP (U.S. EPA, 2025aa). EPA is focusing its CRA on acute duration exposures because—as described further in the *Technical Support Document for the CRA of DEHP, DBP, BBP, DIBP, DCHP, and DINP under TSCA* (U.S. EPA, 2025ai)—there is evidence that effects on the developing male reproductive system consistent with a disruption of androgen action can result from a single exposure during the critical window of development.

### 1.3.1 Potentially Exposed and Susceptible Subpopulations

TSCA section 6(b)(4)(A) requires that risk evaluations "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 3(12) states that "the term 'potentially exposed or susceptible subpopulation' [PESS] means a group of individuals within the general population identified by the Administrator who, due to either greater susceptibility or greater exposure, may be at greater risk than the general population of adverse health effects from exposure to a chemical substance or mixture, such as infants, children, pregnant women, workers, or the elderly."

This risk evaluation considers PESS throughout the human health risk assessment (Section 4), including throughout the exposure assessment, hazard identification, and dose-response analysis supporting this

assessment. EPA incorporated the following PESS into its assessment: females of reproductive age; pregnant women, infants, children and adolescents; people who frequently use consumer products and/or articles containing high-concentrations of DCHP; people exposed to DCHP in the workplace; people who may be in close proximity to releasing facilities (including fenceline communities); and people whose diets include large amounts of fish (*i.e.,* subsistence fishers and Tribal populations). These subpopulations are PESS because some have greater exposure to DCHP per body weight (*e.g.,* infants, children, adolescents), while others experience aggregate or sentinel exposures. EPA also evaluated non-attributable exposures and cumulative risk to other phthalates (*i.e.,* BBP, DBP, DEHP, DIBP, and DINP) for the U.S. civilian population using National Health and Nutrition Examination Survey (NHANES) biomonitoring data. This non-attributable cumulative risk from exposure to DEHP, DBP, BBP, DIBP, and DINP was taken into consideration as part of EPA's cumulative risk calculations for DCHP, presented below in Section 4.4, and around exposures to DCHP from both occupational and consumer COUs/OESs (occupational exposure scenarios).

Section 4.3.5 summarizes (1) how PESS were incorporated into the risk evaluation through consideration of potentially increased exposures and/or potentially increased biological susceptibility; and (2) additional sources of uncertainty related to consideration of PESS.

## 1.4 Organization of the Risk Evaluation

This risk evaluation for DCHP includes five additional major sections and six appendices, as listed below:

- Section 2 summarizes basic physical and chemical characteristics as well as the fate and transport of DCHP.
- Section 3 includes an overview of releases and concentrations of DCHP in the environment.
- Section 4 presents the human health risk assessment, including the exposure, hazard, and risk characterization based on the DCHP COUs. It includes a discussion of PESS based on both greater exposure and/or susceptibility as well as a description of aggregate and sentinel exposures. Section 4 also discusses assumptions and uncertainties and how they potentially impact the strength of the evidence of risk evaluation. Finally, Section 4 presents cumulative risk estimates from exposure to DCHP, DEHP, DBP, BBP, DIBP, and DINP (Section 4.4), as well as a comparison of the individual DCHP risk assessment and the CRA (Section 4.5).
- Section 5 provides a discussion and analysis of the environmental risk assessment, including the environmental exposure, hazard, and risk characterization based on the COUs for DCHP. It also discusses assumptions and uncertainties and how they impact EPA's overall confidence in risk estimates.
- Section 6 presents EPA's determination of whether the chemical presents an unreasonable risk to human health or the environment under the assessed COUs.
- Appendix A provides a list of key abbreviations and acronyms used throughout this risk evaluation.
- Appendix B presents a brief summary of the federal, state, and international regulatory history of DCHP.
- Appendix C includes a list and citations for all TSDs and supplemental files included in the risk evaluation for DCHP.
- Appendix D provides a summary of updates made to COUs for DCHP from the final scope document to this risk evaluation.
- Appendix E provides descriptions of the DCHP COUs evaluated by EPA.
- Appendix F presents the occupational exposure value for DCHP that was derived by EPA.

This risk evaluation describes analyses considering both DCHP exposure under the COUs as the "individual assessment" or "single-chemical assessment" as well as analyses also considering background exposure to other phthalates (*i.e.,* NHANES) as the "cumulative assessment." The risk evaluation includes each of the steps described below.

- The risk evaluation uses two sets of calculations for the single chemical analysis:
  *Step 1. Single chemical, single route evaluation by COU.*
    - Routes include dermal and inhalation for workers, and dermal, inhalation, and oral for consumers.
    - For example, evaluation of inhalation exposure to workers for the manufacturing COU.

  *Step 2. Aggregate exposure and risk: Single chemical, multi-route evaluation by COU*
    - Aggregate assessment is only conducted when the hazard assessment shows that the same hazard is observed from different routes (*i.e.,* dermal, inhalation, and oral).
    - Aggregate risk for workers combines margins of exposure (MOEs) from dermal and inhalation routes by COU from Step 1.
    - Aggregate risk for consumers combines MOEs from dermal, inhalation, and oral routes by COU from Step 1.

- The risk evaluation also uses a third set of calculations:
  *Step 3. "Cumulative" risk: Single chemical, multi-route evaluation by COU from Step 2 combined with NHANES background evaluation of phthalates BBP, DBP, DEHP, DIBP, and DINP.*
    - For phthalates, the multi-chemical aspect of the evaluation is derived from the addition of *background phthalate exposure* as estimated from NHANES biomonitoring data.
      - A detailed description of how this is done can found in the CRA TSD (U.S. EPA, 2025ai). Summary information is found in Section 4.4.2 of this risk evaluation.
    - The "cumulative" calculations start with the aggregate risk estimates from Step 2 for each phthalate by COU.
    - The NHANES background risk is combined with the aggregate risk estimates.
    - As such, the cumulative MOEs from each phthalate-COU scenario are 6.2 to 15.5 percent smaller than the aggregate MOE depending on the life stage. This is because EPA added in the NHANES background risk.

# 2 CHEMISTRY AND FATE AND TRANSPORT OF DCHP

Physical and chemical properties determine the behavior and characteristics of a chemical that inform its COUs, environmental fate and transport, potential toxicity, exposure pathways, routes, and hazards. Environmental fate and transport includes environmental partitioning, accumulation, degradation, and transformation processes. Environmental transport is the movement of the chemical within and between environmental media such as air, water, soil, and sediment. Thus, understanding the environmental fate of DCHP informs the specific exposure pathways as well as the potential human and environmental exposed populations that EPA considered in this risk evaluation.

Sections 2.1 and 2.2 summarize the physical and chemical properties, and environmental fate and transport of DCHP, respectively. EPA's *Physical Chemistry and Fate and Transport Assessment for Dicyclohexyl Phthalate (DCHP)* (U.S. EPA, 2025ac) provides further information and details.

## 2.1 Summary of Physical and Chemical Properties

EPA gathered and evaluated physical and chemical property data and information according to the process described in the *Systematic Review Protocol for Dicyclohexyl Phthalate (DCHP)* (U.S. EPA, 2025ah). During the evaluation of DCHP, EPA considered both measured and estimated physical and chemical property data/information summarized in Table 2-1, as applicable. Information on the full, extracted dataset is available in the *Data Quality Evaluation and Data Extraction Information for Physical and Chemical Properties for Dicyclohexyl Phthalate (DCHP)* (U.S. EPA, 2025j).

**Table 2-1. Physical and Chemical Properties of DCHP**

| Property | Selected Value | Reference | Overall Quality Rating |
|---|---|---|---|
| Molecular formula | $C_{20}H_{26}O_4$ | | |
| Molecular weight | 330.43 g/mol | | |
| Physical form | Solid, prism | (Haynes, 2014) | High |
| Physical properties | White granular solid or crystalline powder | (NLM, 2024) | High |
| Melting point | 66 °C | (Haynes, 2014) | High |
| Boiling point | 225 °C at 4 mm Hg | (Haynes, 2014) | High |
| Density | 1.383 g/cm$^3$ | (Haynes, 2014) | High |
| Vapor pressure | 8.69 ×10$^{-7}$ mmHg | (NLM, 2024) | High |
| Vapor density | No data | | |
| Water solubility | 0.030–1.48 mg/L [a] | (U.S. EPA, 2017) | Medium |
| Octanol:water partition coefficient (log $K_{OW}$) | 4.82 | (EC/HC, 2017) | High |
| Octanol:air partition coefficient (log $K_{OA}$) | 10.23[a] | (U.S. EPA, 2017) | Medium |
| Henry's Law constant | 9.446×10$^{-8}$ atm·m$^3$/mol at 25 °C [a] | (U.S. EPA, 2017) | Medium |
| Flash point | 207 °C | (RSC, 2019) | Medium |
| Auto-flammability | No data | | |
| Viscosity | Solid, N/A | (NLM, 2024) | High |
| [a] Modeled value using EPI Suite™ | | | |

## 2.2 Summary of Environmental Fate and Transport

Reasonably available environmental fate data—including biotic and abiotic biodegradation rates, removal during wastewater treatment, volatilization from lakes and rivers, and organic carbon:water partition coefficient (log $K_{OC}$)—are the parameters used in this risk evaluation. In assessing the environmental fate and transport of DCHP, EPA considered the full range of results from the available data sources with medium and high data quality ratings collected through systematic review. Information on the full extracted dataset is available in the *Data Quality Evaluation and Data Extraction Information for Physical and Chemical Properties for Dicyclohexyl Phthalate (DCHP)* (U.S. EPA, 2025j).

Other fate estimates were based on modeling results from EPI Suite™ (U.S. EPA, 2012b), a predictive tool for physical and chemical properties and environmental fate estimation.

EPA evaluated the reasonably available information to characterize the physical and chemical properties and environmental fate and transport of DCHP. The key points are summarized below; DCHP

- Is a granular, crystalline solid under environmental conditions.
- Has a tendency to partition to soil, sediment, and particulate over water or air.
- Has limited solubility in water.
- Has low volatility in water or soil.

Given consistent results from numerous high-quality studies, there is robust evidence that when present in the environment; DCHP

- May degrade through hydrolysis, photolysis, aerobic or anaerobic biodegradation.
- May transport through the air suspended particles and be deposited to soil or water.
- Will sorb to particulate in the atmosphere and in water.
- Is expected to be removed in wastewater treatment processes by sorbing to particulate, biosolids, and sludge.

As a result of limited studies identified, there is moderate confidence that DCHP

- Might be partially removed in conventional drinking water treatment.
- Might accumulate in individual fish and aquatic organisms but is not likely to be biomagnified in aquatic environments.

The following bullets summarize the key points of the partitioning analysis; DCHP

- Will remain mostly in water but may sorb to sediment when released to aquatic environments.
- Will sorb to atmospheric particulate but may end up in small amounts in soil, water, and sediment when released to air.
- Will remain exclusively in soil when released to soil.
- Will sorb to particulate phases (soil, sediment, air particulate) with a small amount ending up in water when released to all three phases (air, water, and soil).

# 3 RELEASES AND CONCENTRATIONS OF DCHP IN THE ENVIRONMENT

EPA estimated environmental releases and concentrations of DCHP. Section 3.1 describes the approach and methodology for estimating releases, Section 3.2 presents environmental release estimates, and Section 3.3 presents the approach and methodology for estimating environmental concentrations as well as a summary of concentrations of DCHP in the environment.

## 3.1 Approach and Methodology

At the time of this risk evaluation, releases of DCHP have not been reported to programmatic databases, including the Toxics Release Inventory (TRI), Discharge Monitoring Report (DMR), or National Emissions Inventory (NEI). Therefore, EPA utilized models to estimate environmental releases for each OES. This section provides an overview of the approach and methodology for assessing releases to the environment from industrial, commercial, and consumer uses. Specifically, Sections 3.1.1 through 3.1.3 describe the approach and methodology for estimating releases to the environment from industrial and commercial uses, and Section 3.1.4 describes the approach and methodology for assessing down-the-drain releases from consumer uses.

### 3.1.1 Manufacturing, Processing, Industrial and Commercial Use

This subsection describes the grouping of manufacturing, processing, industrial and commercial COUs into OESs, as well as the use of DCHP within each OES. Section 3.1.1.1 provides a crosswalk of COUs to OESs and Section 3.1.1.2 provides descriptions for the use of DCHP within each OES.

#### 3.1.1.1 Crosswalk of Conditions of Use to Occupational Exposure Scenarios

EPA categorized the COUs listed in Table 1-1 into OESs. Table 3-1 and Table 3-2 provides a crosswalk between the COUs and OESs. 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 that 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 the given OES in the United States. In some cases, the Agency defined only a single OES for multiple COUs, while in other cases EPA developed multiple OESs for a single COU. EPA made this determination by considering variability in release and use conditions and whether the variability required discrete scenarios or could be captured as a distribution of exposures. The *Environmental Release and Occupational Exposure Assessment for Dicyclohexyl Phthalate (DCHP)* (U.S. EPA, 2025s) provides further information on specific OESs.

**Table 3-1. Crosswalk of Conditions of Use to Assessed Occupational Exposure Scenarios**

| COU | | | OES [d] |
|---|---|---|---|
| **Life Cycle Stage [a]** | **Category [b]** | **Subcategory [c]** | |
| Manufacturing | Domestic manufacturing | Domestic manufacturing | Manufacturing |
| | Importing | Importing | Import and repackaging |
| Processing | Repackaging | Repackaging (*e.g.*, laboratory chemicals) | Import and repackaging |
| | Processing – incorporation into formulation, mixture, or reaction product | Adhesive and sealant chemicals in:<br>– Adhesive manufacturing | Incorporation into adhesives and sealants |
| | | Plasticizer in:<br>– Adhesive manufacturing<br>– Paint and coating manufacturing<br>– Plastics product manufacturing<br>– Printing ink manufacturing<br>– Rubber product manufacturing<br>– Plastic material and resin manufacturing | Incorporation into adhesives and sealants;<br>Incorporation into paints and coatings;<br>PVC plastics compounding;<br>Non-PVC material compounding |
| | | Stabilizing agent in:<br>– Plastics product manufacturing<br>– Paint and coating manufacturing<br>– Asphalt paving, roofing, and coating materials manufacturing<br>– Adhesive manufacturing | Incorporation into adhesives and sealants;<br>Incorporation into paints and coatings;<br>Incorporation into other formulations, mixtures, or reaction products;<br>PVC plastics compounding;<br>Non-PVC material compounding |
| | Processing – incorporation into article | Plasticizer in:<br>– Plastics product manufacturing<br>– Rubber product manufacturing | PVC plastics converting;<br>Non-PVC material converting |
| | Recycling | Recycling | Recycling |
| Distribution | Distribution in commerce | Distribution in commerce | Distribution in commerce |
| Industrial Use | Adhesives and sealants | Adhesives and sealants in:<br>– Transportation equipment manufacturing<br>– Computer and electronic product manufacturing | Application of adhesives and sealants |
| | Finishing agent | Cellulose film production | Application of paints and coatings |
| | Inks, toner, and colorant products | Inks, toner, and colorant products (*e.g.*, screen printing ink) | Application of paints and coatings |
| | Paints and coatings | Paints and coatings | Application of paints and coatings |
| | Other articles with routine direct contact during normal use including rubber articles; plastic articles (hard) | Other articles with routine direct contact during normal use including rubber articles; plastic articles (hard) (*e.g.*, transportation equipment manufacturing) | Fabrication or use of final products or articles |

| COU | | | OES [d] |
|---|---|---|---|
| **Life Cycle Stage [a]** | **Category [b]** | **Subcategory [c]** | |
| Commercial Use | Adhesives and sealants | Adhesives and sealants | Application of adhesives and sealants |
| | Building/construction materials not covered elsewhere | Building/construction materials not covered elsewhere | Fabrication or use of final products or articles |
| | Inks, toner, and colorant products | Inks, toner, and colorant products (*e.g.*, screen printing ink) | Application of paints and coatings |
| | Laboratory chemicals | Laboratory chemicals | Use of laboratory chemicals |
| | Paints and coatings | Paints and coatings | Application of paints and coatings |
| | Other articles with routine direct contact during normal use including rubber articles; plastic articles (hard) | Other articles with routine direct contact during normal use including rubber articles; plastic articles (hard) | Fabrication or use of final products or articles |
| Disposal | Disposal | Disposal | Waste handling, treatment, and disposal |

[a] Life Cycle Stage Use Definitions (40 CFR 711.3)
- "Industrial use" means use at a site at which 1 or more chemicals or mixtures are manufactured (including imported) or processed.
- "Commercial use" means the use of a chemical or a mixture containing a chemical (including as part of an article) in a commercial enterprise providing saleable goods or services.
- "Consumer use" means the use of a chemical or a mixture containing a chemical (including as part of an article, such as furniture or clothing) when sold to or made available to consumers for their use.
- Although EPA has identified both industrial and commercial uses here for purposes of distinguishing scenarios in this document, the Agency interprets the authority over "any manner or method of commercial use" under TSCA section 6(a)(5) to reach both.

[b] These categories of COU appear in the life cycle diagram, reflect CDR codes, and broadly represent COUs of DCHP in industrial and/or commercial settings.
[c] These subcategories represent more specific activities within the life cycle stage and category of the COU of DCHP.
[d] 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 conditions of use (multiple COUs mapped to single OES), or there may be several ways in which releases/exposures take place for a given condition of use (single COU mapped to multiple OESs).

## Table 3-2. Crosswalk of Assessed Occupational Exposure Scenarios to Conditions of Use

| OES [a] | COU | | |
|---|---|---|---|
| | **Life Cycle Stage [b]** | **Category [c]** | **Subcategory [d]** |
| Manufacturing | Manufacturing | Domestic manufacturing | Domestic manufacturing |
| Import and repackaging | Manufacturing | Importing | Importing |
| | Processing | Repackaging | Repackaging (*e.g.*, laboratory chemicals) |
| Incorporation into adhesives and sealants | Processing | Processing – incorporation into formulation, mixture, or reaction product | Adhesive and sealant chemicals in:<br>– Adhesive manufacturing |
| | | | Plasticizer in:<br>– Adhesive manufacturing |
| | | | Stabilizing agent in:<br>– Adhesive manufacturing |

| OES [a] | COU | | |
|---|---|---|---|
| | Life Cycle Stage [b] | Category [c] | Subcategory [d] |
| Incorporation into paints and coatings | Processing | Processing – incorporation into formulation, mixture, or reaction product | Plasticizer in:<br>– Paint and coating manufacturing<br>– Printing ink manufacturing |
| | | | Stabilizing agent in:<br>– Paint and coating manufacturing |
| Incorporation into other formulations, mixtures, or reaction products | Processing | Processing – incorporation into formulation, mixture, or reaction product | Stabilizing agent in:<br>– Asphalt paving, roofing, and coating materials manufacturing |
| PVC plastics compounding | Processing | Processing – incorporation into formulation, mixture, or reaction product | Plasticizer in:<br>– Plastics product manufacturing<br>– Plastic material and resin manufacturing |
| | | | Stabilizing agent in:<br>– Plastics product manufacturing |
| PVC plastics converting | Processing | Processing – incorporation into article | Plasticizer in:<br>– Plastics product manufacturing |
| Non-PVC material compounding | Processing | Processing – incorporation into formulation, mixture, or reaction product | Plasticizer in:<br>– Plastics product manufacturing<br>– Rubber product manufacturing<br>– Plastic material and resin manufacturing |
| | | | Stabilizing agent in:<br>– Plastics product manufacturing |
| Non-PVC material converting | Processing | Processing – incorporation into article | Plasticizer in:<br>– Plastics product manufacturing<br>– Rubber product manufacturing |
| Recycling | Processing | Recycling | Recycling |
| Distribution in commerce | Distribution | Distribution in commerce | Distribution in commerce |
| Application of paints and coatings | Industrial Use | Inks, toner, and colorant products | Inks, toner, and colorant products (*e.g.*, screen printing ink) |
| | | Paints and coatings | Paints and coatings |
| | | Finishing agent | Cellulose film production |
| | Commercial Use | Paints and coatings | Paints and coatings |
| | | Inks, toner, and colorant products | Inks, toner, and colorant products (*e.g.*, screen printing ink) |
| Application of adhesives and sealants | Industrial Use | Adhesives and sealants | Adhesives and sealants in:<br>– Computer and electronic product manufacturing<br>– Transportation equipment manufacturing |
| | Commercial Use | Adhesives and sealants | Adhesives and sealants |
| Use of laboratory chemicals | Commercial Use | Laboratory chemicals | Laboratory chemicals |

| OES [a] | COU | | |
|---|---|---|---|
| | Life Cycle Stage [b] | Category [c] | Subcategory [d] |
| Fabrication or use of final products or articles | Industrial Use | Other articles with routine direct contact during normal use including rubber articles; plastic articles (hard) | Other articles with routine direct contact during normal use including rubber articles; plastic articles (hard) (*e.g.*, transportation equipment manufacturing) |
| | Commercial Use | Building/construction materials not covered elsewhere | Building/construction materials not covered elsewhere |
| | Commercial Use | Other articles with routine direct contact during normal use including rubber articles; plastic articles (hard) | Other articles with routine direct contact during normal use including rubber articles; plastic articles (hard) |
| Waste handling, treatment and disposal | Disposal | Disposal | Disposal |

[a] 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 conditions of use (multiple COUs mapped to single OES), or there may be several ways in which releases/exposures take place for a given condition of use (single COU mapped to multiple OESs).

[b] Life Cycle Stage Use Definitions (40 CFR 711.3)

- "Industrial use" means use at a site at which 1 or more chemicals or mixtures are manufactured (including imported) or processed.
- "Commercial Use" means the use of a chemical or a mixture containing a chemical (including as part of an article) in a commercial enterprise providing saleable goods or services.
- "Consumer use" means the use of a chemical or a mixture containing a chemical (including as part of an article, such as furniture or clothing) when sold to or made available to consumers for their use.
- Although EPA has identified both industrial and commercial uses here for purposes of distinguishing scenarios in this document, the Agency interprets the authority over "any manner or method of commercial use" under TSCA section 6(a)(5) to reach both.

[c] These categories of COU appear in the life cycle diagram, reflect CDR codes, and broadly represent COUs of DCHP in industrial and/or commercial settings.

[d] These subcategories represent more specific activities within the life cycle stage and category of the COU of DCHP.

#### 3.1.1.2 Description of DCHP Use for Each OES

After EPA characterized the OESs for the occupational exposure assessment of DCHP, the occupational uses of DCHP for all OESs were summarized. Brief summaries of the uses of DCHP for all OESs are presented below in Table 3-3.

**Table 3-3. Description of the Use of DCHP for Each OES**

| OES | Use of DCHP |
|---|---|
| Manufacturing | DCHP is formed through the reaction of phthalic anhydride with cyclohexane ring alcohols (cyclohexanol). |
| Import and repackaging | DCHP is imported domestically for use and/or may be repackaged before shipment to formulation sites. |
| PVC plastics compounding | DCHP is used as an additive in PVC plastics to increase flexibility. |
| PVC plastics converting | |
| Incorporation into adhesives and sealants | DCHP is a plasticizer and stabilizing agent in adhesive and sealant products for industrial and commercial use. |
| Incorporation into paints and coatings | DCHP is a plasticizer and stabilizing agent in paint and coating products for industrial and commercial use. |
| Incorporation into other formulations, mixtures, or reaction products | DCHP is incorporated into products, such as laboratory chemicals and asphalt paving, roofing, and coating materials. |

| OES | Use of DCHP |
|---|---|
| Non-PVC material compounding | DCHP is used as an additive in non-PVC polymers, such as rubber and cellulose, to increase flexibility. |
| Non-PVC material converting | |
| Application of adhesives and sealants | Industrial and commercial sites often apply DCHP in powdered form to serve as a hardener, thickener, or curing agent for adhesive and sealant materials. Liquid adhesive and sealant products containing DCHP are generally thick and paste-like, and these products are applied using roll or bead application methods. Products may also be applied using a syringe or caulk gun. |
| Application of paints and coatings | Industrial and commercial sites apply DCHP-containing paints and coatings using roll, brush, trowel, and spray application methods. |
| Use of laboratory chemicals | DCHP is a laboratory chemical used for laboratory analyses in solid and liquid forms. |
| Recycling | A fraction of PVC plastics that contain DCHP are recycled either in-house or at PVC recycling facilities for continuous compounding of new PVC material. |
| Fabrication or use of final products or articles | DCHP is found in a wide array of different final articles not found in other OES such as wall coverings or other solid plastic or rubber products. |
| Waste handling, treatment, and disposal | DCHP-containing products or residuals are managed as waste to be treated and/or disposed. |

### 3.1.2 Estimating the Number of Release Days per Year for Facilities in Each OES

Based on the limited data on the number of release days for the majority of the OESs, EPA developed generic estimates of the number of annual operating days (days/year) for facilities in each OES, as presented in Table 3-4. Generally, EPA does not have information on the number of operating days for facilities; however, the Agency used generic scenarios (GSs) or emission scenario documents (ESDs) to assess the number of operating days for a given OES. EPA estimated average daily releases for facilities by assuming that the number of release days is equal to the number of operating days.

**Table 3-4. Generic Estimates of Number of Operating Days per Year for Each OES**

| Occupational Exposure Scenario | Operating Days (days/year) | Basis |
|---|---|---|
| Manufacturing | 250 | EPA assumed year-round site operation for 5 days each week, considering a 2-week downtime, totaling 250 days/year. |
| Import and repackaging | 208–260 | The 2022 Chemical Repackaging GS estimated the total number of operating days as one of three discrete values based on the typical shift lengths of operators over the course of a full year. Shift lengths include 8- 10-, or 12-hour shifts, which resulted in operating day estimates of 174, 208, or 260 days/year, respectively. EPA assessed releases using Monte Carlo modeling (see *Environmental Release and Occupational Exposure Assessment for Dicyclohexyl Phthalate (DCHP)* (U.S. EPA, 2025s)), which used a 50th to 95th percentile range of 208–260 days/year (U.S. EPA, 2022a). |
| Incorporation into adhesives and sealants | 250 | EPA assumed year-round site operation for 5 days each week, considering a 2-week downtime, totaling 250 days/year. |
| Incorporation into paints and coatings | 250 | EPA assumed year-round site operation for 5 days each week, considering a 2-week downtime, totaling 250 days/year. |

| Occupational Exposure Scenario | Operating Days (days/year) | Basis |
|---|---|---|
| Incorporation into other formulations, mixtures, or reaction products | 250 | EPA assumed year-round site operation for 5 days each week, considering a 2-week downtime, totaling 250 days/year. |
| PVC plastics compounding | 223–254 | The 2021 Revised Draft GS on the Use of Additives in Plastic Compounding estimated the number of operating days as 148–264 days/year. Release estimates that EPA assessed using Monte Carlo modeling (see *Environmental Release and Occupational Exposure Assessment for Dicyclohexyl Phthalate (DCHP)* (U.S. EPA, 2025s)) used a 50th to 95th percentile range of 223–254 days/year (U.S. EPA, 2021d, 2014c). |
| PVC plastics converting | 219–251 | The 2021 Revised Draft GS on the Use of Additives in the Thermoplastics Converting Industry estimated the number of operating days as 138–253 days/year. Release estimates that EPA assessed using Monte Carlo modeling (see *Environmental Release and Occupational Exposure Assessment for Dicyclohexyl Phthalate (DCHP)* (U.S. EPA, 2025s)) used a 50th to 95th percentile range of 219–251 days/year (U.S. EPA, 2021e). |
| Non-PVC material compounding | 234–280 | The 2021 Revised Draft GS on the Use of Additives in Plastic Compounding and the 2020 *SpERC Factsheet on Rubber Production and Processing* estimated the total number of operating days as 148–300 days/year. Release estimates that EPA assessed using Monte Carlo modeling (see *Environmental Release and Occupational Exposure Assessment for Dicyclohexyl Phthalate (DCHP)* (U.S. EPA, 2025s)) used a 50th to 95th percentile range of 234–280 days/year (U.S. EPA, 2021d; ESIG, 2020; U.S. EPA, 2014c) |
| Non-PVC material converting | 219–251 | The 2021 Revised Draft GS on the Use of Additives in the Thermoplastics Converting Industry estimated the number of operating days as 137–254 days/year. Release estimates that EPA assessed using Monte Carlo modeling (see *Environmental Release and Occupational Exposure Assessment for Dicyclohexyl Phthalate (DCHP)* (U.S. EPA, 2025s)) used a 50th to 95th percentile range of 219–251 days/year (U.S. EPA, 2021e). |
| Application of adhesives and sealants | 232–325 | Based on several end use products categories, the 2015 ESD on the Use of Adhesives estimated the total number of operating days as 50–365 days/year. Release estimates that EPA assessed using Monte Carlo modeling (*Environmental Release and Occupational Exposure Assessment for Dicyclohexyl Phthalate (DCHP)* (U.S. EPA, 2025s)) used a 50th to 95th percentile range of 232–325 days/year (OECD, 2015b). |
| Application of paints and coatings | 257–287 | EPA assessed the total number of operating days based on the 2011 ESD on Radiation Curable Coatings, Inks and Adhesives, the 2011 ESD on Coating Application via Spray-Painting in the Automotive Finishing Industry, the 2004 GS on Spray Coatings in the Furniture Industry, and the *SpERC Factsheet for Industrial Application of Coatings and Inks by Spraying*. These sources estimated the total number of operating days as 225–300 days/year. Release estimates that EPA assessed using Monte Carlo modeling (*Environmental Release and Occupational Exposure Assessment for Dicyclohexyl* |

| Occupational Exposure Scenario | Operating Days (days/year) | Basis |
|---|---|---|
| | | *Phthalate (DCHP)* (U.S. EPA, 2025s)) used a 50th to 95th percentile range of 257–287 days/year (CEPE, 2020; OECD, 2011a, b; U.S. EPA, 2004c). |
| Use of laboratory chemicals | Solid and liquid: 235–258 | The 2023 Use of Laboratory Chemicals GS estimated the total number of operating days with a discrete distribution based on the shift lengths of operators over the course of a full year. Shift lengths include 8- 10-, or 12-hour shifts, which result in a range of 174–260 days/year for operating days. Release estimates that EPA assessed using Monte Carlo modeling (*Environmental Release and Occupational Exposure Assessment for Dicyclohexyl Phthalate (DCHP)* (U.S. EPA, 2025s)) used a 50th to 95th percentile range of 235–258 days/year (U.S. EPA, 2023g). |
| Fabrication or use of final products or articles | 250 | EPA assumed year-round site operation for 5 days each week, considering a 2-week downtime, totaling 250 days/year. However, EPA was not able to perform a quantitative release assessment for this OES because the release parameters were unknown and unquantifiable. |
| Recycling | 223–254 | The 2021 Revised Draft GS on the Use of Additives in Plastic Compounding estimated the number of operating days as 148–264 days/year. Release estimates that EPA assessed using Monte Carlo modeling (see *Environmental Release and Occupational Exposure Assessment for Dicyclohexyl Phthalate (DCHP)* (U.S. EPA, 2025s)) used a 50th to 95th percentile range of 223–254 days/year (U.S. EPA, 2021d, 2014c). |
| Waste handling, treatment, and disposal | 250 | EPA assumed year-round site operation for 5 days each week, considering a 2-week downtime, totaling 250 days/year. |

### 3.1.3 Daily Release Estimation

For each OES, the Agency estimated releases to each medium of release using 2020 CDR data (U.S. EPA, 2020a), GSs and ESDs, and published EPA models as shown in Figure 3-1. Where available, EPA used GSs or ESDs to estimate number of release days, which the Agency used to convert between annual release estimates and daily release estimates. EPA used 2020 CDR, 2020 U.S. County Business Practices, and Monte Carlo modeling data to estimate the number of sites using DCHP within an OES. Generally, information for reporting sites in CDR was sufficient to accurately characterize each reporting site's OESs. The *Environmental Release and Occupational Exposure Assessment for Dicyclohexyl Phthalate (DCHP)* (U.S. EPA, 2025s) describes EPA's approach and methodology for estimating daily releases and provides detailed facility level results for each OES.

For each OES, EPA estimated DCHP releases per facility to each release medium applicable to that OES. For DCHP, the Agency assessed releases to water, air, or land (*i.e.*, disposal to land).

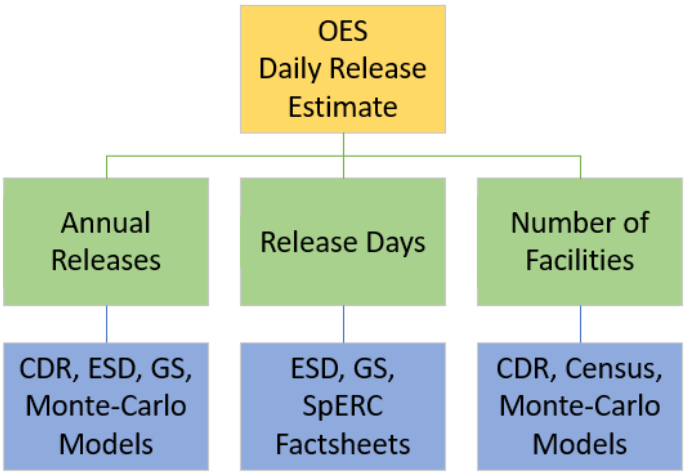


**Figure 3-1. An Overview of How EPA Estimated Daily Releases for Each OES**
CDR = Chemical Data Reporting; ESD = emission scenario document; GS = generic scenario; SpERC = Specific Environmental Release Category

### 3.1.4 Consumer Down-the-Drain and Landfills

EPA evaluated down-the-drain releases of DCHP for consumer COUs qualitatively. Although the Agency acknowledges that there may be DCHP releases to the environment via the cleaning and disposal of adhesives and sealants, the Agency did not quantitatively assess down-the-drain and disposal scenarios of consumer products due to limited information from monitoring data as well as limited availability of modeling tools that can adequately quantify disposal. EPA provides a qualitative assessment of down-the-drain releases of DCHP using physical and chemical properties in this section. See EPA's *Consumer and Indoor Dust Exposure Assessment for Dicyclohexyl Phthalate (DCHP)* (U.S. EPA, 2025c) for further details. For example, adhesives and sealants can be disposed down-the-drain when people using them wash their hands, brushes, sponges, and other product-applying tools. Very limited information is available on wastewater treatment and the removal of DCHP in drinking water treatment plants. As stated in the *Physical Chemistry and Fate and Transport Assessment for Dicyclohexyl Phthalate (DCHP)* (U.S. EPA, 2025ac), no data were identified by EPA for DCHP in drinking water. Based on the low water solubility and log $K_{OW}$, DCHP in water is expected to mainly partition to suspended solids present in water. The available information suggest that the use of flocculants and filtering media could potentially help remove DCHP during drinking water treatment by sorption into suspended organic matter, settling, and physical removal.

In addition, adhesives and sealant products can be disposed of when users no longer have use for them or when the products have reached the product shelf life and are taken to landfills. All other solid products and articles listed in Table 4-6 can be removed and disposed of in landfills or other waste handling locations that properly manage the disposal of products like adhesives and sealants. DCHP is expected to be persistent as it leaches from consumer products disposed of in landfills. Due to low water solubility, DCHP is likely to be present in landfill leachate up to its aqueous limit of solubility (1.48 mg/L). However, due to its affinity for organic carbon, it is expected to be immobile in groundwater. Even in cases where landfill leachate containing DCHP were to migrate to groundwater, DCHP would likely partition from groundwater to organic carbon present in the subsurface (U.S. EPA, 2025p).

## 3.2 Summary of Environmental Releases

### 3.2.1 Manufacturing, Processing, Industrial and Commercial

EPA combined its estimates for total production volume, release days, number of facilities, and hours of release per day to estimate a range of daily releases for each OES. Table 3-5 presents a summary of these ranges across facilities. See the *Environmental Release and Occupational Exposure Assessment for Dicyclohexyl Phthalate (DCHP)* (U.S. EPA, 2025s) for additional information on deriving the overall confidence score for each OES. EPA was not able to estimate site-specific releases for the Fabrication or use of final products or articles OES. Disposal sites handling post-consumer, end-use DCHP were not quantifiable due to the wide and dispersed use of DCHP in PVC and other products. Pre-consumer waste handling, treatment, and disposal are assumed to be captured in upstream OESs.

**Table 3-5. Summary of EPA's Daily Release Estimates for Each OES and EPA's Overall Confidence in these Estimates**

| OES | Estimated Daily Release Across Sites (kg/site-day) | | Type of Discharge, [a] Air Emission, [b] or Transfer for Disposal [c] | Estimated Release Frequency Across Sites (days) [d] | | Number of Facilities and Production Volume (PV) [e] | Weight of Scientific Evidence Rating [f] | Source |
|---|---|---|---|---|---|---|---|---|
| | Central Tendency | High-End | | Central Tendency | High-End | | | |
| Manufacturing | 9.4E–02 | 0.42 | Stack Air | 250 | | 1 – LANXESS Corporation, Pittsburgh, PA PV: 7,843 kg/yr | Slight to Moderate | CDR, Peer-reviewed literature (GS/ESD) |
| | 0.12 | 0.55 | Fugitive Air, Water, Incineration, or Landfill | | | | | |
| | 0.94 | | Water, Incineration, or Landfill | | | | | |
| | 0.15 | 0.57 | Incineration or Landfill | | | | | |
| | 2.5 | 11 | Stack Air | 250 | | 1 – Vertellus LLC, Indianapolis, IN PV: 207,064 kg/yr | Slight to Moderate | CDR, Peer-reviewed literature (GS/ESD) |
| | 3.2 | 15 | Fugitive air, water, incineration, or landfill | | | | | |
| | 12 | | Water, Incineration, or Landfill | | | | | |
| | 4.0 | 15 | Incineration or Landfill | | | | | |
| Import and repackaging | 1.5 | 9.3 | Stack Air | 208 | 260 | 2 – United Initiators, Inc., Elyria, OH; Nouryon Chemicals LLC, Chicago, IL PV: 5,945 – 119,343 kg/yr | Slight to Moderate | CDR, Peer-reviewed literature (GS/ESD) |
| | 1.9 | 12 | Fugitive air, water, incineration, or landfill | | | | | |
| | 4.0 | 8.2 | Water, Incineration, or Landfill | | | | | |
| | 2.4 | 13 | Incineration or Landfill | | | | | |
| Incorporation into adhesives and sealants | 0.11 | 0.70 | Stack Air | 250 | | 5–9 generic sites PV: 20,706 kg/yr | Slight to Moderate | CDR, Peer-reviewed literature (GS/ESD) |
| | 0.14 | 0.93 | Fugitive air, water, incineration, or landfill | | | | | |
| | 2.6 | 4.9 | Water, Incineration, or Landfill | | | | | |
| | 0.18 | 0.99 | Incineration or Landfill | | | | | |
| Incorporation into paints and coatings | 1.2E–02 | 0.10 | Stack Air | 250 | | 20–34 generic sites PV: 1,070 – 21,482 kg/yr | Slight to Moderate | CDR, Peer-reviewed literature (GS/ESD) |
| | 1.6E–02 | 0.14 | Fugitive air, water, incineration, or landfill | | | | | |
| | 1.1 | 3.0 | Water, Incineration, or Landfill | | | | | |
| | 2.0E–02 | 0.15 | Incineration or Landfill | | | | | |

| OES | Estimated Daily Release Across Sites (kg/site-day) | | Type of Discharge, [a] Air Emission, [b] or Transfer for Disposal [c] | Estimated Release Frequency Across Sites (days) [d] | | Number of Facilities and Production Volume (PV) [e] | Weight of Scientific Evidence Rating [f] | Source |
|---|---|---|---|---|---|---|---|---|
| | Central Tendency | High-End | | Central Tendency | High-End | | | |
| Incorporation into other formulations, mixtures, or reaction products | 8.3E–02 | 0.78 | Stack Air | 250 | | 11–22 generic sites PV: 34,412 kg/yr | Slight to Moderate | CDR, Peer-reviewed literature (GS/ESD) |
| | 0.11 | 1.0 | Fugitive air, water, incineration, or landfill | | | | | |
| | 0.13 | 1.2 | Water, Incineration, or Landfill | | | | | |
| | 0.13 | 1.2 | Incineration or Landfill | | | | | |
| PVC plastics compounding | 0.12 | 4.1 | Fugitive or Stack Air | 223 | 254 | 5–9 generic sites PV: 18,543 – 222,659 kg/yr | Slight to Moderate | CDR, Peer-reviewed literature (GS/ESD) |
| | 0.83 | 7.9 | Fugitive air, water, incineration, or landfill | | | | | |
| | 3.5 | 18 | Water, Incineration, or Landfill | | | | | |
| | 1.1 | 6.1 | Water | | | | | |
| | 1.4 | 11 | Incineration or Landfill | | | | | |
| PVC plastics converting | 7.2E–03 | 0.19 | Fugitive or Stack Air | 219 | 251 | 42–67 generic sites PV: 18,543 – 222,659 kg/yr | Slight to Moderate | CDR, Peer-reviewed literature (GS/ESD) |
| | 4.7E–02 | 0.35 | Fugitive air, water, incineration, or landfill | | | | | |
| | 0.96 | 1.9 | Water, Incineration, or Landfill | | | | | |
| | 0.13 | 0.41 | Water | | | | | |
| | 0.43 | 1.4 | Incineration or Landfill | | | | | |
| Non-PVC material compounding | 3.1E–02 | 0.88 | Fugitive or Stack Air | 234 | 280 | 2–4 generic sites PV: 11,340 – 22,680 kg/yr | Slight to Moderate | CDR, Peer-reviewed literature (GS/ESD) |
| | 0.25 | 1.6 | Fugitive air, water, incineration, or landfill | | | | | |
| | 1.5 | 2.9 | Water, Incineration, or Landfill | | | | | |
| | 0.30 | 0.90 | Water | | | | | |
| | 0.41 | 2.1 | Incineration or Landfill | | | | | |
| Non-PVC material converting | 2.0E–02 | 0.47 | Fugitive or Stack Air | 219 | 251 | 2–4 generic sites PV: 11,340 – 22,680 kg/yr | Slight to Moderate | CDR, Peer-reviewed literature (GS/ESD) |
| | 0.13 | 0.86 | Fugitive air, water, incineration, or landfill | | | | | |
| | 1.1 | 2.9 | Water, Incineration, or Landfill | | | | | |
| | 0.32 | 0.96 | Water | | | | | |
| | 1.1 | 3.3 | Incineration or Landfill | | | | | |

| OES | Estimated Daily Release Across Sites (kg/site-day) | | Type of Discharge, [a] Air Emission, [b] or Transfer for Disposal [c] | Estimated Release Frequency Across Sites (days) [d] | | Number of Facilities and Production Volume (PV) [e] | Weight of Scientific Evidence Rating [f] | Source |
|---|---|---|---|---|---|---|---|---|
| | Central Tendency | High-End | | Central Tendency | High-End | | | |
| Application of paints and coatings with overspray controls (no overspray controls) | 5.8E–09 [5.8E–09] | 1.3E–08 [1.3E–08] | Fugitive Air | 257 | 287 | 1–14 generic sites [1–14 generic sites] PV: 1,070 – 21,482 kg/yr | Slight to Moderate | CDR, Peer-reviewed literature (GS/ESD) |
| | 1.4 [7.4E–02] | 5.1 [0.63] | Stack Air | | | | | |
| | 9.4E–02 [13] | 0.82 [47] | Fugitive Air, Water, Incineration, or Landfill | | | | | |
| | 1.3 [1.3] | 3.3 [3.3] | Water, Incineration, or Landfill | | | | | |
| | 11 [0.12] | 42 [0.88] | Incineration or Landfill | | | | | |
| Application of adhesives and sealants | 5.7E–10 | 1.5E–09 | Fugitive Air | 232 | 325 | 6–80 generic sites PV: 20,706 kg/yr | Slight to Moderate | CDR, Peer-reviewed literature (GS/ESD) |
| | 4.2E–02 | 0.46 | Stack Air | | | | | |
| | 5.3E–02 | 0.61 | Fugitive Air, Water, Incineration, or Landfill | | | | | |
| | 0.33 | 1.6 | Water, Incineration, or Landfill | | | | | |
| | 0.67 | 3.6 | Incineration or Landfill | | | | | |
| Use of laboratory chemicals – liquid | 1.5E–12 | 2.6E–12 | Fugitive or Stack Air | 235 | 258 | 36,873 generic sites PV: 34,412 kg/yr | Slight to Moderate | CDR, Peer-reviewed literature (GS/ESD) |
| | 4.0E–03 | 5.0E–03 | Water, Incineration, or Landfill | | | | | |
| Use of laboratory chemicals – solid | 1.2E–04 | 1.0E–03 | Stack Air | 235 | 258 | 1,978–25,643 generic sites PV: 34,412 kg/yr | Slight to Moderate | |
| | 2.3E–04 | 2.0E–03 | Unknown Media (Air, Water, Incineration, or Landfill) | | | | | |
| | 6.6E–02 | 0.27 | Water, Incineration, or Landfill | | | | | |
| | 3.1E–04 | 3.0E–03 | Incineration or Landfill | | | | | |
| Recycling | 7.4E–04 | 4.3E–03 | Stack Air | 223 | 254 | 58 generic sites PV: 5,857 kg/yr | Slight to Moderate | CDR, Peer-reviewed literature (GS/ESD) |
| | 2.8E–03 | 9.2E–03 | Fugitive Air, Water, Incineration, or Landfill | | | | | |
| | 1.9E–03 | 3.9E–03 | Water | | | | | |
| | 1.3 | 1.8 | Water, Incineration, or Landfill | | | | | |

| OES | Estimated Daily Release Across Sites (kg/site-day) | | Type of Discharge, [a] Air Emission, [b] or Transfer for Disposal [c] | Estimated Release Frequency Across Sites (days) [d] | | Number of Facilities and Production Volume (PV) [e] | Weight of Scientific Evidence Rating [f] | Source |
|---|---|---|---|---|---|---|---|---|
| | Central Tendency | High-End | | Central Tendency | High-End | | | |

[a] Direct discharge to surface water; indirect discharge to non-POTWs; indirect discharge to POTWs
[b] Emissions via fugitive air or stack air, or treatment via incineration
[c] Transfer to surface impoundment, land application, or landfills
[d] Where available, EPA used industry provided information, ESDs, or GSs to estimate the number of release days for each COU.
[e] Where available, EPA used 2020 CDR (U.S. EPA, 2020a), 2020 U.S. County Business Practices (U.S. Census Bureau, 2022), and Monte Carlo models to estimate the number of sites that use DCHP for each COU.
[f] See Section 3.2.2 for details on EPA's determination of the weight of scientific evidence rating.

### 3.2.2 Weight of Scientific Evidence Conclusions for Environmental Releases from Industrial and Commercial Sources

For each OES, EPA considered the assessment approach, the quality of the data and models, and the uncertainties in the assessment results to determine a level of confidence for the environmental release estimates. Table 3-6 provides the Agency's weight of scientific evidence rating for each OES.

EPA integrated numerous evidence streams across systematic review sources to develop environmental estimates for DCHP. The Agency made a judgment on the weight of scientific evidence supporting the release estimates based on the strengths, limitations, and uncertainties associated with the release estimates. EPA described this judgment using the following confidence descriptors: robust, moderate, slight, or indeterminate.

In determining the strength of the overall weight of scientific evidence, EPA considered factors that increase or decrease the strength of the evidence supporting the release estimate (whether measured or estimated)—including quality of the data/information, relevance of the data to the release scenario (including considerations of temporal and spatial relevance), and the use of surrogate data when appropriate. In general, higher rated studies (as determined through data evaluation) increase the weight of scientific evidence when compared to lower rated studies, and EPA gave preference to chemical- and scenario-specific data over surrogate data (*e.g.,* data from a similar chemical or scenario). For example, a conclusion of moderate weight of scientific evidence 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 weight of scientific evidence is appropriate where there is limited information that does not sufficiently cover all sites within the COU, and the assumptions and uncertainties are not fully known or documented. See EPA's *Draft Systematic Review Protocol Supporting TSCA Risk Evaluations for Chemical Substances, Version 1.0: A Generic TSCA Systematic Review Protocol with Chemical-Specific Methodologies* (also called "Draft Systematic Review Protocol") (U.S. EPA, 2021a) for additional information on weight of scientific evidence conclusions.

Table 3-6 summarizes EPA's overall weight of scientific evidence conclusions for its release estimates for each OES. In general, modeled data had data quality ratings of medium. As a result, for releases that used GSs/ESDs, the weight of scientific evidence conclusion was slight to moderate, when used in tandem with Monte Carlo modeling.

**Table 3-6. Summary of Overall Confidence in Environmental Release Estimates by Occupational Exposure Scenario**

| OES | Weight of Scientific Evidence Conclusion in Release Estimates |
|---|---|
| Manufacturing | EPA found limited chemical specific data for the manufacturing OES and assessed environmental releases using models and model parameters derived from CDR, the *2023 Methodology for Estimating Environmental Releases from Sampling Wastes* (U.S. EPA, 2023e), and sources identified through systematic review (including surrogates DINP and DIDP industry-supplied data). The Agency used EPA/OPPT models combined with Monte Carlo modeling to estimate releases to the environment, with media of release assessed using assumptions from EPA/OPPT models and industry-supplied data. EPA believes a strength of the Monte Carlo modeling approach is that variation in model input values allows for estimation of a range of potential release values that are more likely to capture actual releases than a discrete value. Additionally, Monte Carlo modeling uses a large number of data points (simulation runs) and considers the full distributions of input parameters. EPA used facility-specific DCHP manufacturing volumes for all facilities that reported this information to CDR and non-DCHP-specific operating parameters derived using data from a current U.S. manufacturing site for DIDP and DINP that is assumed to operate using similar operating parameters as DCHP manufacturing. This information was used to provide more accurate estimates than the generic values provided by EPA/OPPT models. These strengths increase the weight of evidence.<br><br>The primary limitation of EPA's approach is the uncertainty in the representativeness of release estimates toward the true distribution of potential releases. In addition, 1 DCHP manufacturing site claimed their DCHP production volume as CBI for the purpose of CDR reporting; therefore, DCHP throughput estimates for this site are based on the site's reported export volume and their reported PV percentage for industrial use. Additional limitations include uncertainties in the representativeness of the surrogate industry-provided operating parameters from DIDP and DINP and the generic EPA/OPPT models for DCHP manufacturing sites. These limitations decrease the weight of evidence.<br><br>As discussed above, the strength of the analysis includes using Monte Carlo modeling, which can use a range as an input, increases confidence in the analysis. However, several limitations discussed above, such as using surrogate parameters, reduced the confidence of the analysis. Therefore, EPA concluded that the weight of scientific evidence for this assessment is slight to moderate, considering the strengths and limitations of the reasonably available data. |
| Import and repackaging | EPA found limited chemical specific data for the import and repackaging OES and assessed releases to the environment using the assumptions and values from the Chemical Repackaging GS (U.S. EPA, 2022a), which the systematic review process rated high for data quality. EPA also referenced the *2023 Methodology for Estimating Environmental Releases from Sampling Wastes* (U.S. EPA, 2023e). The Agency used EPA/OPPT models combined with Monte Carlo modeling to estimate releases to the environment. EPA assessed the media of release using assumptions from the GS and EPA/OPPT models. The Agency believes a strength of the Monte Carlo modeling approach is that variation in model input values allows for estimation of a range of potential release values that are more likely to capture actual releases than a discrete value. Additionally, Monte Carlo modeling uses a large number of data points (simulation runs) and the full distributions of input parameters. These strengths increase the weight of evidence.<br><br>The primary limitation of EPA's approach is the uncertainty in the representativeness of estimated release values toward the true distribution of potential releases at all sites in this OES. Specifically, because the default values in the GS are generic, there is uncertainty in the representativeness of these generic site estimates in characterizing actual releases from real-world sites that import and repackage DCHP. In addition, EPA lacks DCHP facility import volume data for all CDR-reporting import and repackaging sites due to claims of CBI; therefore, throughput estimates for these sites are based on the CDR reporting threshold of 25,000 lb and an annual DCHP national aggregate production volume range from CDR. These limitations decrease the weight of evidence.<br><br>As discussed above, the strength of the analysis includes using Monte Carlo modeling, which can use a range as an input, increases confidence in the analysis. However, several limitations discussed above, such as using default generic parameters, reduced the confidence of the analysis. Therefore, |

| OES | Weight of Scientific Evidence Conclusion in Release Estimates |
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| | EPA concluded that the weight of scientific evidence for this assessment is slight to moderate, considering the strengths and limitations of the reasonably available data. |
| Incorporation into adhesives and sealants | EPA found limited chemical specific data for the incorporation into adhesives and sealants OES and assessed releases to the environment using the ESD on the Formulation of Adhesives (OECD, 2009a), which has a high data quality rating based on the systematic review process. The Agency used EPA/OPPT models combined with Monte Carlo modeling to estimate releases to the environment and assessed the media of release using assumptions from the ESD and EPA/OPPT models. The Agency believes a strength of the Monte Carlo modeling approach is that variation in model input values allows for estimation of a range of potential release values that are more likely to capture actual releases than a discrete value. Monte Carlo modeling also considers a large number of data points (simulation runs) and the full distributions of input parameters. Additionally, EPA used DCHP-specific data on concentrations in adhesive and sealant products in the analysis to provide more accurate estimates than the generic values provided by the ESD. The safety and product data sheets that EPA obtained these values from have high and medium data quality ratings based on the systematic review process. These strengths increase the weight of evidence.<br><br>The primary limitation of EPA's approach is the uncertainty in the representativeness of estimated release values toward the true distribution of potential releases at all sites in this OES. Specifically, the default values in the ESD may not be representative of actual releases from real-world sites that incorporate DCHP into adhesives and sealants. In addition, EPA lacks data on DCHP-specific facility production volume and number of formulation sites, which are needed to estimate site throughput of DCHP. EPA based throughput on the CDR reporting threshold of 25,000 lb, an annual DCHP national aggregate production volume range, and ranges of downstream sites. These limitations decrease the weight of evidence.<br><br>As discussed above, the strength of the analysis includes using Monte Carlo modeling, which can use a range as an input, increases confidence in the analysis. However, several limitations discussed above, such as using default generic parameters, reduced the confidence of the analysis. Therefore, EPA concluded that the weight of scientific evidence for this assessment is slight to moderate, considering the strengths and limitations of the reasonably available data. |
| Incorporation into paints and coatings | EPA found limited chemical specific data for the incorporation into paints and coatings OES and assessed releases to the environment using the Draft GS for the Formulation of Waterborne Coatings (U.S. EPA, 2014a), which has a medium data quality rating based on systematic review. The Agency used EPA/OPPT models combined with Monte Carlo modeling to estimate releases to the environment and assessed the media of release using assumptions from the GS and EPA/OPPT models. The Agency believes a strength of the Monte Carlo modeling approach is that variation in model input values allows for estimation of a range of potential release values that are more likely to capture actual releases than a discrete value. Monte Carlo modeling also considers a large number of data points (simulation runs) and the full distributions of input parameters. Additionally, EPA used DCHP-specific data on concentrations in paint and coating products to provide more accurate estimates of DCHP concentrations than the generic values provided by the GS. The safety and product data sheets that EPA obtained these values from have medium to high data quality ratings based on the systematic review process. These strengths increase the weight of evidence.<br><br>The primary limitation of EPA's approach is the uncertainty in the representativeness of estimated release values toward the true distribution of potential releases at all sites in this OES. Specifically, the generic default values in the GS are specific to waterborne coatings and may not be representative of releases from real-world sites that incorporate DCHP into paints and coatings, particularly for sites formulating other coating types (*e.g.*, solvent-borne coatings). In addition, EPA lacks data on DCHP-specific facility production volume and number of formulation sites; therefore, EPA based throughput and production volume estimates on CDR, which has a reporting threshold of 25,000 lb, an annual DCHP production national aggregate production volume range, and ranges of downstream sites. These limitations decrease the weight of evidence.<br><br>As discussed above, the strength of the analysis includes using Monte Carlo modeling, which can use a range as an input, increases confidence in the analysis. However, several limitations discussed above, such as using default generic parameters, reduced the confidence of the analysis. Therefore, |

| OES | Weight of Scientific Evidence Conclusion in Release Estimates |
|---|---|
| | EPA concluded that the weight of scientific evidence for this assessment is slight to moderate, considering the strengths and limitations of the reasonably available data. |
| Incorporation into other formulations, mixtures, or reaction products | EPA found limited chemical specific data for the incorporation into other formulations, mixtures, or reaction products OES and assessed releases to the environment using the Draft GS for the Formulation of Waterborne Coatings (U.S. EPA, 2014a), which has a medium data quality rating based on systematic review process. The Agency 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. The Agency believes a strength of the Monte Carlo modeling approach is that variation in model input values allows for estimation of a range of potential release values that are more likely to capture actual releases than a discrete value. Monte Carlo modeling also considers a large number of data points (simulation runs) and the full distributions of input parameters. Additionally, EPA used DCHP-specific data on concentrations in other formulation, mixture, and reaction products in the analysis to provide more accurate estimates than the generic values provided by the GS. The safety and product data sheets that EPA obtained these values from have high and medium data quality ratings based on the systematic review process. These strengths increase the weight of evidence.<br><br>The primary limitation of EPA's approach is the uncertainty in the representativeness of estimated release values toward the true distribution of potential releases at all sites in this OES. Specifically, the generic default values in the GS are based on the formulation of paints and coatings and may not represent releases from real-world sites that incorporate DCHP into other formulations, mixtures, or reaction products. In addition, because no entries in CDR indicated a use relevant to this formulation OES, and there were no other sources to estimate the volume of DCHP used in this OES, EPA developed a high-end bounding estimate for production volume based on the CDR reporting threshold of 25,000 lb or 5% of total product volume for a given use, which by definition is expected to over-estimate the average release case. For DCHP facility throughputs, EPA used a range of generic default values in the GS. These limitations decrease the weight of evidence.<br><br>As discussed above, the strength of the analysis includes using Monte Carlo modeling, which can use a range as an input, increases confidence in the analysis. However, several limitations discussed above, such as using default generic parameters, reduced the confidence of the analysis. Therefore, EPA concluded that the weight of scientific evidence for this assessment is slight to moderate, considering the strengths and limitations of the reasonably available data. |
| PVC plastics compounding | EPA found limited chemical specific data for the plastics compounding OES and assessed releases to the environment using the Revised Draft GS for the Use of Additives in Plastic Compounding (U.S. EPA, 2021d), which has a medium data quality rating based on systematic review. The Agency 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. The Agency believes a strength of the Monte Carlo modeling approach is that variation in model input values allows for estimation of a range of potential release values that are more likely to capture actual releases than a discrete value. Monte Carlo modeling also considers a large number of data points (simulation runs) and the full distributions of input parameters. These strengths increase the weight of evidence.<br><br>The primary limitation of EPA's approach is the uncertainty in the representativeness of estimated release values toward the true distribution of potential releases at all sites in this OES. The generic default concentration values in the GS consider all types of plastic compounding and may not represent releases from real-world sites that compound DCHP into specific types of plastic raw material. In addition, EPA lacks data on DCHP-specific facility production volume and number of compounding sites; therefore, the Agency estimated throughput and production volume based on CDR, which has a reporting threshold of 25,000 lb and an annual DCHP production national aggregate production volume range. These limitations decrease the weight of evidence.<br><br>As discussed above, the strength of the analysis includes using Monte Carlo modeling, which can use a range as an input, increases confidence in the analysis. However, several limitations discussed above, such as using default generic parameters, reduced the confidence of the analysis. Therefore, |

| OES | Weight of Scientific Evidence Conclusion in Release Estimates |
|---|---|
| | EPA concluded that the weight of scientific evidence for this assessment is slight to moderate, considering the strengths and limitations of the reasonably available data. |
| PVC plastics converting | EPA found limited chemical specific data for the plastics converting OES and assessed releases to the environment using the Revised Draft GS on the Use of Additives in the Thermoplastics Converting Industry, which has a medium data quality rating based on systematic review (U.S. EPA, 2021e). The Agency 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. The Agency believes a strength of the Monte Carlo modeling approach is that variation in model input values allows for estimation of a range of potential release values that are more likely to capture actual releases than a discrete value. Monte Carlo also considers a large number of data points (simulation runs) and the full distributions of input parameters. These strengths increase the weight of evidence.<br><br>The primary limitation of EPA's approach is the uncertainty in the representativeness of estimated release values toward the true distribution of potential releases at all sites in this OES. Specifically, the generic default values in the ESD are based on all types of thermoplastics converting sites and processes and may not represent actual releases from real-world sites that convert DCHP-containing raw material into plastic articles using a variety of methods, such as extrusion or calendering. In addition, EPA lacks data on DCHP-specific facility production volume and number of converting sites; therefore, EPA estimated throughput based on CDR, which has a reporting threshold of 25,000 lb, an annual DCHP national aggregate production volume range, and ranges of downstream sites. These limitations decrease the weight of evidence.<br><br>As discussed above, the strength of the analysis includes using Monte Carlo modeling, which can use a range as an input, increases confidence in the analysis. However, several limitations discussed above, such as using default generic parameters, reduced the confidence of the analysis. Therefore, EPA concluded that the weight of scientific evidence for this assessment is slight to moderate, considering the strengths and limitations of the reasonably available data. |
| Non-PVC material compounding | EPA found limited chemical specific data for the non-PVC material compounding OES and assessed releases to the environment using the Revised Draft GS for the Use of Additives in Plastic Compounding and the ESD on Additives in the Rubber Industry (U.S. EPA, 2021d; OECD, 2004). Both sources have a medium data quality rating based on the systematic review process. The Agency used EPA/OPPT models combined with Monte Carlo modeling to estimate releases to the environment, and media of release using assumptions from the GS, ESD, and EPA/OPPT models. The Agency believes a strength of the Monte Carlo modeling approach is that variation in model input values allows for estimation of a range of potential release values that are more likely to capture actual releases than a discrete value. Monte Carlo modeling also considers a large number of data points (simulation runs) and the full distributions of input parameters. These strengths increase the weight of evidence.<br><br>The primary limitation of EPA's approach is the uncertainty in the representativeness of estimated release values toward the true distribution of potential releases at all sites in this OES. Specifically, there was a lack of concentration data for specific products that contained DCHP; EPA relied on the GS and ESD to generate concentration estimates. These values may not be representative of actual values from real-world sites that compound DCHP into non-PVC material. In addition, because no entries in CDR indicated a use relevant to compounding or converting non-PVC material, and there were no other sources to estimate the volume of DCHP used in this OES, EPA developed a high-end bounding estimate based on the CDR reporting threshold of 25,000 lb or 5% of total product volume for a given use, which by definition is expected to over-estimate the average release case. These limitations decrease the weight of evidence.<br><br>As discussed above, the strength of the analysis includes using Monte Carlo modeling, which can use a range as an input, increases confidence in the analysis. However, several limitations discussed above, such as using generic concentration values, reduced the confidence of the analysis. Therefore, EPA concluded that the weight of scientific evidence for this assessment is slight to moderate, considering the strengths and limitations of the reasonably available data. |

| OES | Weight of Scientific Evidence Conclusion in Release Estimates |
|---|---|
| Non-PVC material converting | EPA found limited chemical specific data for the non-PVC material converting OES and assessed releases to the environment using the Revised Draft GS on the Use of Additives in the Thermoplastics Converting Industry and the ESD on Additives in the Rubber Industry (U.S. EPA, 2021e; OECD, 2004). Both documents have a medium data quality rating based on systematic review. The Agency used EPA/OPPT models combined with Monte Carlo modeling to estimate releases to the environment, and media of release using assumptions from the GS, ESD, and EPA/OPPT models. The Agency believes a strength of the Monte Carlo modeling approach is that variation in model input values allows for estimation of a range of potential release values that are more likely to capture actual releases than a discrete value. Monte Carlo modeling also considers a large number of data points (simulation runs) and the full distributions of input parameters. These strengths increase the weight of evidence.<br><br>The primary limitation of EPA's approach is the uncertainty in the representativeness of estimated release values toward the true distribution of potential releases at all sites in this OES. Specifically, there was a lack of concentration data for specific products that contained DCHP; EPA relied on the GS and ESD to generate concentration estimates. These values may not be representative of actual values from real-world sites that convert DCHP into non-PVC articles. In addition, because no entries in CDR indicated a use relevant to compounding or converting non-PVC material, and there were no other sources to estimate the volume of DCHP or number of sites used in this OES, EPA developed a range of high-end bounding estimates based on the CDR reporting thresholds, or 25,000 lb of 5% of total product volume for a given use, which by definition is expected to over-estimate the average release case. These limitations decrease the weight of evidence.<br><br>As discussed above, the strength of the analysis includes using Monte Carlo modeling, which can use a range as an input, increases confidence in the analysis. However, several limitations discussed above, such as using generic concentration values, reduced the confidence of the analysis. Therefore, EPA concluded that the weight of scientific evidence for this assessment is slight to moderate, considering the strengths and limitations of the reasonably available data. |
| Application of adhesives and sealants | EPA found limited chemical specific data for the application of adhesives and sealants OES and assessed releases to the environment using the *ESD on the Use of Adhesives* (OECD, 2015a), which has a medium data quality rating based on systematic review. The Agency 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. The Agency believes a strength of the Monte Carlo modeling approach is that variation in model input values allows for estimation of a range of potential release values that are more likely to capture actual releases than a discrete value. Monte Carlo modeling also considers a large number of data points (simulation runs) and the full distributions of input parameters. Additionally, EPA used DCHP-specific data on concentration and application methods for different DCHP-containing adhesives and sealant products in the analysis. These data provide more accurate estimates than the generic values provided by the ESD. The safety and product data sheets from which these values were obtained have high and medium data quality ratings from the systematic review process. These strengths increase the weight of evidence.<br><br>The primary limitation of EPA's approach is the uncertainty in the representativeness of estimated release values toward the true distribution of potential releases at all sites in this OES. Specifically, the generic default values in the ESD may not represent releases from real-world sites that incorporate DCHP into adhesives and sealants. The overall production volume of DCHP for this OES was based on CDR data using the same assumptions as the Incorporation into adhesives and sealants OES. EPA lacks data on DCHP-specific facility use volume and number of use sites; therefore, EPA based facility throughput estimates and number of sites on industry-specific default facility throughputs from the ESD, DCHP product concentrations, and the overall production volume range from CDR data, which has a reporting threshold of 25,000 lb. EPA also had minimal data for solid additives in adhesives, and had to base the DCHP concentration range for solid additives on the safety data sheet (SDS) for 1 product. These limitations decrease the weight of evidence.<br><br>As discussed above, the strength of the analysis includes using Monte Carlo modeling, which can use a range as an input, increases confidence in the analysis. However, several limitations discussed above, such as using generic default values, reduced the confidence of the analysis. Therefore, EPA |

| OES | Weight of Scientific Evidence Conclusion in Release Estimates |
|---|---|
| | concluded that the weight of scientific evidence for this assessment is slight to moderate, considering the strengths and limitations of the reasonably available data. |
| Application of paints and coatings | EPA found limited chemical specific data for the application of paints and coatings OES and assessed releases to the environment using the ESD on the Application of Radiation Curable Coatings, Inks and Adhesives and the GS on Coating Application via Spray Painting in the Automotive Refinishing Industry (U.S. EPA, 2014b; OECD, 2011b). These documents have a medium data quality rating based on the systematic review process. The Agency used EPA/OPPT models combined with Monte Carlo modeling to estimate releases to the environment. EPA assessed media of release using assumptions from the ESD, GS, and EPA/OPPT models and a default assumption that all paints and coatings are applied via spray application. The Agency believes a strength of the Monte Carlo modeling approach is that variation in model input values allows for estimation of a range of potential release values that are more likely to capture actual releases than a discrete value. Monte Carlo modeling also considers a large number of data points (simulation runs) and the full distributions of input parameters. Additionally, EPA used DCHP-specific data on concentration for different DCHP-containing paints and coatings in the analysis. These data provide more accurate estimates than the generic values provided by the GS and ESD. The safety and product data sheets that EPA obtained these values from have high and medium data quality ratings based on the systematic review process. These strengths increase the weight of evidence.<br><br>The primary limitation of EPA's approach is the uncertainty in the representativeness of estimated release values toward the true distribution of potential releases at all sites in this OES. Specifically, the generic default values in the GS and ESD may not represent releases from real-world sites that incorporate DCHP into paints and coatings. Additionally, EPA assumes spray applications of the coatings, which may not be representative of other coating application methods. In addition, EPA lacks data on DCHP-specific facility use volume and number of use sites; therefore, EPA based throughput estimates on values from ESD, GS, and CDR data, which has a reporting threshold of 25,000 lb and an annual DCHP production volume range. EPA also lacked data for ready-to-apply coatings and consequently assumed a concentration range for liquid coatings based on the SDS for 1 product. These limitations decrease the weight of evidence.<br><br>As discussed above, the strength of the analysis includes using Monte Carlo modeling, which can use a range as an input, increases confidence in the analysis. However, several limitations discussed above, such as using generic default values, reduced the confidence of the analysis. Therefore, EPA concluded that the weight of scientific evidence for this assessment is slight to moderate, considering the strengths and limitations of the reasonably available data. |
| Use of laboratory chemicals | EPA found limited chemical specific data for the use of laboratory chemicals OES and assessed releases to the environment using the Draft GS on the Use of Laboratory Chemicals (U.S. EPA, 2023g), which has a high data quality rating based on systematic review. The Agency 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 DCHP materials. The Agency believes a strength of the Monte Carlo modeling approach is that variation in model input values allows for estimation of a range of potential release values that are more likely to capture actual releases than a discrete value. 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 DCHP products to inform product concentration and material states. These strengths increase the weight of evidence.<br><br>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 DCHP-specific laboratory chemical throughput and number of laboratories; therefore, EPA based the number of laboratories and throughput estimates on stock solution throughputs from the GS on the Use of Laboratory Chemicals (U.S. EPA, 2023c) and on CDR reporting thresholds. Additionally, because no entries in CDR indicate a laboratory use and there were no other sources to estimate the volume of DCHP used in this OES, EPA developed a high-end bounding estimate based on the CDR reporting threshold of 25,000 lb or 5% of total product volume for a given use, which by definition is expected to over-estimate the average release case. These limitations decrease the weight of evidence. |

| OES | Weight of Scientific Evidence Conclusion in Release Estimates |
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| | As discussed above, the strength of the analysis includes using Monte Carlo modeling, which can use a range as an input, increases confidence in the analysis. However, several limitations discussed above, such as using generic default values, reduced the confidence of the analysis. Therefore, EPA concluded that the weight of scientific evidence for this assessment is slight to moderate, considering the strengths and limitations of the reasonably available data. |
| Fabrication or use of final products or articles | No data were available to estimate releases for this OES and there were no suitable surrogate release data or models. This release is described qualitatively. |
| Recycling | EPA found limited chemical specific data for the recycling OES. EPA assessed releases to the environment from recycling activities using the Revised Draft GS for the Use of Additives in Plastic Compounding (U.S. EPA, 2021d) as surrogate for the recycling process. The GS has a medium data quality rating based on systematic review. EPA/OPPT models were combined with Monte Carlo modeling to estimate releases to the environment. 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 referenced the *Quantification and Evaluation of Plastic Waste in the United States*, which has a medium quality rating based on systematic review (Milbrandt et al., 2022), to estimate the rate of PVC recycling in the United States. EPA estimated the DCHP PVC market share (based on the surrogate market shares from DINP and DIDP) to define an approximate recycling volume of PVC containing DCHP. These strengths increase the weight of evidence.<br><br>The primary limitation of EPA's approach is the uncertainty in the representativeness of estimated release values toward the true distribution of potential releases at all sites in this OES. Specifically, the generic default values and release points in the GS represent all types of plastic compounding sites and may not represent sites that recycle PVC products containing DCHP. In addition, EPA lacks DCHP-specific PVC recycling rates and facility production volume data; therefore, EPA based throughput estimates on PVC plastics compounding data and U.S. PVC recycling rates, which are not specific to DCHP, and may not accurately reflect current U.S. recycling volume. DCHP may also be present in non-PVC plastics that are recycled; however, EPA was unable to identify information on these recycling practices. These limitations decrease the weight of evidence.<br><br>As discussed above, the strength of the analysis includes using Monte Carlo modeling, which can use a range as an input, increases confidence in the analysis. However, several limitations discussed above, such as using generic default values, reduced the confidence of the analysis. Therefore, EPA concluded that the weight of scientific evidence for this assessment is slight to moderate, considering the strengths and limitations of the reasonably available data. |
| Waste handling, treatment, and disposal | No data were available to estimate releases for this OES and there were no suitable surrogate release data or models. This release is described qualitatively. |

### 3.2.3 Strengths, Limitations, Assumptions, and Key Sources of Uncertainty for the Environmental Release Assessment

Manufacturers and importers of DCHP submit CDR data to EPA if they meet reporting threshold requirements. Sites are only required to load production data into CDR if their yearly production volume exceeds 25,000 lb. Sites can claim their production volume as CBI, further limiting the production volume information in CDR. As a result, some sites that produce or use DCHP may not be included in the CDR dataset and the total production volume for a given OES may be under or overestimated. The extent to which sites that are not captured in the CDR reports release DCHP into the environment is unknown. The media of release for these sites is also unknown.

CDR information on the downstream use of DCHP at facilities is also limited; therefore, there is some uncertainty as to the production volume attributed to a given OES. For OES with limited CDR data, EPA developed potential production volume ranges given reported CDR data, known reporting thresholds, and the national aggregate production volume of 500,000 to less than 1,000,000 lb for DCHP in 2019. The Agency used the potential production volume ranges as uniform distributions in Monte Carlo modeling when assessing releases for each OES. Due to the wide range of potential production volumes attributable to certain OES, the overall releases may be over or underestimated. DCHP releases at each site may vary from day to day, such that on any given day the actual daily release rate may be higher or lower than the estimated average daily release rate.

EPA has further identified the following additional uncertainties that contribute to the overall uncertainty in the environmental release assessment:

- ***Use of Census Bureau Data for Number of Facilities:*** In some cases, EPA determined the maximum number of facilities for a given OES (for use in Monte Carlo modeling) from industry data from the U.S. Census Bureau, County and Business Patterns dataset (U.S. Census Bureau, 2022).
- ***Uncertainties Associated with Facility Throughputs:*** EPA estimated facility throughputs of DCHP or DCHP-containing products using various methods, including using generic industry data presented in the relevant GS or ESD, or by calculation based on estimated number of facilities and overall production volume of DCHP from CDR for the given OES. In either case, the values used for facility throughputs may encompass a wide range of possible values. Due to these uncertainties, the facility throughputs may be under or overestimated.
- ***Uncertainties Associated with Number of Release Days:*** For most OESs, EPA estimated the number of release days using data from GSs, ESDs, or SpERC factsheets. In such cases, EPA used applicable sources to estimate a range of release days over the course of an operating year. Due to uncertainty in DCHP-specific facility operations, release days may be under or overestimated.
- ***Uncertainties Associated with DCHP-Containing Product Concentrations:*** In most cases, the number of identified products for a given OES were limited. In such cases, EPA estimated a range of possible DCHP concentrations for products in the OES. However, the extent to which these products represent all DCHP-containing products within the OES is uncertain. For OESs with little-to-no product data, EPA estimated DCHP concentrations from GSs or ESDs. Due to these uncertainties, the average product concentrations may be under or overestimated.

## 3.3 Summary of Concentrations of DCHP in the Environment

The environmental release assessment summarized in Section 3.2 and detailed in EPA's *Environmental Release and Occupational Exposure Assessment for Dicyclohexyl Phthalate (DCHP)* (U.S. EPA, 2025s) indicate DCHP is expected to be released to the environment via air, water, biosolids, and disposal to landfills. Environmental media concentrations were quantified in ambient air, soil from ambient air deposition, sediment, and surface water. Additional analysis of surface water used as drinking water was conducted for the Human Health Risk Assessment (see Section 4.1.3). Given the physical and chemical properties and fate parameters of DCHP (Section 2), concentrations of DCHP in soil and groundwater from releases to biosolids and landfills were not quantified. Instead, DCHP in soil and groundwater are discussed qualitatively.

EPA relied on its fate assessment to determine which environmental pathways to consider for its screening level analysis of environmental exposure and general population exposure to environmental releases. Details on the environmental partitioning and media assessment can be found in *Physical Chemistry and Fate and Transport Assessment for Dicyclohexyl Phthalate (DCHP)* (U.S. EPA, 2025ac). Briefly, based on DCHP's fate parameters (*e.g.*, Henry's Law constant, log $K_{OC}$, water solubility, fugacity modeling), EPA anticipated DCHP to be predominantly in water, soil, and sediment. Soil concentration of DCHP from land applications were not quantitatively assessed in the screening level analysis as DCHP was expected to have limited persistence potential and mobility in soils receiving biosolids.

Details on the screening level assessment of each environmental pathway can be found in EPA's *Environmental Media, General Population, and Environmental Exposure Assessment for Dicyclohexyl Phthalate (DCHP)* (U.S. EPA, 2025p). Screening level assessments are useful when there is little facility location- or scenario-specific information available. Because of limited environmental monitoring data and limited reported release data, EPA began its environmental and general population exposure assessment with a screening level approach for the environmental pathways expected to be of greatest concern. Details on the use of screening level analyses in exposure assessment can be found in EPA's *Guidelines for Human Exposure Assessment* (U.S. EPA, 2019b). Additional details of the screening level approaches used for general population exposure are discussed in 4.1.3. If any pathways were identified as a pathway of concern for the general population or the environment, further exposure assessments for that pathway would be conducted to include higher tiers of modeling when available, refinement of exposure estimates, and exposure estimates for additional subpopulations and OES/COUs.

For this assessment, the Agency used the highest EPA-estimated environmental media concentrations for the purpose of a screening level analysis. Each estimated release was categorized into an OES, which in turn was associated with one or more TSCA COUs. These EPA-estimated releases by OES were then paired with a series of conservative assumptions utilized as inputs for the various models used. This approach is expected to provide a conservative, high-end modeled estimate for the concentration of DCHP in a given environmental media type. EPA did not estimate environmental concentrations of DCHP resulting from all OESs presented in Table 3-3. The OESs resulting in the highest environmental concentration of DCHP varied by environmental media as shown in Table 3-7.

For the water pathway, different hydrological flow rates were used for the different screening level exposure scenarios. The 30Q5[3] flows are used to estimate acute, incidental human exposure through

[3] 30Q5 is defined as the lowest 30-day average flow that occurs (on average) once every 5 years. These flows are used to determine acute human exposures via drinking water (Versar, 2014).

swimming or recreational contact and acute drinking water exposure. The harmonic mean[4] flows provide a more conservative estimate, as compared to annual average flows, and are therefore preferred for assessing potential chronic human exposure via drinking water. The harmonic mean is also used for estimating human exposure through fish ingestion because it takes time for chemical concentrations to accumulate in fish. Lastly, for aquatic or ecological exposure, a 7Q10 flow (lowest 7-day average flow that occurs, on average, once every 10 years) is used to estimate exceedances of concentrations of concern for aquatic life (U.S. EPA, 2007b).

In lieu of facility-specific receiving water body information for DCHP, flow statistics were drawn from a generic distribution of receiving water body flow rates derived from receiving water bodies listed on National Pollutant Discharge Elimination System (NPDES) permits for facilities with relevant North American Industry Classification System (NAICS) codes. These modeled distributions of hydrologic flow data are specific to industry sectors rather than individual facilities but provide a reasonable estimate of the distribution of location-specific values. The complete methods for retrieving and processing flow data by NAICS code are detailed in Appendix B of the *Environmental Media, General Population, and Environmental Exposure Assessment for Dicyclohexyl Phthalate (DCHP)* (U.S. EPA, 2025p). Briefly, EPA selected a median flow (P50) from the distribution of resulting receiving water body flow rates across the pooled flow data of all relevant NAICS codes as a conservative low flow condition across modeled releases. Additional refined analyses were conducted for the scenarios resulting in the greatest environmental concentrations by applying the 75th and 90th percentile (P75 and P90, respectively) flow metrics from the distribution to represent a more complete range of potential flow rates. When comparing generic scenario releases and flow percentiles to known releases from facilities within relevant phthalate COUs and their respective receiving water bodies, EPA was unable to constrain the analysis to a single flow percentile, as the P50, P75, and P90 flows are derived from relevant facilities and each condition is plausible.

For the screening level assessment, EPA identified the Application of paints and coatings OES as yielding the highest water concentrations using a 7Q10, 30Q5, and harmonic mean flow (Table 3-7). As described in EPA's *Environmental Media, General Population, and Environmental Exposure Assessment for Dicyclohexyl Phthalate (DCHP)* (U.S. EPA, 2025p), the Agency estimated the surface water concentrations for Application of paints and coatings OES using releases estimated from generic scenarios. However, releases associated with the Application of paints and coatings OES were categorized to multiple release categories and the proportion discharged only to surface water was indeterminable. Therefore, EPA conservatively assumed that all releases associated with Application of paints and coating OES went directly to surface water. EPA has slight confidence in this assumption as described in Section 3.3.1.1 but robust confidence that Application of paints and coatings OES would represent a conservative estimate of surface water concentrations appropriate for use in a screening level assessment. EPA included surface water concentrations derived from the PVC plastics compounding OES (the OES with the highest estimated release to surface water) into the screening analysis for a higher confidence estimate. Details on the input assumptions and the confidence of the surface water concentrations can be found in *Environmental Media, General Population, and Environmental Exposure Butyl Benzyl Phthalate (BBP)* (U.S. EPA, 2025r) and partly in Section 3.3.1.1.

For ambient air, the maximum EPA estimated daily release value for DCHP was 46.8 kg/site-day and categorized under the Use of paints and coatings – no engineering controls OES with an unknown media of release (could be releases to air, land, water, or incineration, or any combination and could be either

[4] Harmonic mean is defined as the inverse mean of reciprocal daily arithmetic mean flow values. These flows represent a long-term average and are used to generate estimates of chronic human exposures via drinking water and fish ingestion.

fugitive, stack, or any combination). Because the release type is unknown, under the methodology used, EPA assumed the entire release was either all fugitive or all stack releases and modeled the entire release as each type. Although this assumption captures the highest release of each type possible, it also limits the analysis to exposure from an individual release type because the modeled concentrations and deposition rates for fugitive and stack releases are not additive as they cannot happen at the same time. Nonetheless, for this screening level analysis, EPA provides a total exposure and deposition rate from both release types as if they occurred at the same time. This provides a very conservative exposure scenario and an overestimate of ambient concentrations and deposition rates at the evaluated distances, but ensures findings are health protective. Given the very conservative nature of this modeled exposure scenario, if results indicate the total exposure or deposition rate do not indicate an exposure or risk concern, no further analysis is needed because lower releases would be expected to result in lower exposures and lower associated risks. If results indicated an exposure or risk concern, EPA would conduct a refined analysis using a more representative and real exposure scenario (*e.g.*, only determine exposures and derive risk estimates based on a single release type).

Table 3-7 provides a summary of the highest environmental media concentrations. These values were used for the initial screening level analysis. If further refinements, including the consideration of wastewater treatment removal, were necessary, they were applied and discussed in the general population and environmental risk sections in Section 4.1.3 and Section 5, respectively.

**Table 3-7. Summary of High-End DCHP Concentrations in Various Environmental Media from Environmental Releases**

| OES [a] | Release Media | Environmental Media | DCHP Concentration | Environmental or General Population |
|---|---|---|---|---|
| Application of paints and coatings *without wastewater treatment* | Water | Total water column (7Q10,[b] median flow) | 33,700 [f] µg/L | Environmental |
| | | Median 7Q10 (benthic pore water) | 19,900 [f] µg/L | Not carried forward to environmental risk assessment [c] |
| | | Median 7Q10 (benthic sediment) | 23,500,000 [f] µg/kg | Not carried forward to environmental risk assessment[c] |
| PVC plastics compounding *without wastewater treatment* | Water | Total water column (7Q10,[b] median flow) | 218 µg/L | Environmental |
| | | Median 7Q10 (benthic pore water) | 126 µg/L | Not carried forward to environmental risk assessment [c] |
| | | Median 7Q10 (benthic sediment) | 148,000 µg/kg | Not carried forward to environmental risk assessment[c] |
| Application of paints and coatings *without wastewater treatment* | Water | Surface water (30Q5,[d] median flow) | 19,900 [f] µg/L | General population |
| | | Surface water (harmonic mean,[e] median flow) | 11,600 [f] µg/L | General population |
| PVC plastics compounding *without wastewater treatment* | Water | Surface water (30Q5, median flow) | 70.5 µg/L | General population |
| | | Surface water (harmonic mean, median flow) | 124 µg/L | General population |
| Application of paints, and coatings-no engineering controls | Air | Daily-averaged total (fugitive and stack, 100 m) | 90.25 µg/m$^3$ | General population |
| | | Annual-averaged total (fugitive and stack, 100 m) | 87.29 µg/m$^3$ | General population |

| OES [a] | Release Media | Environmental Media | DCHP Concentration | Environmental or General Population |
|---|---|---|---|---|

[a] Table 3-1 provides the crosswalk of OES to COUs.
[b] 7Q10 is the 7 consecutive days of lowest flow over a 10-year period.
[c] See Section 4.4 for further details.
[d] 30Q5 is the 30 consecutive days of lowest flow over a 5-year period.
[e] Harmonic mean is defined as the inverse mean of reciprocal daily arithmetic mean flow values. These flows represent a long-term average.
[f] Exceeds the water solubility range reported in the *Physical Chemistry and Fate and Transport Assessment for Dicyclohexyl Phthalate (DCHP)* (U.S. EPA, 2025ac) of 0.030–1.48 mg/L.

### 3.3.1 Weight of Scientific Evidence Conclusions

Detailed discussion of the strengths, limitations, and sources of uncertainty for modeled environmental media concentration leading to a weight of scientific evidence conclusion can be found in EPA's *Environmental Media, General Population, and Environmental Exposure Assessment for Dicyclohexyl Phthalate (DCHP)* (U.S. EPA, 2025p). The weight of scientific evidence conclusion is summarized below for the modeled DCHP concentrations in surface water, sediment, and ambient air, including ambient air to soil deposition.

#### 3.3.1.1 Surface Water

As detailed in *Environmental Release and Occupational Exposure Assessment for Dicyclohexyl Phthalate (DCHP)* (U.S. EPA, 2025s) EPA did not have access to facility release records for DCHP, and releases were modeled as generic scenarios. The high-end estimate for each COU was used as an input for surface water modeling. Additionally, due to the lack of site-specific release information, a generic distribution of hydrologic flows was developed for each OES from facilities that had been classified under relevant NAICS codes and that had NPDES permits. These modeled distributions of hydrologic flow data are specific to industry sectors rather than individual facilities but provide a reasonable estimate of the distribution of location-specific values. The complete methods for retrieving and processing flow data by NAICS code are detailed in Appendix B of the *Environmental Media, General Population, and Environmental Exposure Assessment for Dicyclohexyl Phthalate (DCHP)* (U.S. EPA, 2025p). For the screening level assessment, EPA utilized releases associated with the Application of paints and coating and PVC plastics compounding OESs as they resulted in the highest surface water concentrations for use in environmental and general population risk. EPA determined the surface water concentration associated with these OES represented a conservative high-end exposure scenario and was appropriate to use in its screening level assessment to assess all other OESs and their associated COUs.

EPA utilized daily release information to estimate surface water concentrations for use in general population and environmental exposure assessment. As detailed in *Environmental Release and Occupational Exposure Assessment for Dicyclohexyl Phthalate (DCHP)* (U.S. EPA, 2025s), EPA estimated a range for daily releases for each OES. The Agency EPA was not able to estimate site-specific releases for the Fabrication of final products from articles OES. EPA assessed releases from the Distribution in commerce OES as part of the individual OESs where the relevant activities occur. Disposal sites handling post-consumer, end-use DCHP were not quantifiable due to the wide and disperse use of DCHP in PVC and other products. EPA assumed that releases during consumer waste handling, treatment, and disposal are captured in the upstream OESs.

For DCHP, daily releases for each OES were estimated using generic scenarios. EPA summarized the overall weight of scientific evidence conclusions for its DCHP release estimate for each OES in the *Environmental Release and Occupational Exposure Assessment for Dicyclohexyl Phthalate (DCHP)*

(U.S. EPA, 2025s, 2024a). Overall EPA concluded the weight of scientific conclusion was generally slight to moderate for releases that use GSs/ESDs.

Daily releases to water for each OES were reported to the following categories for DCHP:

- Water
- Water, Incineration, or Landfill
- Fugitive Air, Water, Incineration, or Landfill

Only the discharge type categorized as Water is known to be discharged only to water. For the other releases categorized as releasing to multiple media types, EPA could not differentiate the proportion of DCHP released only to surface water. For these generic scenario OESs, there were insufficient data to quantify what portion of a release (for the Manufacturing; Import and repackaging; Incorporation into adhesives and sealants; Incorporation into paints and coatings; Incorporation into other formulations, mixtures, or reaction products; Application of adhesives and sealants; Application of paints and coatings OESs; Use of laboratory chemicals) may be discharged specifically to surface water. The Application of paints and coatings OES, which was utilized for screening, had releases associated with multiple media types (fugitive air, water, incineration, or landfill). Therefore, EPA conservatively assumed that all releases associated with the Application of paints and coatings OES went directly to surface water. EPA has slight confidence in this assumption but robust confidence that Application of paints and coatings OES would represents a conservative estimate of surface water concentrations appropriate for use in a screening level assessment. For all other OESs with estimated releases, surface water concentrations were lower than the surface water concentration estimated for Application of paints and coatings, which was used as the high-end estimate for screening analysis.

Table 3-8 below identifies the data available for use in modeling surface water concentrations for each OES and EPA's confidence in the estimated surface water concentrations used for exposure assessment. In considering the various OES for use in a screening assessment, the Agency identified Application of paints and coatings and PVC plastics compounding OESs for use in environmental exposure and general population exposure. EPA determined these OESs as most appropriate for use in screening as it resulted in a high-end surface water concentration based on many conservative assumptions, such as the assumption that there is no removal of DCHP prior to release in surface water, and that in the case of the Application of paints and coatings OES, the total multimedia release is assumed to be discharged directly to surface water. Due to the lower flow rates selected from the generated distributions, coupled with high-end release scenarios, EPA has moderate confidence in the modeled concentrations from the PVC plastics compounding OES as being representative of actual releases, with a slight bias toward overestimation. EPA has only slight confidence in the high-end estimated concentrations for the Application of paints and coatings OES, with a bias toward overestimation, due to the uncertainty around the portion of the total estimated release being discharged to surface water. The incorporation of higher percentile flows (P75 and P90) with the high-end release estimates increase confidence in the representativeness of the concentrations presented. Additionally, EPA has robust confidence that no surface water release scenarios exceed the highest concentrations presented in this evaluation. This is because of conservative assumptions that include use of high-end releases for each COU and coupling those with lower flow rates from the generated distributions. Other model inputs were derived from reasonably available literature collected and evaluated through EPA's systematic review process for TSCA risk evaluations.

All monitoring and experimental data included in EPA's analysis and presented in *Environmental Media, General Population, and Environmental Exposure Assessment for Dicyclohexyl Phthalate (DCHP)* (U.S. EPA, 2025p) were from articles rated as medium or high quality from this process. The

highest reported monitored surface water concentration was 0.014 µg/L Keil et al. (2011), which is many magnitudes lower than the modeled concentrations reported in Table 3-7. This confirms EPA's expectation that modeled concentrations for DCHP presented in this risk evaluation are biased toward overestimation and are appropriate to be used as a screening evaluation. Additionally, surface water concentrations estimated using P50 flow exceeded the water solubility of 1.48 mg/L. The physical and chemical properties of DCHP suggest that close to continuous releases, colloidal suspensions will likely form, allowing concentrations in excess of solubility limits, which will likely quickly sorb to suspended and benthic sediments (U.S. EPA, 2025ac).

Overall, EPA has robust confidence that the high-end estimated surface water concentration modeled using the Application of paints and coating and PVC plastics compounding OESs is appropriate to use in its screening level assessment for surface water exposure and fish ingestion exposure to the general population to assess all other OESs and their associated COUs, including OESs and COUs with releases that could not be quantified.

**Table 3-8. DCHP Release Data Used for Modeling Surface Water Concentrations**

| OES | Water Release Data Type | Weight of Scientific Evidence for Surface Water Concentrations |
|---|---|---|
| Manufacturing | Generic Scenario (multimedia) | No facilities reported releases for this OES, so EPA modeled releases using generic scenarios. Because the Agency was unable to model releases to just surface water, EPA calculated a surface water concentration based on the assumption that the total multimedia release was directed to surface water, and the resulting range of estimated concentrations were below the high-end releases applied for screening. EPA has robust confidence that the OES selected for screening will cover this OES. |
| Import and repackaging | Generic Scenario (multimedia) | No facilities reported releases for this OES, so EPA modeled releases using generic scenarios. Because the Agency was unable to model releases to just surface water, EPA calculated a surface water concentration based on the assumption that the total multimedia release was directed to surface water, and the resulting range of estimated concentrations were below the high-end releases applied for screening. EPA has robust confidence that the OES selected for screening will cover this OES. |
| Incorporation into adhesives and sealants | Generic Scenario (multimedia) | No facilities reported releases for this OES, so EPA modeled releases using generic scenarios. Because the Agency was unable to model releases to just surface water, EPA calculated a surface water concentration based on the assumption that the total multimedia release was directed to surface water, and the resulting range of estimated concentrations were below the high-end releases applied for screening. EPA has robust confidence that the OES selected for screening will cover this OES. |
| Incorporation into paints and coatings | Generic Scenario (multimedia) | No facilities reported releases for this OES, so EPA modeled releases using generic scenarios. Because the Agency was unable to model releases to just surface water, EPA calculated a surface water concentration based on the assumption that the total multimedia release was directed to surface water, and the resulting range of estimated concentrations were below the high-end releases applied for screening. EPA has robust confidence that the OES selected for screening will cover this OES. |
| Incorporation into other formulations, mixtures, and reaction products not covered elsewhere | Generic Scenario (multimedia) | No facilities reported releases for this OES, so EPA modeled releases using generic scenarios. Because the Agency was unable to model releases to just surface water, EPA calculated a surface water concentration based on the assumption that the total multimedia release was directed to surface water, and the resulting range of estimated concentrations were below the high-end releases applied for screening. EPA has robust confidence that the OES selected for screening will cover this OES. |

| OES | Water Release Data Type | Weight of Scientific Evidence for Surface Water Concentrations |
|---|---|---|
| PVC plastics compounding | Generic Scenario (water-specific) | No facilities reported releases for this OES, so EPA modeled releases using generic scenarios. Sufficient release data were available to model a surface water-specific release, and the high-end estimated concentrations were applied in the screening analysis. EPA has greater confidence in the representativeness of this OES releasing to actual surface water concentrations compared to the Application of paints and coating OES. EPA has moderate confidence in the surface water concentration but robust confidence that this OES represents a conservative surface water concentration appropriate for screening. |
| PVC plastics converting | Generic Scenario (water-specific) | No facilities reported releases for this OES, so EPA modeled releases using generic scenarios. Sufficient release data were available to model a surface water-specific release, and the resulting range of estimated concentrations were below the high-end releases applied for screening. EPA has robust confidence that the OES selected for screening will cover this OES. |
| Non-PVC material compounding | Generic Scenario (water-specific) | No facilities reported releases for this OES, so EPA modeled releases using generic scenarios. Sufficient release data were available to model a surface water-specific release, and the resulting range of estimated concentrations were below the high-end releases applied for screening. EPA has robust confidence that the OES selected for screening will cover this OES. |
| Non-PVC material converting | Generic Scenario (water-specific) | No facilities reported releases for this OES, so EPA modeled releases using generic scenarios. Sufficient release data were available to model a surface water-specific release, and the resulting range of estimated concentrations were below the high-end releases applied for screening. EPA has robust confidence that the OES selected for screening will cover this OES. |
| Application of adhesives and sealants | Generic Scenario (multimedia) | No facilities reported releases for this OES, so EPA modeled releases using generic scenarios. Because the Agency was unable to model releases to just surface water, EPA calculated a surface water concentration based on the assumption that the total multimedia release was directed to surface water, and the resulting range of estimated concentrations were below the high-end releases applied for screening. EPA has robust confidence that the OES selected for screening will cover this OES. |
| Application of paints and coatings | Generic Scenario (multimedia) | No facilities reported releases for this OES, so EPA modeled releases using generic scenarios. Because the Agency was unable to model releases to just surface water, EPA calculated a surface water concentration based on the assumption that the total multimedia release was directed to surface water, and the high-end estimated concentrations were applied in the screening analysis. EPA has greater confidence in the representativeness of the PVC plastic compounding OES releases to surface water compared to this OES. The Agency has slight confidence in the surface water concentration but robust confidence that this OES represents a conservative surface water concentration appropriate for screening. |
| Use of laboratory chemicals – liquid | Generic Scenario (multimedia) | No facilities reported releases for this OES, so EPA modeled releases using generic scenarios. Because the Agency was unable to model releases to just surface water, EPA calculated a surface water concentration based on the assumption that the total multimedia release was directed to surface water, and the resulting range of estimated concentrations were below the high-end releases applied for screening. EPA has robust confidence that the OES selected for screening will cover this OES. |
| Use of laboratory chemicals – solid | Generic Scenario (multimedia) | No facilities reported releases for this OES, so EPA modeled releases using generic scenarios. Because the Agency was unable to model releases to just surface water, EPA calculated a surface water concentration based on the assumption that the total multimedia release was directed to surface water, and the resulting range of estimated concentrations were below the high-end releases applied for screening. EPA has robust confidence that the OES selected for screening will cover this OES. |

| OES | Water Release Data Type | Weight of Scientific Evidence for Surface Water Concentrations |
|---|---|---|
| Fabrication or use of final products or articles – dust generation | No release data | Release to surface water expected to be negligible or captured in other up-stream OES. EPA has robust confidence that the OES selected for screening will cover this OES. |
| Fabrication or use of final products or articles – vapor generation | No release data | Release to surface water expected to be negligible or captured in other up-stream OES. EPA has robust confidence that the OES selected for screening will cover this OES. |
| Recycling | Generic Scenario (water-specific) | No facilities reported releases for this OES, so EPA modeled releases using generic scenarios. Sufficient release data were available to model a surface water-specific release, and the resulting range of estimated concentrations were below the high-end releases applied for screening. |
| Waste handling, treatment, and disposal | No release data | Release to surface water expected to be negligible or captured in other up-stream OES. EPA has robust confidence that the OES selected for screening will cover this OES. |

#### 3.3.1.2 Ambient Air

EPA used the Integrated Indoor-Outdoor Air Calculator (IIOAC) model, previously peer-reviewed methodology for fenceline communities (U.S. EPA, 2022b) and integrated recommendations from that and other peer reviews to evaluate exposures and deposition rates via the ambient air pathway for this assessment. The IIOAC Model was developed based on a series of pre-run scenarios within the American Meteorological Society/Environmental Protection Agency Regulatory Model (AERMOD; the Agency's regulatory model) that gives EPA greater confidence in the IIOAC results. However, because results from IIOAC are based on the pre-run AERMOD scenarios, IIOAC modeling is limited to the parameters (*e.g.*, stack parameters, meteorological data, and other factors) used as inputs to those pre-run AERMOD scenarios; thus, limiting the flexibility of the IIOAC results for highly site-specific, or date specific modeling needs (*e.g.*, if refined analyses are needed). For the screening level analyses presented in this risk evaluation, IIOAC provides reliable and reproduceable results that can be used to characterize upper bound exposures and derive screening level risk estimates, giving EPA moderate confidence in the results and findings.

DCHP did not have any reported releases in databases the Agency typically relies upon for facility-reported release data (*e.g.*, TRI or NEI). Therefore, the screening level analysis for ambient air for DCHP relied upon EPA-estimated releases that gives the Agency low confidence the releases are representative but moderate confidence that high-end releases are not missed. The Agency uses the maximum EPA-estimated daily releases of DCHP across all OESs/COUs as direct inputs to the IIOAC Model, giving EPA high confidence that the releases used are health protective for a screening level analysis. However, the use of EPA-estimated annual release data and number of operating days to calculate daily average releases assumes operations are continuous and releases are the same for each day of operation. This can underestimate short-term or daily exposure and deposition rates because results may miss actual peak releases (and associated exposures) if higher and lower releases occur on different days. The uncertainties associated with EPA-estimated release data used for this screening level assessment are detailed in the *Environmental Release and Occupational Exposure Assessment for Dicyclohexyl Phthalate (DCHP)* (U.S. EPA, 2025s) and carry over to the ambient air exposure assessment. EPA evaluated human health exposures to DCHP due to direct inhalation of DCHP from the ambient air. EPA also evaluated direct deposition of DCHP from the ambient air to soil for ecological exposures.

The maximum EPA-estimated daily release value used for the ambient air assessment was categorized under the Use of paints and coatings – no engineering controls OES with an unknown media of release (could be releases to air, land, water, or incineration, or any combination and could be either fugitive, stack, or any combination). As described in the *Environmental Release and Occupational Exposure Assessment for Dicyclohexyl Phthalate (DCHP)* (U.S. EPA, 2025s), because the release type is unknown EPA assumed the entire release was either entirely fugitive or entirely stack release and models each release type separately. Under this assumption, the modeled concentrations and deposition rates attributable to either all fugitive or all stack releases are not additive and do not align temporally as they cannot happen at the same time. Nonetheless, EPA still provides a total exposure and deposition rate from both release types assuming they occurred at the same time for this screening level assessment. This assumption results in a very conservative "total exposure" to DCHP, ensures possible exposures are not missed, and retains health protective exposure and associated risks estimates. Given these assumptions, the Agency has low confidence in the exposure scenario modeled (cannot occur at the same time under the assumptions modeled) and recognizes results are likely overestimates of ambient concentrations and deposition rates at the evaluated distances.

Due to the conservative assumptions made along with the use of the highest release estimates, EPA has robust confidence the modeled ambient air concentrations and deposition rates are appropriately conservative to use for a screening level analysis for all OESs and associated COUs. Based on the risk findings described in Section 4.1.3—even with these very conservative assumptions and exposure scenario modeled—results indicate the total exposure or deposition rate under the exposure scenario modeled does not indicate an exposure or risk concern. Therefore, EPA has robust confidence that exposure to and deposition rates of DCHP via the ambient air pathway do not pose an exposure or risk concern and no further refined analysis was pursued. If new information becomes available, and after the Agency's consideration of such information, results under the same scenario and assumptions indicate an exposure or risk concern, then EPA would (1) have low confidence in the results, and (2) refine the analysis to be more representative of an environmentally-relevant exposure scenario (*e.g.*, only determine exposures and derive risk estimates based on a single facility reporting both release types).

# 4 HUMAN HEALTH RISK ASSESSMENT

**DCHP – Human Health Risk Assessment (Section 4):**
**Key Points**

EPA evaluated all reasonably available information to support human health risk characterization of DCHP for workers, ONUs, consumers, bystanders, and the general population, including PESS. Exposures to workers, ONUs, consumers, bystanders, and the general population are described in Section 4.1. Human health hazards are described in Section 4.2, whereas human health risk characterization is discussed in Section 4.3.

***Exposure Key Points***

- EPA assessed inhalation and dermal exposures for workers and ONUs, as appropriate, for each OES (Section 4.1.1). The primary route of exposure was inhalation.
- EPA assessed inhalation, dermal, and oral exposures for consumers and bystanders, as appropriate, for each TSCA COU (Section 4.1.2) in scenarios that represent a range of use patterns and behaviors. The primary route of exposure was dermal for most products, followed by inhalation.
- EPA assessed inhalation, oral, and dermal exposures for the general population via ambient air, surface water, drinking water, and fish ingestion for tribal populations and determined that all DCHP exposures assessed for the general population were not of concern (Sections 4.1.3 and 4.3.4).
- EPA assessed non-attributable cumulative exposure to phthalates DEHP, BBP, DBP, DIBP, and DINP for the U.S. civilian population using NHANES urinary biomonitoring data and reverse dosimetry (Section 4.4.2).

***Hazard Key Points***

- EPA identified effects on the developing male reproductive system consistent with a disruption of androgen action, leading to phthalate syndrome, as the most sensitive and robust non-cancer hazard associated with oral exposure to DCHP in experimental animal models (Section 4.2).
- A non-cancer point of departure (POD) of 2.4 mg/kg-day was selected to characterize non-cancer risks for acute, intermediate, and chronic durations of exposure. A total uncertainty factor (UF) of 30 was selected for use as the benchmark margin of exposure.
- EPA derived relative potency factors (RPFs) based on a common hazard endpoint (*i.e.*, reduced fetal testicular testosterone). RPFs were derived via meta-analysis and benchmark dose (BMD) modeling (Section 4.4.1).

***Risk Assessment Key Points***

- Dermal and ingestion exposures were not a risk driver for any duration of exposure or population.
- Inhalation exposures drive acute non-cancer risks to workers in occupational settings (Section 4.3.2).
- No potential non-cancer risk was identified for consumers (Section 4.3.3).
- No potential non-cancer risk was identified for the general population (Section 4.3.4).
- EPA considered combined exposure across all routes of exposure for each individual occupational and consumer COU to calculate aggregate risks (Sections 4.3.2 and 4.3.3). No potential aggregate risk was identified for consumer COUs.
- EPA considered cumulative risk to workers and consumers through exposure to DCHP from individual COUs in combination with cumulative non-attributable national exposure to DEHP, BBP, DBP, DIBP, and DINP as estimated from NHANES biomonitoring data (Sections 4.4.4 and 4.4.5).
- EPA considered PESS throughout the exposure assessment, hazard identification, and dose-response analysis supporting this risk evaluation (Section 4.3.5).

## 4.1 Summary of Human Exposures

### 4.1.1 Occupational Exposures

The following subsections briefly describe EPA's approach to assessing occupational exposures and provide exposure assessment results for each OES. As stated in the final scope document (U.S. EPA, 2020b), the Agency evaluated exposures to workers and ONUs via the inhalation route—including incidental ingestion of inhaled dust and exposures to workers via the dermal route from direct contact with DCHP. Also, EPA accounted for dermal exposure to workers and ONUs from mist and dust deposited on surfaces. The *Environmental Release and Occupational Exposure Assessment for Dicyclohexyl Phthalate (DCHP)* (U.S. EPA, 2025s) provides additional details on the development of approaches and the exposure assessment results.

#### 4.1.1.1 Approach and Methodology

As described in the final scope (U.S. EPA, 2020b), EPA distinguished exposure levels among potentially exposed employees for workers and ONUs. In general, the primary difference between workers and ONUs is that workers may handle DCHP and have direct contact with DCHP, while ONUs work in the general vicinity of DCHP but do not handle DCHP. Where possible, for each COU, EPA identified job types and categories for workers and ONUs.

As discussed in Section 3.1.1.1, EPA established OESs to assess the exposure scenarios within each COU. Table 3-1 provides a crosswalk between COUs and OESs. EPA did not identify relevant chemical-specific inhalation exposure monitoring data for the OESs. In the absence of inhalation monitoring data, EPA used inhalation exposure models to estimate both central tendency and high-end exposures. For inhalation exposure to dust in occupational settings, EPA used the data and approaches from the Generic Model for Central Tendency and High-End Inhalation Exposure to Total and Respirable Particulates Not Otherwise Regulated (PNOR [Model]) (U.S. EPA, 2021b). In all cases of occupational dermal exposure to DCHP, EPA used a flux-limited dermal absorption model to estimate high-end and central tendency dermal exposures for workers in each OES, as described in the *Environmental Release and Occupational Exposure Assessment for Dicyclohexyl Phthalate (DCHP)* (U.S. EPA, 2025s).

EPA evaluated the quality of the models and data sources using the data quality review evaluation metrics and the rating criteria described in the Draft Systematic Review Protocol (U.S. EPA, 2021a). The Agency assigned an overall quality level of high, medium, or low to the relevant data. In addition, EPA established an overall confidence level for the data when integrated into the occupational exposure assessment. The Agency considered the assessment approach, the quality of the data and models, and uncertainties in assessment results to assign an overall weight of scientific evidence rating of robust, moderate, or slight.

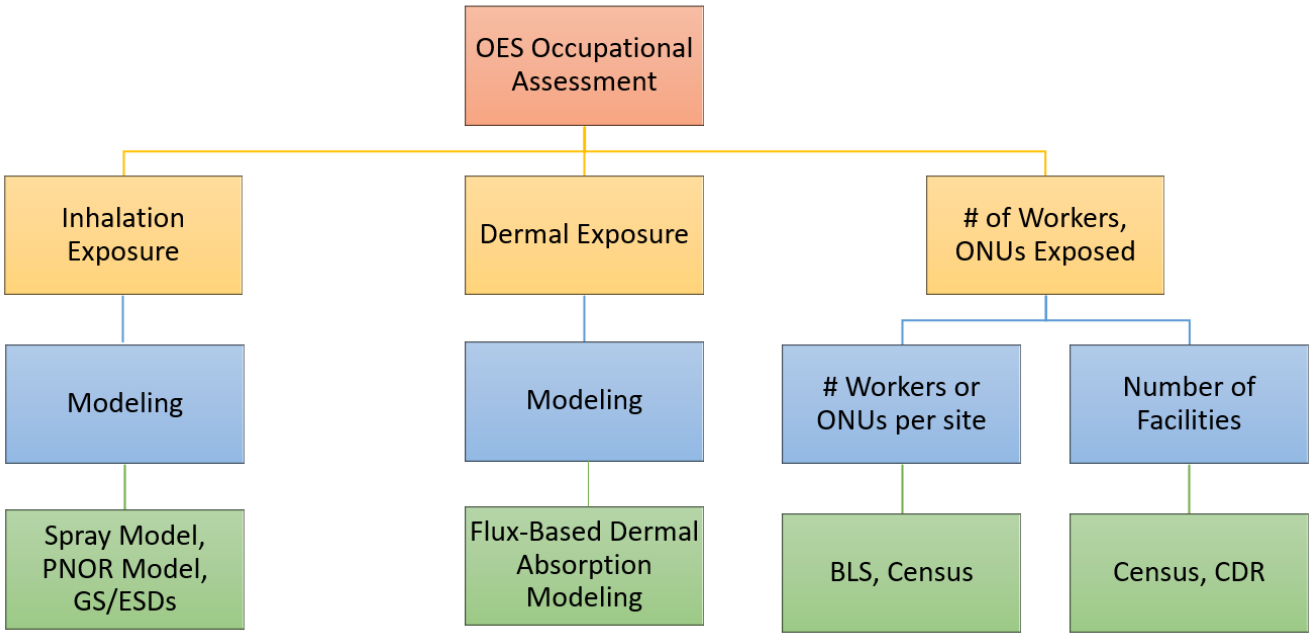


**Figure 4-1. Approaches Used for Each Component of the Occupational Assessment for Each OES**
BLS = (U.S.) Bureau of Labor Statistics; CDR = Chemical Data Reporting; ESD = emission scenario document; GS = generic scenario; OES = occupational exposure scenario; ONU = occupational non-user; PNOR = particulates not otherwise regulated

For inhalation and dermal exposure routes, EPA provides occupational exposure results representative of both central tendency and high-end exposure conditions. The central tendency is expected to represent occupational exposures in the center of the distribution for a given COU. For this risk evaluation, EPA used the 50th percentile (median), mean (arithmetic or geometric), mode, or midpoint value of a distribution to represent the central tendency scenario. Although the Agency preferred to report the 50th percentile of the distribution, if the full distribution was unknown, EPA used either the mean, mode, or midpoint of the distribution to represent the central tendency depending on the statistics available for the distribution. The high-end exposure is expected to represent occupational exposures that occur at probabilities above the 90th percentile, but below the highest exposure for any individual (U.S. EPA, 1992). For this risk evaluation, EPA reported high-end results at the 95th percentile. If the 95th percentile was not reasonably available, the Agency used a different percentile greater than or equal to the 90th percentile but less than or equal to the 99th percentile—depending on the data that was available for the distribution. If the full distribution is not known and the preferred statistics were not reasonably available, EPA estimated a maximum or bounding estimate in lieu of the high-end. Table 4-1 provides a summary of the approach used to assess worker and ONU exposures and the Agency's weight of scientific evidence rating for the given exposure assessments.

**Table 4-1. Summary of Exposure Monitoring and Modeling Data for DCHP Occupational Exposure Scenarios**

| OES | Inhalation Exposure | | | | | | | | | Dermal Exposure | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Monitoring | | | | | Modeling | | Weight of Scientific Evidence Conclusion | | Modeling | | Weight of Scientific Evidence Conclusion | |
| | Worker | # Data Points | ONU | # Data Points | Data Quality Ratings | Worker | ONU | Worker | ONU | Worker | ONU | Worker | ONU |
| Manufacturing | ✗ | N/A | ✗ | N/A | N/A | ✓ | ✓ | Moderate | Slight to Moderate | ✓ | ✓ | Moderate | Slight to Moderate |
| Import and repackaging | ✗ | N/A | ✗ | N/A | N/A | ✓ | ✓ | Moderate | Slight to Moderate | ✓ | ✓ | Moderate | Slight to Moderate |
| Incorporation into adhesives and sealants | ✗ | N/A | ✗ | N/A | N/A | ✓ | ✓ | Moderate | Slight to Moderate | ✓ | ✓ | Moderate | Slight to Moderate |
| Incorporation into paints and coatings | ✗ | N/A | ✗ | N/A | N/A | ✓ | ✓ | Moderate | Slight to Moderate | ✓ | ✓ | Moderate | Slight to Moderate |
| Incorporation into other formulations, mixtures, or reaction products | ✗ | N/A | ✗ | N/A | N/A | ✓ | ✓ | Moderate | Slight to Moderate | ✓ | ✓ | Moderate | Slight to Moderate |
| PVC plastics compounding | ✗ | N/A | ✗ | N/A | N/A | ✓ | ✓ | Moderate | Slight to Moderate | ✓ | ✓ | Moderate | Slight to Moderate |
| PVC plastics converting | ✗ | N/A | ✗ | N/A | N/A | ✓ | ✓ | Moderate | Slight to Moderate | ✓ | ✓ | Moderate | Slight to Moderate |
| Non-PVC material compounding | ✗ | N/A | ✗ | N/A | N/A | ✓ | ✓ | Moderate | Slight to Moderate | ✓ | ✓ | Moderate | Slight to Moderate |
| Non-PVC material converting | ✗ | N/A | ✗ | N/A | N/A | ✓ | ✓ | Moderate | Slight to Moderate | ✓ | ✓ | Moderate | Slight to Moderate |
| Application of adhesives and sealants | ✗ | N/A | ✗ | N/A | N/A | ✓ | ✓ | Moderate | Slight to Moderate | ✓ | ✓ | Moderate | Slight to Moderate |
| Application of paints and coatings | ✗ | N/A | ✗ | N/A | N/A | ✓ | ✓ | Moderate | Slight to Moderate | ✓ | ✓ | Moderate | Slight to Moderate |
| Use of laboratory chemicals | ✗ | N/A | ✗ | N/A | N/A | ✓ | ✓ | Moderate | Slight to Moderate | ✓ | ✓ | Moderate | Slight to Moderate |

| OES | Inhalation Exposure | | | | | | | | | Dermal Exposure | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Monitoring | | | | | Modeling | | Weight of Scientific Evidence Conclusion | | Modeling | | Weight of Scientific Evidence Conclusion | |
| | Worker | # Data Points | ONU | # Data Points | Data Quality Ratings | Worker | ONU | Worker | ONU | Worker | ONU | Worker | ONU |
| Fabrication or use of final products or articles | × | N/A | × | N/A | N/A | ✓ | ✓ | Moderate | Slight to Moderate | ✓ | ✓ | Moderate | Slight to Moderate |
| Recycling | × | N/A | × | N/A | N/A | ✓ | ✓ | Moderate | Slight to Moderate | ✓ | ✓ | Moderate | Slight to Moderate |
| Waste handling, treatment, and disposal | × | N/A | × | N/A | N/A | ✓ | ✓ | Moderate | Slight to Moderate | ✓ | ✓ | Moderate | Slight to Moderate |
| Distribution in Commerce [a] | × | N/A | × | N/A | N/A | × | × | N/A | N/A | × | × | N/A | N/A |

ONU = occupational non-user, OES = occupational exposure scenario
Where EPA was not able to estimate ONU inhalation exposure from monitoring data or models, this was assumed equivalent to the central tendency experienced by workers for the corresponding OES.
[a] Activities related to distribution (*e.g.*, loading, unloading) are considered throughout the DCHP life cycle, as well as qualitatively through a single distribution scenario.

#### 4.1.1.2 Summary of Number of Workers and ONUs

The *Environmental Release and Occupational Exposure Assessment for Dicyclohexyl Phthalate (DCHP)* (U.S. EPA, 2025s) provides a summary of the estimates of the number of exposed workers and ONUs for each OES. To prepare these estimates, EPA first identified relevant NAIC codes for each OES. For these NAICS codes, the Standard Occupational Classification (SOC) codes from the Bureau of Labor Statistics (BLS) were used to classify SOC codes as either workers or ONUs. The Agency assumed that all other SOC codes represent occupations where exposure is unlikely. EPA also estimated the total number of facilities associated with the relevant NAIC codes based on data from the U.S. Census Bureau. 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 *Environmental Release and Occupational Exposure Assessment for Dicyclohexyl Phthalate (DCHP)* (U.S. EPA, 2025s) provides additional details on the approach and methodology for estimating the number of facilities using DCHP as well as the number of potentially exposed workers and ONUs.

Table 4-2 summarizes the number of facilities and total number of exposed workers for all OESs. For scenarios in which the results are expressed as a range, the low 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.

**Table 4-2. Summary of Total Number of Workers and ONUs Potentially Exposed to DCHP for Each OES**

| OES | Total Exposed Workers [a b] | Total Exposed ONUs [a b] | Number of Facilities [a b] | Notes |
|---|---|---|---|---|
| Manufacturing | 77 | 36 | 2 | Number of workers and ONU estimates based on the BLS and U.S. Census Bureau data (U.S. BLS, 2016; U.S. Census Bureau, 2015). |
| Import and repackaging | 40 | 18 | 2 | Number of workers and ONU estimates based on the BLS and U.S. Census Bureau data (U.S. BLS, 2016; U.S. Census Bureau, 2015). Averaged for 2 NAICS codes identified. |
| Incorporation into adhesives and sealants | 90–162 | 35–126 | 5–9 | Number of workers and ONU estimates based on the BLS and U.S. Census Bureau data (U.S. BLS, 2016; U.S. Census Bureau, 2015). |
| Incorporation into paints and coatings | 280–476 | 70–170 | 20–34 | Number of workers and ONU estimates based on the BLS and U.S. Census Bureau data (U.S. BLS, 2016; U.S. Census Bureau, 2015). |
| Incorporation into other formulations, mixtures, or reaction products | 561–1,122 | 264–528 | 11–21 | Number of workers and ONU estimates based on the BLS and U.S. Census Bureau data (U.S. BLS, 2016; U.S. Census Bureau, 2015). Averaged for two NAICS codes identified. |
| PVC plastics compounding | 135–243 | 60–108 | 5–9 | Number of workers and ONU estimates based on the BLS and U.S. Census Bureau data (U.S. BLS, 2016; U.S. Census Bureau, 2015). |
| PVC plastics converting | 756–1,206 | 210–335 | 42–67 | Number of workers and ONU estimates based on the BLS and U.S. Census Bureau data (U.S. BLS, 2016; U.S. Census Bureau, 2015). |

| OES | Total Exposed Workers [a] [b] | Total Exposed ONUs [a] [b] | Number of Facilities [a] [b] | Notes |
|---|---|---|---|---|
| Non-PVC material compounding | 46–92 | 12–24 | 2–4 | Number of workers and ONU estimates based on the BLS and U.S. Census Bureau data (U.S. BLS, 2016; U.S. Census Bureau, 2015). Averaged for three NAICS codes identified. |
| Non-PVC material converting | 46–92 | 12–24 | 2–4 | Number of workers and ONU estimates based on the BLS and U.S. Census Bureau data (U.S. BLS, 2016; U.S. Census Bureau, 2015). Averaged for 3 NAICS codes identified. |
| Application of adhesives and sealants | 336–4,480 | 108–1,440 | 6–80 | Number of workers and ONU estimates based on the BLS and U.S. Census Bureau data (U.S. BLS, 2016; U.S. Census Bureau, 2015). Averaged for 18 NAICS codes identified. |
| Application of paints and coatings | 12–168 | 5–70 | 1–14 | Number of workers and ONU estimates based on the BLS and U.S. Census Bureau data (U.S. BLS, 2016; U.S. Census Bureau, 2015). Averaged for 10 NAICS codes identified. |
| Use of laboratory chemicals (liquid) | 36,873 | 331,857 | 36,873 | Number of workers and ONU estimates based on the BLS and U.S. Census Bureau data (U.S. BLS, 2016; U.S. Census Bureau, 2015). Averaged for two NAICS codes identified. |
| Use of laboratory chemicals (solid) | 1,978–25,643 | 7,912–102,572 | 1,978–25,643 | Number of workers and ONU estimates based on the BLS and U.S. Census Bureau data (U.S. BLS, 2016; U.S. Census Bureau, 2015). Averaged for two NAICS codes identified. |
| Fabrication or use of final products or articles | N/A | | | Number of sites data were unavailable for this OES. Based on the BLS and U.S. Census Bureau data (U.S. BLS, 2016; U.S. Census Bureau, 2015), the average exposed workers per site was 9, and the average exposed ONUs per site was 3. |
| Recycling | 348 | 232 | 58 | Number of workers and ONU estimates based on the BLS and U.S. Census Bureau data (U.S. BLS, 2016; U.S. Census Bureau, 2015). Averaged for three NAICS codes identified. |
| Waste handling, treatment, and disposal | 348 | 232 | 58 | Number of workers and ONU estimates based on the BLS and U.S. Census Bureau data (U.S. BLS, 2016; U.S. Census Bureau, 2015). Averaged for three NAICS codes identified. |

OES = occupational exposure scenario; ONU = occupational non-user
[a] EPA's approach and methodology for estimating the number of facilities using DCHP and the number of workers and ONUs potentially exposed to DCHP can be found in the *Environmental Release and Occupational Exposure Assessment for Dicyclohexyl Phthalate (DCHP)* (U.S. EPA, 2025s).
[b] When there is a range, the low-end of the range is based on the 50th percentile estimate of the number of sites and the upper end is based on the 95th percentile estimate of the number of sites.

#### 4.1.1.3 Summary of Inhalation Exposure Assessment

Table 4-3 presents a summary of inhalation exposure results based on exposure modeling for each OES. This tables provides a summary of the 8-hour time weighted average (8-hour TWA) inhalation exposure estimates for females of reproductive age, as well as the acute dose (AD), the intermediate average daily dose (IADD), and the chronic average daily dose (ADD). The *Environmental Release and Occupational Exposure Assessment for Dicyclohexyl Phthalate (DCHP)* (U.S. EPA, 2025s) provides exposure results specific to females of reproductive age and ONUs. The *Environmental Release and Occupational*

*Exposure Assessment for Dicyclohexyl Phthalate (DCHP)* also provides additional details regarding AD, IADD, and ADD calculations along with EPA's approach and methodology for estimating inhalation exposures.

**Table 4-3. Summary of Females of Reproductive Age Inhalation Exposure Results for Each Occupational Exposure Scenario**

| OES | Inhalation Estimates (Females of Reproductive Age) | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Mist 8-Hour TWA ($mg/m^3$) | | PNOR 8-Hour TWA ($mg/m^3$) | | AD (mg/kg/day) | | IADD (mg/kg/day | | ADD (mg/kg/day) | |
| | CT | HE | CT | HE | CT | HE | CT | HE | CT | HE |
| Manufacturing | N/A | N/A | 0.48 | 5.0 | 6.6E−02 | 0.69 | 4.9E−02 | 0.51 | 4.5E−02 | 0.47 |
| Import and repackaging | N/A | N/A | 0.13 | 3.0 | 1.8E−02 | 0.41 | 1.3E−02 | 0.30 | 1.0E−02 | 0.28 |
| Incorporation into adhesives and sealants | N/A | N/A | 0.48 | 5.0 | 6.6E−02 | 0.69 | 4.9E−02 | 0.51 | 4.5E−02 | 0.47 |
| Incorporation into paints and coatings | N/A | N/A | 0.48 | 5.0 | 6.6E−02 | 0.69 | 4.9E−02 | 0.51 | 4.5E−02 | 0.47 |
| Incorporation into other formulations, mixtures, or reaction products | N/A | N/A | 0.48 | 5.0 | 6.6E−02 | 0.69 | 4.9E−02 | 0.51 | 4.5E−02 | 0.47 |
| PVC plastics compounding | N/A | N/A | 0.23 | 4.7 | 3.2E−02 | 0.65 | 2.3E−02 | 0.48 | 1.9E−02 | 0.44 |
| PVC plastics converting | N/A | N/A | 0.10 | 2.1 | 1.4E−02 | 0.29 | 1.0E−02 | 0.21 | 8.6E−03 | 0.20 |
| Non-PVC materials compounding | N/A | N/A | 0.14 | 2.8 | 1.9E−02 | 0.39 | 1.4E−02 | 0.29 | 1.2E−02 | 0.27 |
| Non-PVC materials converting | N/A | N/A | 4.6E−02 | 0.94 | 6.4E−03 | 0.13 | 4.7E−03 | 9.5E−02 | 3.8E−03 | 8.9E−02 |
| Application of paints and coatings (liquids) | 0.422 | 8.84 | N/A | N/A | 5.8E−02 | 1.2 | 4.3E−02 | 0.90 | 4.0E−02 | 0.84 |
| Application of paints and coatings (solids) | N/A | N/A | 0.28 | 4.9 | 3.9E−02 | 0.68 | 2.8E−02 | 0.50 | 2.6E−02 | 0.46 |
| Application of adhesives and sealants (liquids) | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| Application of adhesives and sealants (solids) | N/A | N/A | 0.15 | 2.7 | 2.1E−02 | 0.37 | 1.5E−02 | 0.27 | 1.3E−02 | 0.26 |
| Use of laboratory chemicals (liquids) | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| Use of laboratory chemicals (solids) | N/A | N/A | 0.19 | 2.7 | 2.6E−02 | 0.37 | 1.9E−02 | 0.27 | 1.7E−02 | 0.26 |
| Recycling | N/A | N/A | 0.11 | 1.6 | 1.5E−02 | 0.22 | 1.1E−02 | 0.16 | 9.1E−03 | 0.15 |
| Fabrication or use of final products or articles | N/A | N/A | 0.09 | 0.81 | 1.2E−02 | 0.11 | 9.1E−03 | 8.2E−02 | 8.5E−03 | 7.7E−02 |

| OES | Inhalation Estimates (Females of Reproductive Age) | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Mist 8-Hour TWA ($mg/m^3$) | | PNOR 8-Hour TWA ($mg/m^3$) | | AD (mg/kg/day) | | IADD (mg/kg/day | | ADD (mg/kg/day) | |
| | CT | HE | CT | HE | CT | HE | CT | HE | CT | HE |
| Waste handling, treatment, and disposal | N/A | N/A | 0.11 | 1.6 | 1.5E−02 | 0.22 | 1.1E−02 | 0.16 | 9.1E−03 | 0.15 |

AD = acute dose (8 hours for a single work day); ADD = average daily dose (8 hours per work day for 250 days per year for 31 or 40 working years); CT = central tendency; HE = high-end; IADD = intermediate average daily dose (8 hours per work day for 22 days per 30-day period); PNOR = particulates not otherwise regulated; TWA = time-weighted average

#### 4.1.1.4 Summary of Dermal Exposure Assessment

Table 4-4 presents a summary of dermal exposure results for the average adult worker, which are based on dermal absorption modeling. The table includes the acute potential dose rate (APDR) for occupational dermal exposure estimates, as well as the AD, IADD, and chronic ADD for the average adult worker. The *Environmental Release and Occupational Exposure Assessment for Dicyclohexyl Phthalate (DCHP)* (U.S. EPA, 2025s) provides exposure results for females of reproductive age and ONUs. The *Environmental Release and Occupational Exposure Assessment for Dicyclohexyl Phthalate (DCHP)* provides additional details regarding AD, IADD, and ADD calculations along with EPA's approach and methodology for estimating dermal exposures.

**Table 4-4. Summary of Females of Reproductive Age Dermal Exposure Results for Each OES**

| OES(s) | Dermal Estimates (Females of Reproductive Age) | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Exposure Type | | APDR (mg/day) | | AD (mg/kg/day) | | IADD (mg/kg/day) | | ADD (mg/kg/day) | |
| | Liquid | Solid | CT | HE | CT | HE | CT | HE | CT | HE |
| Manufacturing; Incorporation into adhesives and sealants; Incorporation into paints and coatings; Incorporation into other formulations, mixtures, or reaction products; Application of paints and coatings (solids); Use of laboratory chemicals (solids); Fabrication or use of final products or articles | | X | 0.18 | 0.36 | 2.1E−03 | 4.1E−03 | 1.5E−03 | 3.0E−03 | 1.4E−03 | 2.8E−03 |
| Import and repackaging; PVC plastics converting; non-PVC materials converting; | | X | 0.18 | 0.36 | 2.1E−03 | 4.1E−03 | 1.5E−03 | 3.0E−03 | 1.2E−03 | 2.8E−03 |
| PVC plastics compounding; Non-PVC materials compounding; Application of adhesives and sealants (solids); Recycling; Waste handling, treatment, and disposal | | X | 0.18 | 0.36 | 2.1E−03 | 4.1E−03 | 1.5E−03 | 3.0E−03 | 1.3E−03 | 2.8E−03 |
| Application of paints and coatings (liquids); Use of laboratory chemicals (liquids) | X | | 0.18 | 0.36 | 2.1E−03 | 4.1E−03 | 1.5E−03 | 3.0E−03 | 1.4E−03 | 2.8E−03 |
| Application of adhesives and sealants (liquids) | X | | 0.18 | 0.36 | 2.1E−03 | 4.1E−03 | 1.5E−03 | 3.0E−03 | 1.3E−03 | 2.8E−03 |

AD = acute dose; ADD = average daily dose; APDR = acute potential dose rate; CT = central tendency; HE = high-end; IADD = intermediate average daily dose; OES = occupational exposure scenario

#### 4.1.1.5 Weight of Scientific Evidence Conclusions for Occupational Exposure

Judgment on the weight of scientific evidence is based on the strengths, limitations, and uncertainties associated with the exposure estimates. The Agency considers factors that increase or decrease the strength of the evidence supporting the exposure estimate—including quality of the data/information, applicability of the exposure data to the COU (including considerations of temporal and 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, in accordance with the Draft Systematic Review Protocol (U.S. EPA, 2021a). For example, a conclusion of moderate is appropriate where exposure data are generated from a generic model with high quality data and some chemical-specific or industry-specific inputs, such that the exposure estimate is a reasonable representation of potential sites within the OES. A conclusion of slight weight of scientific evidence is appropriate where there is limited information that does not sufficiently cover all potential exposures within the COU, and the assumptions and uncertainties are not fully known or documented. See the Draft Systematic Review Protocol for additional information on weight of scientific evidence conclusions. Table 4-5 provides a summary of EPA's overall confidence in its occupational exposure estimates for each of the OESs assessed.

**Table 4-5. Summary of Assumptions, Uncertainty, and Overall Confidence in Exposure Estimates by OES**

| OES | Weight of Scientific Evidence Conclusion in Exposure Estimates |
|---|---|
| Manufacturing | EPA considered the assessment approach, the quality of the data, and uncertainties in assessment results to determine a weight of scientific evidence conclusion for the 8-hour TWA inhalation exposure estimates for the manufacturing OES. EPA utilized the PNOR Model (U.S. EPA, 2021b) to estimate worker inhalation exposure to solid particulate. The respirable particulate concentrations used by the generic model were rated high for data quality from the systematic review process, and the model was built using Occupational Safety and Health Administration (OSHA) Chemical Exposure Health Data (CEHD) data (OSHA, 2020). EPA used a subset of the respirable particulate data from the generic model identified with the Chemical Manufacturing NAICS code (NAICS code 325) to assess this OES, which EPA expects to be the most representative subset of the particulate data in the absence of chemical-specific data. EPA estimated the highest expected concentration of DCHP in particulates during manufacturing using DCHP concentration information from CDR reporters, which was also rated high for data quality in the systematic review process (U.S. EPA, 2020a). These strengths increase the weight of scientific evidence.<br><br>The primary limitation is the uncertainty in the representativeness of values toward the true distribution of potential inhalation exposures. Specifically, EPA lacks facility-specific particulate concentrations in air, and the representativeness of the dataset used in the model towards sites that actually handle DCHP is uncertain. Furthermore, the model is not chemical specific and lacks metadata on worker activities. EPA also assumed eight exposure hours per day and 250 exposure days per year based on continuous DCHP exposure each working day for a typical worker schedule; it is uncertain whether this captures actual worker schedules and exposures. EPA did not account for vapor inhalation exposures, but vapor exposures are not expected to significantly contribute to overall inhalation exposure when compared to particulate exposures. This is based on DCHP's vapor pressure, and the solid physical form assessed for this OES. These limitations decrease the weight of evidence.<br><br>The use of the PNOR Model, which contains industry monitoring data from OSHA CEHD dataset increases the confidence of the assessment, but limitations of the model discussed above like data not being chemical specific and not containing worker activities reduces confidence of the analysis. Therefore, based on these strengths and limitations, EPA concluded that the weight of scientific evidence in the assessed inhalation exposures for average adult workers and females of reproductive age is moderate. EPA has slight to moderate confidence in the assessed inhalation exposures for ONUs since worker central tendency exposure values were assumed to be representative of ONU inhalation exposures. |
| Import and repackaging | EPA considered the assessment approach, the quality of the data, and uncertainties in assessment results to determine a weight of scientific evidence conclusion for the 8-hour TWA inhalation exposure estimates for the import and repackaging OES. EPA utilized the PNOR Model (U.S. EPA, 2021b) to estimate worker inhalation exposure to solid particulate. The respirable particulate concentrations used by the generic model were rated high for data quality from the systematic review process, and the model was built using OSHA CEHD data (OSHA, 2020). EPA used a subset of the respirable particulate data from the generic model identified with the Wholesale and Retail Trade NAICS codes (NAICS codes 42 through 45) to assess this OES, which EPA expects to be the most representative subset of the particulate data in the absence of chemical-specific data. EPA estimated the highest expected concentration of DCHP in particulates during import and repackaging using DCHP concentration information from CDR reporters, which was also rated high for data quality in the systematic review process (U.S. EPA, 2020a). These strengths increase the weight of evidence.<br><br>The primary limitation is the uncertainty in the representativeness of values toward the true distribution of potential inhalation exposures. Specifically, EPA lacks facility-specific particulate concentrations in air, and the representativeness of the dataset used in the model towards sites that actually handle DCHP is uncertain. Further, the model is not chemical specific and lacks metadata on worker activities. EPA also assumed eight exposure hours per day and 208 to 250 exposure days per year based on continuous DCHP exposure each working day for a typical worker schedule; it is uncertain whether this captures actual worker schedules and exposures. EPA did not account for vapor inhalation exposures, but vapor exposures are not expected to significantly contribute to overall inhalation exposure compared to particulate exposures based on DCHP's vapor pressure and the solid physical form assessed for this OES. These limitations decrease the weight of evidence. |

| OES | Weight of Scientific Evidence Conclusion in Exposure Estimates |
|---|---|
| | The use of the PNOR Model, which contains industry monitoring data from OSHA CEHD dataset increases the confidence of the assessment, but limitations of the model discussed above like data not being chemical specific and not containing worker activities reduces confidence of the analysis. Therefore, based on these strengths and limitations, EPA concluded that the weight of scientific evidence in the assessed inhalation exposures for average adult workers and females of reproductive age is moderate. EPA has slight to moderate confidence in the assessed inhalation exposures for ONUs since worker central tendency exposure values were assumed to be representative of ONU inhalation exposures. |
| Incorporation into adhesives and sealants | EPA considered the assessment approach, the quality of the data, and uncertainties in assessment results to determine a weight of scientific evidence conclusion for the 8-hour TWA inhalation exposure estimates for the incorporation into adhesives and sealants OES. EPA utilized the PNOR Model (U.S. EPA, 2021b) to estimate worker inhalation exposure to solid particulate. The respirable particulate concentrations used by the generic model were rated high for data quality from the systematic review process, and the model was built using OSHA CEHD data (OSHA, 2020). EPA used a subset of the respirable particulate data from the generic model identified with the Chemical Manufacturing NAICS code (NAICS code 325) to assess this OES, which EPA expects to be the most representative subset of the particulate data for chemical product manufacturing in the absence of DCHP-specific data. EPA estimated the highest expected concentration of DCHP in particulates during adhesive and sealant manufacturing using DCHP concentration information from CDR reporters, which was also rated high for data quality in the systematic review process (U.S. EPA, 2020a). These strengths increase the weight of evidence.<br><br>The primary limitation is the uncertainty in the representativeness of values toward the true distribution of potential inhalation exposures. Specifically, EPA lacks facility-specific particulate concentrations in air, and the representativeness of the dataset used in the model towards sites that actually handle DCHP is uncertain. Further, the model is not chemical specific and lacks metadata on worker activities. EPA also assumed eight exposure hours per day and 250 exposure days per year based on continuous DCHP particulate exposure while unpacking DCHP received on site each working day for a typical worker schedule; it is uncertain whether this captures actual worker schedules and exposures. EPA did not account for vapor inhalation exposures, but vapor exposures are not expected to significantly contribute to overall inhalation exposure compared to particulate exposures based on DCHP's vapor pressure and the solid physical form assessed for this OES. These limitations decrease the weight of evidence.<br><br>The use of the PNOR Model, which contains industry monitoring data from OSHA CEHD dataset increases the confidence of the assessment, but limitations of the model discussed above like data not being chemical specific and not containing worker activities reduces confidence of the analysis. Therefore, based on these strengths and limitations, EPA concluded that the weight of scientific evidence in the assessed inhalation exposures for average adult workers and females of reproductive age is moderate. EPA has slight to moderate confidence in the assessed inhalation exposures for ONUs since worker central tendency exposure values were assumed to be representative of ONU inhalation exposures. |
| Incorporation into paints and coatings | EPA considered the assessment approach, the quality of the data, and uncertainties in assessment results to determine a weight of scientific evidence conclusion for the 8-hour TWA inhalation exposure estimates for the incorporation into paints and coatings OES. EPA utilized the PNOR Model (U.S. EPA, 2021b) to estimate worker inhalation exposure to solid particulate. The respirable particulate concentrations used by the generic model were rated high for data quality from the systematic review process, and the model was built using OSHA CEHD data (OSHA, 2020). EPA used a subset of the respirable particulate data from the generic model identified with the Chemical Manufacturing NAICS code (NAICS code 325) to assess this OES, which EPA expects to be the most representative subset of the particulate data for chemical product manufacturing in the absence of DCHP-specific data. EPA estimated the highest expected concentration of DCHP in particulates during paint and coating manufacturing using DCHP concentration information from CDR reporters, which was also rated high for data quality in the systematic review process (U.S. EPA, 2020a). These strengths increase the weight of evidence.<br><br>The primary limitation is the uncertainty in the representativeness of values toward the true distribution of potential inhalation exposures. Specifically, EPA lacks facility-specific particulate concentrations in air, and the representativeness of the dataset used in the model towards sites |

| OES | Weight of Scientific Evidence Conclusion in Exposure Estimates |
|---|---|
| | that actually handle DCHP is uncertain. Further, the model is not chemical specific and lacks metadata on worker activities. EPA also assumed eight exposure hours per day and 250 exposure days per year based on continuous DCHP particulate exposure while unpacking DCHP received on site each working day for a typical worker schedule; it is uncertain whether this captures actual worker schedules and exposures. EPA did not account for vapor inhalation exposures, but vapor exposures are not expected to significantly contribute to overall inhalation exposure compared to particulate exposures based on DCHP's vapor pressure and the solid physical form assessed for this OES. These limitations decrease the weight of evidence.<br><br>The use of the PNOR Model, which contains industry monitoring data from OSHA CEHD dataset increases the confidence of the assessment, but limitations of the model discussed above like data not being chemical specific and not containing worker activities reduces confidence of the analysis. Therefore, based on these strengths and limitations, EPA concluded that the weight of scientific evidence in the assessed inhalation exposures for average adult workers and females of reproductive age is moderate. EPA has slight to moderate confidence in the assessed inhalation exposures for ONUs since worker central tendency exposure values were assumed to be representative of ONU inhalation exposures. |
| Incorporation into other formulations, mixtures, or reaction products | EPA considered the assessment approach, the quality of the data, and uncertainties in assessment results to determine a weight of scientific evidence conclusion for the 8-hour TWA inhalation exposure estimates for the incorporation into other formulations, mixtures, or reaction products OES. EPA utilized the PNOR Model (U.S. EPA, 2021b) to estimate worker inhalation exposure to solid particulate. The respirable particulate concentrations used by the generic model were rated high for data quality from the systematic review process, and the model was built using OSHA CEHD data (OSHA, 2020). EPA used a subset of the respirable particulate data from the generic model identified with the Chemical Manufacturing NAICS code (NAICS code 325) to assess this OES, which EPA expects to be the most representative subset of the particulate data for chemical product manufacturing in the absence of DCHP-specific data. EPA estimated the highest expected concentration of DCHP in particulates during formulation, mixture or other chemical product manufacturing using DCHP concentration information from CDR reporters, which was also rated high for data quality in the systematic review process (U.S. EPA, 2020a). These strengths increase the weight of evidence.<br><br>The primary limitation is the uncertainty in the representativeness of values toward the true distribution of potential inhalation exposures. Specifically, EPA lacks facility-specific particulate concentrations in air, and the representativeness of the dataset used in the model towards sites that actually handle DCHP is uncertain. Further, the model is not chemical specific and lacks metadata on worker activities. EPA also assumed eight exposure hours per day and 250 exposure days per year based on continuous DCHP particulate exposure while unpacking DCHP received on site each working day for a typical worker schedule; it is uncertain whether this captures actual worker schedules and exposures. EPA did not account for vapor inhalation exposures, but vapor exposures are not expected to significantly contribute to overall inhalation exposure compared to particulate exposures based on DCHP's vapor pressure and the solid physical form assessed for this OES. These limitations decrease the weight of evidence.<br><br>The use of the PNOR Model, which contains industry monitoring data from OSHA CEHD dataset increases the confidence of the assessment, but limitations of the model discussed above like data not being chemical specific and not containing worker activities reduces confidence of the analysis. Therefore, based on these strengths and limitations, EPA concluded that the weight of scientific evidence in the assessed inhalation exposures for average adult workers and females of reproductive age is moderate. EPA has slight to moderate confidence in the assessed inhalation exposures for ONUs since worker central tendency exposure values were assumed to be representative of ONU inhalation exposures. |
| PVC plastics compounding | EPA considered the assessment approach, the quality of the data, and uncertainties in assessment results to determine a weight of scientific evidence conclusion for the 8-hour TWA inhalation exposure estimates for PVC plastics compounding OES. EPA utilized the PNOR Model (U.S. EPA, 2021b) to estimate worker inhalation exposure to solid particulate. The respirable particulate concentrations used by the generic model were rated high for data quality from the systematic review process, and the model was built using OSHA CEHD data (OSHA, 2020). EPA used a subset of the respirable particulate data from the generic model identified with the Plastics and Rubber Manufacturing NAICS code (NAICS code 326) to |

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| | assess this OES, which EPA expects to be the most representative subset of the particulate data for PVC plastic manufacturing in the absence of DCHP-specific data. EPA estimated the highest expected concentration of DCHP in particulates during PVC plastic compounding using DCHP concentration information from CDR reporters, which was also rated high for data quality in the systematic review process (U.S. EPA, 2020a). These strengths increase the weight of evidence.<br><br>The primary limitation is the uncertainty in the representativeness of values toward the true distribution of potential inhalation exposures. Specifically, EPA lacks facility-specific particulate concentrations in air, and the representativeness of the dataset used in the model towards sites that actually handle DCHP is uncertain. Further, the model is not chemical specific and lacks metadata on worker activities. EPA also assumed eight exposure hours per day based on continuous DCHP particulate exposure while unpacking DCHP received on site each working day for a typical worker schedule; it is uncertain whether this captures actual worker schedules and exposures. EPA set the number of exposure days based on Monte Carlo modeling of the operating days from the release assessment, with a maximum number of working days capped at 250 days per year based on EPA default assumptions. The high-end exposures are based on 250 days per year as the exposure frequency since the 95th percentile of operating days in the release assessment exceeded 250 days per year. The central tendency exposures use 223 days per year as the exposure frequency based on the 50th percentile of operating days from the release assessment. EPA did not account for vapor inhalation exposures, but vapor exposures are not expected to significantly contribute to overall inhalation exposure compared to particulate exposures based on DCHP's vapor pressure and the solid physical form assessed for this OES. These limitations decrease the weight of evidence.<br><br>The use of the PNOR Model, which contains industry monitoring data from OSHA CEHD dataset increases the confidence of the assessment, but limitations of the model discussed above like data not being chemical specific and not containing worker activities reduces confidence of the analysis. Therefore, based on these strengths and limitations, EPA concluded that the weight of scientific evidence in the assessed inhalation exposures for average adult workers and females of reproductive age is moderate. EPA has slight to moderate confidence in the assessed inhalation exposures for ONUs since worker central tendency exposure values were assumed to be representative of ONU inhalation exposures. |
| PVC plastics converting | EPA considered the assessment approach, the quality of the data, and uncertainties in assessment results to determine a weight of scientific evidence conclusion for the 8-hour TWA inhalation exposure estimates for PVC plastics converting OES. EPA utilized the PNOR Model (U.S. EPA, 2021b) to estimate worker inhalation exposure to solid particulate. The respirable particulate concentrations used by the generic model were rated high for data quality from the systematic review process, and the model was built using OSHA CEHD data (OSHA, 2020). EPA used a subset of the respirable particulate data from the generic model identified with the Plastics and Rubber Manufacturing NAICS code (NAICS code 326) to assess this OES, which EPA expects to be the most representative subset of the particulate data for PVC plastics product manufacturing in the absence of DCHP-specific data. EPA estimated the highest expected concentration of DCHP in particulates during PVC plastic converting using plasticizer additive concentration information from the Use of Additives in Plastic Converting GS that was rated medium for data quality in the systematic review process (U.S. EPA, 2004a). These strengths increase the weight of evidence.<br><br>The primary limitation is the uncertainty in the representativeness of values toward the true distribution of potential inhalation exposures. Specifically, EPA lacks facility-specific particulate concentrations in air, and the representativeness of the dataset used in the model towards sites that actually handle DCHP is uncertain. Further, the model is not chemical specific and lacks metadata on worker activities. EPA also assumed eight exposure hours per day based on continuous DCHP particulate exposure while handling DCHP-containing plastics on-site each working day for a typical worker schedule; it is uncertain whether this captures actual worker schedules and exposures. EPA set the number of exposure days based on Monte Carlo modeling of the operating days from the release assessment, with a maximum number of working days capped at 250 days per year based on EPA default assumptions. The high-end exposures are based on 250 days per year as the exposure frequency since the 95th percentile of operating days in the release assessment exceeded 250 days per year. The central tendency exposures use 219 days per year as the exposure frequency based on the 50th percentile of operating days from the release assessment. EPA did not account for vapor inhalation |

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| | exposures, but vapor exposures are not expected to significantly contribute to overall inhalation exposure compared to particulate exposures based on DCHP's vapor pressure and the solid physical form assessed for this OES. These limitations decrease the weight of evidence.<br><br>The use of the PNOR Model, which contains industry monitoring data from OSHA CEHD dataset increases the confidence of the assessment, but limitations of the model discussed above like data not being chemical specific and not containing worker activities reduces confidence of the analysis. Therefore, based on these strengths and limitations, EPA concluded that the weight of scientific evidence in the assessed inhalation exposures for average adult workers and females of reproductive age is moderate. EPA has slight to moderate confidence in the assessed inhalation exposures for ONUs since worker central tendency exposure values were assumed to be representative of ONU inhalation exposures. |
| Non-PVC material compounding | EPA considered the assessment approach, the quality of the data, and uncertainties in assessment results to determine a weight of scientific evidence conclusion for the 8-hour TWA inhalation exposure estimates for non-PVC material compounding OES. EPA utilized the PNOR Model (U.S. EPA, 2021b) to estimate worker inhalation exposure to solid particulate. The respirable particulate concentrations used by the generic model were rated high for data quality from the systematic review process, and the model was built using OSHA CEHD data (OSHA, 2020). EPA used a subset of the respirable particulate data from the generic model identified with the Plastics and Rubber Manufacturing NAICS code (NAICS code 326) to assess this OES, which EPA expects to be the most representative subset of the particulate data for non-PVC plastic or rubber manufacturing in the absence of DCHP-specific data. EPA estimated the highest expected concentration of DCHP in particulates during non-PVC material compounding using DCHP concentration information from CDR reporters, which was also rated high for data quality in the systematic review process (U.S. EPA, 2020a). These strengths increase the weight of evidence.<br><br>The primary limitation is the uncertainty in the representativeness of values toward the true distribution of potential inhalation exposures. Specifically, EPA lacks facility-specific particulate concentrations in air, and the representativeness of the dataset used in the model towards sites that actually handle DCHP is uncertain. Further, the model is not chemical specific and lacks metadata on worker activities. EPA also assumed eight exposure hours per day based on continuous DCHP particulate exposure while unpacking DCHP received on site each working day for a typical worker schedule; it is uncertain whether this captures actual worker schedules and exposures. EPA set the number of exposure days based on Monte Carlo modeling of the operating days from the release assessment, with a maximum number of working days capped at 250 days per year based on EPA default assumptions. The high-end exposures are based on 250 days per year as the exposure frequency since the 95th percentile of operating days in the release assessment exceeded 250 days per year. The central tendency exposures use 227 days per year as the exposure frequency based on the 50th percentile of operating days from the release assessment. EPA did not account for vapor inhalation exposures, but vapor exposures are not expected to significantly contribute to overall inhalation exposure compared to particulate exposures based on DCHP's vapor pressure and the solid physical form assessed for this OES. These limitations decrease the weight of evidence.<br><br>The use of the PNOR Model, which contains industry monitoring data from OSHA CEHD dataset increases the confidence of the assessment, but limitations of the model discussed above like data not being chemical specific and not containing worker activities reduces confidence of the analysis. Therefore, based on these strengths and limitations, EPA concluded that the weight of scientific evidence in the assessed inhalation exposures for average adult workers and females of reproductive age is moderate. EPA has slight to moderate confidence in the assessed inhalation exposures for ONUs since worker central tendency exposure values were assumed to be representative of ONU inhalation exposures. |
| Non-PVC material converting | EPA considered the assessment approach, the quality of the data, and uncertainties in assessment results to determine a weight of scientific evidence conclusion for the 8-hour TWA inhalation exposure estimates for non-PVC material converting OES. EPA utilized the PNOR Model (U.S. EPA, 2021b) to estimate worker inhalation exposure to solid particulate. The respirable particulate concentrations used by the generic model were rated high for data quality from the systematic review process, and the model was built using OSHA CEHD data (OSHA, 2020). EPA used a subset of the respirable particulate data from the generic model identified with the Plastics and Rubber Manufacturing NAICS code (NAICS code 326) to assess this OES, which EPA expects to be the most representative subset of the particulate data for non-PVC plastic and rubber product |

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| | manufacturing in the absence of DCHP-specific data. EPA estimated the highest expected concentration of DCHP in particulates during non-PVC material converting using rubber plasticizer concentration information from the ESD on Additives in Rubber Industry, which has a medium rating for data quality in the systematic review process (OECD, 2004). These strengths increase the weight of evidence.<br><br>The primary limitation is the uncertainty in the representativeness of values toward the true distribution of potential inhalation exposures. Specifically, EPA lacks facility-specific particulate concentrations in air, and the representativeness of the dataset used in the model towards sites that actually handle DCHP is uncertain. Further, the model is not chemical specific and lacks metadata on worker activities. EPA also assumed eight exposure hours per day based on continuous DCHP particulate exposure while handling DCHP-containing plastics or rubbers on-site each working day for a typical worker schedule; it is uncertain whether this captures actual worker schedules and exposures. EPA set the number of exposure days based on Monte Carlo modeling of the operating days from the release assessment, with a maximum number of working days capped at 250 days per year based on EPA default assumptions. The high-end exposures are based on 250 days per year as the exposure frequency since the 95th percentile of operating days in the release assessment exceeded 250 days per year. The central tendency exposures use 219 days per year as the exposure frequency based on the 50th percentile of operating days from the release assessment. EPA did not account for vapor inhalation exposures, but vapor exposures are not expected to significantly contribute to overall inhalation exposure compared to particulate exposures based on DCHP vapor pressure and the solid physical form assessed for this OES. These limitations decrease the weight of evidence.<br><br>The use of the PNOR Model, which contains industry monitoring data from OSHA CEHD dataset increases the confidence of the assessment, but limitations of the model discussed above like data not being chemical specific and not containing worker activities reduces confidence of the analysis. Therefore, based on these strengths and limitations, EPA concluded that the weight of scientific evidence in the assessed inhalation exposures for average adult workers and females of reproductive age is moderate. EPA has slight to moderate confidence in the assessed inhalation exposures for ONUs since worker central tendency exposure values were assumed to be representative of ONU inhalation exposures. |
| Application of adhesives and sealants | EPA considered the assessment approach, the quality of the data, and uncertainties in assessment results to determine a weight of scientific evidence conclusion for the 8-hour TWA inhalation exposure estimates for the application of adhesives and sealants OES. EPA utilized the PNOR Model (U.S. EPA, 2021b) to estimate worker inhalation exposure to solid particulate. The respirable particulate concentrations used by the generic model were rated high for data quality from the systematic review process, and the model was built using OSHA CEHD data (OSHA, 2020). EPA used the entire respirable particulate dataset from the generic model to assess this OES, since adhesives and sealants containing DCHP may be used in a variety of end-use industries. EPA estimated the highest expected concentration of DCHP in particulates during application of adhesives and sealants using SDSs and product data sheets from identified DCHP-containing adhesives and sealant products in solid form. These strengths increase the weight of evidence.<br><br>The primary limitation is the uncertainty in the representativeness of values toward the true distribution of potential inhalation exposures. Specifically, EPA lacks facility-specific particulate concentrations in air, and the representativeness of the dataset used in the model towards sites that actually handle DCHP is uncertain. Further, the model is not chemical specific and lacks metadata on worker activities. EPA also assumed eight exposure hours per day based on continuous DCHP particulate exposure while handling DCHP-containing products on-site each working day for a typical worker schedule; it is uncertain whether this captures actual worker schedules and exposures. EPA set the number of exposure days based on Monte Carlo modeling of the operating days from the release assessment, with a maximum number of working days capped at 250 days per year based on EPA default assumptions. The high-end exposures are based on 250 days per year as the exposure frequency since the 95th percentile of operating days in the release assessment exceeded 250 days per year. The central tendency exposures use 232 days per year as the exposure frequency based on the 50th percentile of operating days from the release assessment. EPA did not account for vapor inhalation exposures, but vapor exposures are not expected to significantly contribute to overall inhalation exposure compared to particulate exposures based on DCHP's vapor pressure and the solid physical form assessed for this OES. These limitations decrease the weight of evidence. |

| OES | Weight of Scientific Evidence Conclusion in Exposure Estimates |
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| | The use of the PNOR Model, which contains industry monitoring data from OSHA CEHD dataset increases the confidence of the assessment, but limitations of the model discussed above like data not being chemical specific and not containing worker activities reduces confidence of the analysis. Therefore, based on these strengths and limitations, EPA concluded that the weight of scientific evidence in the assessed inhalation exposures for average adult workers and females of reproductive age is moderate. EPA has slight to moderate confidence in the assessed inhalation exposures for ONUs since worker central tendency exposure values were assumed to be representative of ONU inhalation exposures. |
| Application of paints and coatings | EPA considered the assessment approach, the quality of the data, and uncertainties in assessment results to determine a weight of scientific evidence conclusion for the 8-hour TWA inhalation exposure estimates. EPA used surrogate 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 to DCHP in the liquid form (OECD, 2011a). EPA also used the PNOR Model (U.S. EPA, 2021b) to estimate worker inhalation exposure to solid particulate, since DCHP may be received on site in solid form. The respirable particulate concentrations used by the generic model were rated high for data quality from the systematic review process, and the model was built using OSHA CEHD data (OSHA, 2020). EPA used the entire respirable particulate dataset from the generic model to assess this OES, since paints and coatings containing DCHP may be used in a variety of end-use industries. EPA used SDSs and product data sheets from identified DCHP-containing products to identify product concentrations for the liquid spray and the solid particulate assessments. A strength of this approach is that both models (for solid particulate and for mist exposure) resulted in exposure estimates within an order of magnitude of each other. These strengths increase the weight of evidence.<br><br>The primary limitation is the lack of DCHP-specific monitoring data. Specifically, the ESD serves as a surrogate source of monitoring data representing the level of exposure that could be expected at a typical work site for the given spray application method, and the generic model data represents particulate concentrations in air for solids handling exposures. EPA assumes spray applications of the coatings, so the estimates may not be representative of exposure during other coating application methods. Additionally, it is uncertain whether the substrates coated, and products used to generate the surrogate data are representative of those associated with DCHP-containing coatings. EPA only assessed mist or solid exposures to DCHP over a full 8-hour work shift to estimate the level of exposure, though other activities may result in exposures other than mist or solid particulate and application duration may be variable depending on the job site. EPA assessed 250 days of exposure per year based on workers applying coatings on every working day, however, application sites may use DCHP-containing coatings at much lower or variable frequencies. These limitations decrease the weight of evidence.<br><br>The use of the PNOR Model and Automotive Refinishing Spray Coating Mist Inhalation Model, which contains industry monitoring data increases the confidence of the assessment, but limitations of the model discussed above like data not being chemical specific reduces confidence of the analysis. Therefore, based on these strengths and limitations, EPA concluded that the weight of scientific evidence in the assessed inhalation exposures for average adult workers and females of reproductive age is moderate. EPA has slight to moderate confidence in the assessed inhalation exposures for ONUs since worker central tendency exposure values were assumed to be representative of ONU inhalation exposures. |
| Use of laboratory chemicals | EPA considered the assessment approach, the quality of the data, and uncertainties in assessment results to determine a weight of scientific evidence conclusion for the 8-hour TWA inhalation exposure estimates for use of laboratory chemicals OES. EPA utilized the PNOR Model (U.S. EPA, 2021b) to estimate worker inhalation exposure to solid particulate. The respirable particulate concentrations used by the generic model were rated high for data quality from the systematic review process, and the model was built using OSHA CEHD data (OSHA, 2020). EPA used a subset of the respirable particulate data from the generic model identified with the Professional, Scientific, and Technical Services NAICS code (NAICS code 54) to assess this OES, which EPA expects to be the most representative subset of the particulate data for use of laboratory chemicals in the absence of DCHP-specific data. EPA estimated the highest expected concentration of DCHP in particulates during laboratory use using SDSs and product data sheets from identified lab-grade chemicals. These strengths increase the weight of evidence. |

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| | The primary limitation is the uncertainty in the representativeness of values toward the true distribution of potential inhalation exposures. Specifically, EPA lacks facility-specific particulate concentrations in air, and the representativeness of the dataset used in the model towards sites that actually handle DCHP is uncertain. Further, the model is not chemical specific and lacks metadata on worker activities. EPA also assumed eight exposure hours per day based on continuous DCHP particulate exposure while handling DCHP-containing products on-site each working day for a typical worker schedule; it is uncertain whether this captures actual worker schedules and exposures. EPA set the number of exposure days based on Monte Carlo modeling of the operating days from the release assessment, with a maximum number of working days capped at 250 days per year based on EPA default assumptions. The high-end exposures are based on 250 days per year as the exposure frequency since the 95th percentile of operating days in the release assessment exceeded 250 days per year. The central tendency exposures use 232 days per year as the exposure frequency based on the 50th percentile of operating days from the release assessment. EPA did not account for vapor inhalation exposures, but vapor exposures are not expected to significantly contribute to overall inhalation exposure compared to particulate exposures based on DCHP's vapor pressure and the solid physical form assessed for this OES. These limitations decrease the weight of evidence.<br><br>The use of the PNOR Model, which contains industry monitoring data from OSHA CEHD dataset increases the confidence of the assessment, but limitations of the model discussed above like data not being chemical specific and not containing worker activities reduces confidence of the analysis. Therefore, based on these strengths and limitations, EPA concluded that the weight of scientific evidence in the assessed inhalation exposures for average adult workers and females of reproductive age is moderate. EPA has slight to moderate confidence in the assessed inhalation exposures for ONUs since worker central tendency exposure values were assumed to be representative of ONU inhalation exposures. |
| Fabrication or use of final products or articles | EPA considered the assessment approach, the quality of the data, and uncertainties in assessment results to determine a weight of scientific evidence conclusion for the 8-hour TWA inhalation exposure estimates for the fabrication or use of final products or articles OES. EPA utilized the PNOR Model (U.S. EPA, 2021b) to estimate worker inhalation exposure to solid particulate. The respirable particulate concentrations used by the generic model were rated high for data quality from the systematic review process, and the model was built using OSHA CEHD data (OSHA, 2020). EPA used a subset of the respirable particulate data from the generic model identified with the Furniture and Related Product Manufacturing NAICS code (NAICS code 337) to assess this OES, which EPA expects to be the most representative subset of the particulate data for this OES. EPA estimated the highest expected concentration of DCHP in particulates during product fabrication using plasticizer additive concentration information from the Use of Additives in Plastic Converting GS that has a medium rating for data quality from the systematic review process (U.S. EPA, 2004a). These strengths increase the weight of evidence.<br><br>The primary limitation is the uncertainty in the representativeness of values toward the true distribution of potential inhalation exposures. Specifically, EPA lacks facility-specific particulate concentrations in air, and the representativeness of the dataset used in the model towards sites that actually handle DCHP is uncertain. Further, the model is not chemical specific and lacks metadata on worker activities. EPA also assumed eight exposure hours per day based on continuous DCHP particulate exposure while handling DCHP-containing products on-site each working day for a typical worker schedule; it is uncertain whether this captures actual worker schedules and exposures. EPA set the number of exposure days based on Monte Carlo modeling of the operating days from the release assessment, with a maximum number of working days capped at 250 days per year based on EPA default assumptions. The high-end exposures are based on 250 days per year as the exposure frequency since the 95th percentile of operating days in the release assessment exceeded 250 days per year. The central tendency exposures use 232 days per year as the exposure frequency based on the 50th percentile of operating days from the release assessment. EPA did not account for vapor inhalation exposures, but vapor exposures are not expected to significantly contribute to overall inhalation exposure compared to particulate exposures based on DCHP vapor pressure and the solid physical form assessed for this OES. These limitations decrease the weight of evidence.<br><br>The use of the PNOR Model, which contains industry monitoring data from OSHA CEHD dataset increases the confidence of the assessment, but limitations of the model discussed above like data not being chemical specific and not containing worker activities reduces confidence of the |

| OES | Weight of Scientific Evidence Conclusion in Exposure Estimates |
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| | analysis. Therefore, based on these strengths and limitations, EPA concluded that the weight of scientific evidence in the assessed inhalation exposures for average adult workers and females of reproductive age is moderate. EPA has slight to moderate confidence in the assessed inhalation exposures for ONUs since worker central tendency exposure values were assumed to be representative of ONU inhalation exposures. |
| Recycling | EPA considered the assessment approach, the quality of the data, and uncertainties in assessment results to determine a weight of scientific evidence conclusion for the 8-hour TWA inhalation exposure estimates for the recycling OES. EPA utilized the PNOR Model (U.S. EPA, 2021b) to estimate worker inhalation exposure to solid particulate. The respirable particulate concentrations used by the generic model were rated high for data quality from the systematic review process, and the model was built using OSHA CEHD data (OSHA, 2020). EPA used a subset of the respirable particulate data from the generic model identified with the Administrative and Support and Waste Management and Remediation Services NAICS code (NAICS code 56) to assess this OES, which EPA expects to be the most representative subset of the particulate data for this OES. EPA estimated the highest expected concentration of DCHP in plastic using plasticizer additive concentration information from the Use of Additives in Plastic Converting GS that has a medium rating for data quality from the systematic review process (U.S. EPA, 2004a). These strengths increase the weight of evidence.<br><br>The primary limitation is the uncertainty in the representativeness of values toward the true distribution of potential inhalation exposures. Specifically, EPA lacks facility-specific particulate concentrations in air, and the representativeness of the dataset used in the model towards sites that actually handle DCHP is uncertain. Further, the model is not chemical specific and lacks metadata on worker activities. The high-end exposures use 250 days per year as the exposure frequency since the 95th percentile of operating days in the release assessment exceeded 250 days per year, which is the expected maximum number of working days. The central tendency exposures use 223 days per year as the exposure frequency based on the 50th percentile of operating days from the release assessment. Also, it was assumed that each worker is potentially exposed for 8 hours per work day; however, it is uncertain whether this captures actual worker schedules and exposures. These limitations decrease the weight of evidence.<br><br>The use of the PNOR Model, which contains industry monitoring data from OSHA CEHD dataset increases the confidence of the assessment, but limitations of the model discussed above like data not being chemical specific and not containing worker activities reduces confidence of the analysis. Therefore, based on these strengths and limitations, EPA concluded that the weight of scientific evidence in the assessed inhalation exposures for average adult workers and females of reproductive age is moderate. EPA has slight to moderate confidence in the assessed inhalation exposures for ONUs since worker central tendency exposure values were assumed to be representative of ONU inhalation exposures. |
| Waste handling, treatment, and disposal | EPA considered the assessment approach, the quality of the data, and uncertainties in assessment results to determine a weight of scientific evidence conclusion for the 8-hour TWA inhalation exposure estimates for the waste handling, treatment, and disposal OES. EPA utilized the PNOR Model (U.S. EPA, 2021b) to estimate worker inhalation exposure to solid particulate. The respirable particulate concentrations used by the generic model were rated high for data quality from the systematic review process, and the model was built using OSHA CEHD data (OSHA, 2020). EPA used a subset of the respirable particulate data from the generic model identified with the Administrative and Support and Waste Management and Remediation Services NAICS code (NAICS code 56) to assess this OES, which EPA expects to be the most representative subset of the particulate data for this OES. EPA estimated the highest expected concentration of DCHP in plastic using plasticizer additive concentration information from the Use of Additives in Plastic Converting GS that has a medium rating for data quality from the systematic review process (U.S. EPA, 2004a). These strengths increase the weight of evidence.<br><br>The primary limitation is the uncertainty in the representativeness of values toward the true distribution of potential inhalation exposures. Specifically, EPA lacks facility-specific particulate concentrations in air, and the representativeness of the dataset used in the model towards sites that actually handle DCHP is uncertain. Further, the model is not chemical specific and lacks metadata on worker activities. The high-end exposures use 250 days per year as the exposure frequency since the 95th percentile of operating days in the release assessment exceeded 250 days |

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| | per year, which is the expected maximum number of working days. The central tendency exposures use 223 days per year as the exposure frequency based on the 50th percentile of operating days from the release assessment. Also, it was assumed that each worker is potentially exposed for 8 hours per work day; however, it is uncertain whether this captures actual worker schedules and exposures. These limitations decrease the weight of evidence.<br><br>The use of the PNOR Model, which contains industry monitoring data from OSHA CEHD dataset increases the confidence of the assessment, but limitations of the model discussed above like data not being chemical specific and not containing worker activities reduces confidence of the analysis. Therefore, based on these strengths and limitations, EPA concluded that the weight of scientific evidence in the assessed inhalation exposures for average adult workers and females of reproductive age is moderate. EPA has slight to moderate confidence in the assessed inhalation exposures for ONUs since worker central tendency exposure values were assumed to be representative of ONU inhalation exposures. |
| Dermal | EPA considered the assessment approach, the quality of the data, and uncertainties in assessment results to determine a weight of scientific evidence conclusion for the dermal exposure estimates. EPA used dermal modeling of aqueous materials (U.S. EPA, 2023b, 2004b) to estimate occupational dermal exposures of DCHP to workers and ONUs. The modeling approach for determining the aqueous permeability coefficient was within the range of applicability given the physical and chemical parameters of DCHP, and the modeling approach received a medium rating through EPA's systematic review process. Additionally, the neat form of DCHP is a solid, the concentrated formulations are paste-like, and any liquid containing DCHP has very low concentrations; therefore, it is reasonable to assume that flux-limited absorption of aqueous DCHP serves as a reasonable upper bound for the dermal absorption of DCHP from occupational scenarios. Additionally, EPA assumed a standard 8-hour work day and that the chemical is contacted at least once per day. Because DCHP has low volatility and a low rate of 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 DCHP from occupational dermal contact with materials containing DCHP may extend up to 8 hours per day (U.S. EPA, 1991). For average adult workers, the surface area of contact was assumed equal to the area of one hand (or two palms) (*i.e.*, 535 $cm^2$) for central tendency, or two hands (*i.e.*, 1,070 $cm^2$) for high-end exposures (U.S. EPA, 2011a). Regarding surface area of dermal exposure to ONUs experiencing incidental contact to mist or dust deposited on surfaces, EPA assumed a representative exposure surface area equivalent to the mean value for one palm (*i.e.*, 268 $cm^2$) of adult males (U.S. EPA, 2011a). The standard sources for exposure duration and area of contact received high ratings through EPA's systematic review process. These strengths increase the weight of evidence.<br><br>EPA acknowledges that variations in chemical concentration and co-formulant components affect the rate of dermal absorption, and that these variations were not considered in the occupational dermal exposure assessment in favor of an upper-bound dermal absorption estimate from flux-limited absorption of aqueous DCHP. Additionally, worker activity metadata used in the model, such as surface area of skin contact and exposure duration, are not facility or industry-specific and are meant to address generic dermal exposures in all OESs assessed. These limitations decrease the weight of evidence.<br><br>The occupational dermal exposure assessment for contact with materials containing DCHP was based on dermal absorption modeling of aqueous DCHP, 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 for average adult workers and female workers of reproductive age. However, due to the uncertainties in exposure frequency and extent of dermal exposures to ONUs, there is slight to moderate confidence in the dermal exposure estimates for ONUs. |

#### 4.1.1.5.1 Strengths, Limitations, Assumptions, and Key Sources of Uncertainty for the Occupational Exposure Assessment

EPA assigned overall confidence descriptions of high, medium, or low to the exposure assessments, based on the strength of the underlying scientific evidence. When the assessment is supported by robust evidence, the Agency's overall confidence in the exposure assessment is high; when supported by moderate evidence EPA's overall confidence is medium; when supported by slight evidence, the Agency's overall confidence is low.

***Strengths***

The exposure scenarios and exposure factors underlying the inhalation and dermal assessment are supported by moderate to robust evidence. Occupational inhalation exposure scenarios were informed by moderate or robust sources of surrogate monitoring data or GSs/ESDs used to model the inhalation exposure concentration. Exposure factors for occupational inhalation exposure include duration of exposure, body weight, and breathing rate, which were informed by moderate to robust data sources.

A strength of the modeling assessment includes the consideration of variable model input parameters as opposed to using a single static value. Parameter variation increases the likelihood that the true occupational inhalation exposures fall within the range of modeled estimates. An additional strength is that all data that EPA used to inform the modeling parameter distributions have overall data quality ratings of either high or medium from EPA's systematic review process. Strengths associated with dermal exposure assessment are described in Table 4-5.

***Limitations***

The principal limitation of the exposure assessments is uncertainty in the representativeness of the data and models used, as there is no direct exposure monitoring data for DCHP in the literature from systematic review. A limitation of the modeling methodologies is that most of the model input data from GSs/ESDs, such as air speed or loss factors, are generic for the OESs and not specific to the use of DCHP within the OESs. Additionally, the selected generic models and data may not be representative of all chemical- or site-specific work practices and engineering controls. Limitations associated with dermal exposure assessment are described in Table 4-5.

***Assumptions***

When determining the appropriate model for assessing exposures to DCHP, EPA considered the physical form of DCHP during different OESs. DCHP may be present in various physical forms such as a powder, mist, paste, or in solution during the various OESs. EPA assessed each respective OES assuming the physical form of DCHP based on available product data, CDR data, and information from applicable GSs/ESDs. Because the physical form of DCHP can influence exposures substantially, EPA assumed DCHP is present in the physical form that is most prevalent and/or most protective for the given OES when assessing the exposures.

EPA calculated ADD values assuming workers and ONUs are regularly exposed during their entire working lifetime, which likely results in an overestimate. Individuals may change jobs during the course of their career such that they are no longer exposed to DCHP, and the actual ADD values become lower than the estimates presented. Assumptions associated with dermal exposure assessment are described in Table 4-5.

***Uncertainties***

EPA addressed variability in inhalation models by identifying key model parameters and applying statistical distributions that mathematically define the parameter's variability. The Agency defined statistical distributions for parameters using documented statistical variations where available. Where the statistical variation was unknown, EPA made assumptions to estimate the parameter distribution using available literature data, such as GSs and ESDs. However, there is uncertainty as to the representativeness of the parameter distributions because these data are often not specific to sites that use DCHP. In general, the effects of these uncertainties on the exposure estimates are unknown as the uncertainties may result in either overestimation or underestimation of exposures depending on the actual distributions of each of the model input parameters. Uncertainties associated with dermal exposure assessment are described in Table 4-5.

There are several uncertainties surrounding the estimated number of workers potentially exposed to DCHP. First, BLS' OES employment data for each industry/occupation combination are only available at the 3-, 4-, or 5-digit NAICS level, rather than the full 6-digit NAICS level. This lack of granularity could result in an overestimate of the number of exposed workers if some 6-digit NAICS are included in the less granular BLS estimates but are not likely to use DCHP for the assessed applications. EPA addressed this issue by refining the OES estimates using total employment data from the U.S. Census' Statistics of U.S. Businesses (SUSB). However, this approach assumes that the distribution of occupation types (SOC codes) in each 6-digit NAICS is equal to the distribution of occupation types at the parent 5-digit NAICS level. If the distribution of workers in occupations with DCHP exposure differs from the overall distribution of workers in each NAICS, then this approach will result in inaccuracy.

### 4.1.2 Consumer Exposures

The following subsections briefly describe EPA's approach to assessing consumer exposures and provide exposure assessment results for each COU. The *Consumer and Indoor Dust Exposure Assessment for Dicyclohexyl Phthalate (DCHP)* (U.S. EPA, 2025c) provides additional details on the development of approaches and the exposure assessment results. The consumer exposure assessment evaluated exposures from individual COUs while the indoor dust assessment uses a subset of consumer articles with large surface area and presence in indoor environments to garner COU specific contributions to the total exposures from dust.

#### 4.1.2.1 Summary of Consumer and Indoor Dust Exposure Scenarios and Modeling Approach and Methodology

The main steps in performing a consumer exposure assessment are summarized below:

- Identification and mapping of product and article examples following the consumer COU table (Table 1-1), product, and article identification.
- Compilation of products and articles manufacturing use instructions to determine patterns of use.
- Selection of exposure routes and exposed populations according to product/article use descriptions.
- Identification of data gaps and further search to fill gaps with studies, chemical surrogates or product and article proxies, or professional judgment.
- Selection of appropriate modeling tools based on available information and chemical properties.
- Gathering of appropriate modeling input parameters per exposure scenario.
- Parameterization (entering inputs) of selected modeling tools per exposure route (inhalation, ingestion, and dermal).

Consumer products or articles containing DCHP were matched with the identified consumer COUs. Table 4-6 summarizes the consumer exposure scenarios by COU for each product example(s), the exposure routes, which scenarios are also used in the indoor dust assessment, and whether the analysis was conducted qualitatively or quantitatively. The indoor dust assessment uses consumer products and articles information for selected items with the goal of recreating the indoor environment. The subset of consumer products and articles that can be used in the indoor dust assessment are selected for their potential to have large surface area for dust collection, roughly larger than one square meter. Using these criteria, EPA did not identify articles in the modeling exposure estimates to include in the indoor assessment.

When a quantitative analysis of reasonably available information was conducted, exposure from the consumer COUs was estimated by modeling. Exposure via inhalation and ingestion routes were modeled using EPA's Consumer Exposure Model (CEM), Version 3.2 (U.S. EPA, 2023b) (see Section 4.1.2.1.1 for description of approaches and methodology). Dermal exposures were calculated using a using a flux-limited dermal absorption approach for liquid and solid products ( see Section 4.1.2.1.2 for description of approaches and methodology). For each exposure route, since most weight fractions were reported as a range, EPA used the minimum and maximum of the range as the low and high values, respectively. The average of the reported low and high values from the reported range was used for the medium exposure scenario. See *Consumer and Indoor Dust Exposure Assessment for Dicyclohexyl Phthalate (DCHP)* (U.S. EPA, 2025c) for details about the consumer modeling approaches, sources of data, model parameterization, and assumptions. Use of high-, medium-, and low-intensity use exposure scenarios serve as a two-pronged approach. First, it provides a sensitivity analysis with insight on the impact of the main modeling input parameters (*e.g.*, skin contact area, duration of contact, and frequency of contact) in the doses and risk estimates. Secondly, it is used to determine whether refinements are needed.

Exposure via the inhalation route occurs from inhalation of DCHP gas-phase emissions or when DCHP partitions to suspended particulate from direct use or application of products. However, DCHP's low volatility is expected to result in negligible gas-phase inhalation exposures. Sorption to suspended and settled dust is likely to occur based on monitoring data (see indoor dust monitoring data in Section 4.1.2.1) and its affinity for organic matter, which is typically present in household dust. Thus, inhalation and ingestion of suspended and settled dust is considered in this assessment. Exposure via the dermal route can occur from direct contact with products and articles. Exposure via ingestion depends on the product or article use patterns. Exposure can occur via direct mouthing (*i.e.*, directly putting product in mouth) in which the person can ingest settled dust with DCHP, or directly ingesting DCHP from migration to saliva. Additionally, ingestion of suspended dust can occur when DCHP migrates from product to dust or partitions from gas-phase to suspended dust.

EPA labeled CEM life stages to match those listed in the U.S. Centers for Disease Control and Prevention (CDC) guidelines (CDC, 2021) and EPA's *A Framework for Assessing Health Risks of Exposures to Children* (U.S. EPA, 2006). CEM life stages were re-labeled as follows:

- Adult (21+ years) → Adults
- Youth 2 (16–20 years) → Teenagers
- Youth 1 (11–15 years) → Young teens
- Child 2 (6–10 years) → Middle childhood
- Child 1 (3–5 years) → Preschoolers
- Infant 2 (1–2 years) → Toddlers
- Infant 1 (<1 year) → Infants

EPA assessed acute, intermediate, and chronic exposures to DCHP from consumer COUs. For the acute dose rate calculations, an averaging time of 1 day is used representing the maximum time-integrated dose over a 24-hour period during the exposure event. The chronic dose rate is calculated iteratively at a 30-second interval during the first 24 hours and every hour after that for 60 days. Intermediate dose is the exposure to continuous or intermittent (depending on product) use during a 30-day period, which is roughly a month. Professional judgment and product use descriptions were used to estimate events per day and per month/year for the calculation of the intermediate/chronic dose.

**Table 4-6. Summary of Consumer COUs, Exposure Scenarios, and Exposure Routes for DCHP**

| Consumer Condition of Use Category | Consumer Condition of Use Subcategory | Product/Article | Exposure Scenario and Route | Evaluated Routes | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | | Suspended Dust and Vapor Inhalation [a] | Dermal | Ingestion | | |
| | | | | | | Suspended Dust | Settled Dust | Mouthing |
| Adhesives and sealants | Adhesives and sealants | Auto or construction bonding adhesive | Use of product in DIY large-scale home repair activities. Direct contact during use; inhalation of emissions during use. | **QT** | **QT** | *QL* | *QL* | *QL* |
| Adhesives and sealants | Adhesives and sealants | Adhesives for small repairs | Use of product in DIY small-scale home repair activities. Direct contact during use. | *QL* | **QT** | *QL* | *QL* | *QL* |
| Plasticizer in other articles with routine direct contact during normal use including rubber articles; plastic articles (hard) | Plasticizer in other articles with routine direct contact during normal use including rubber articles; plastic articles (hard) | Small articles with the potential for semi-routine contact: labels, nitrocellulose; ethylcellulose; chlorinated rubber; PVAc; PVC | Direct contact during use | *QL* | **QT** | *QL* | *QL* | *QL* |
| Not identified as a COU of DCHP [b] | Not identified as a COU of DCHP [b] | Children's toys [b] | Collection of toys. Direct contact during use; inhalation of emissions / ingestion of airborne particulate; ingestion by mouthing. | **QT** | **QT** | **QT** | **QT** | **QT** |
| Other | Other consumer articles that contain dicyclohexyl phthalate from: inks, toner and colorants; paints and coatings; adhesives and sealants (*e.g.*, paper products, textiles, products using cellulose film, etc.) | Outdoor coated surfaces/seating | Direct contact during use | *QL* | **QT** | *QL* | *QL* | *QL* |

| Consumer Condition of Use Category | Consumer Condition of Use Subcategory | Product/Article | Exposure Scenario and Route | Evaluated Routes | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | | Suspended Dust and Vapor Inhalation [a] | Dermal | Ingestion | | |
| | | | | | | Suspended Dust | Settled Dust | Mouthing |
| Other | Other consumer articles that contain dicyclohexyl phthalate from: inks, toner and colorants; paints and coatings; adhesives and sealants (*e.g.*, paper products, textiles, products using cellulose film, etc.) | Small articles with the potential for semi-routine contact: labels, and packaging adhesives, foil and cellophane lacquers, and printing inks | Direct contact during use | *QL* | **QT** | *QL* | *QL* | *QL* |
| Other | Other consumer articles that contain dicyclohexyl phthalate from: inks, toner and colorants; paints and coatings; adhesives and sealants (*e.g.*, paper products, textiles, products using cellulose film, etc.) | Electronics containing dye adhesive | No exposures expected | *QL* | *QL* | *QL* | *QL* | *QL* |
| Disposal | Disposal | Down the drain products and articles | Down the drain and releases to environmental media | *QL* | *QL* | *QL* | *QL* | *QL* |
| Disposal | Disposal | Residential end-of-life disposal, product demolition for disposal | Product and article end-of-life disposal and product demolition for disposal | *QL* | *QL* | *QL* | *QL* | *QL* |

DIY= do-it-yourself; *QL* = qualitative consideration; **QT** = quantitative consideration
[a] Inhalation scenarios consider suspended dust and gas-phase emissions.
[b] Although children's toys were not identified as a COU of DCHP, EPA considered data identified in the High Priority Chemicals Data System (HPCDS) (WSDE, 2020) database and used it to provide an exposure assessment.

#### 4.1.2.1.1 Inhalation and Ingestion Exposure Routes Modeling Approaches

Key parameters for articles modeled in CEM 3.2 are summarized in detail in Section 2 in the *Consumer and Indoor Exposure Assessment for Dicyclohexyl Phthalate (DCHP)* (U.S. EPA, 2025c). Calculations, information and data sources, input parameters, and results are available in the *Consumer Exposure Analysis for Dicyclohexyl Phthalate (DCHP)* (U.S. EPA, 2025d). Generally, and when possible, model parameters were determined based on specific articles identified in this assessment and CEM defaults were only used where specific information was not available. A list of some of the most important input parameters in developing representative scenarios for the selected modeling tools and approaches for exposure from articles and products is included below. Of these, the chemical migration rate from articles to saliva and area mouthed are most important parameters for mouthing exposure scenarios. Duration, frequency, and amount used have been determined to be key determinants of estimated exposure concentrations according to a sensitivity analysis conducted for input parameters in CEM Version 3.2 (U.S. EPA, 2023b), as follows:

- weight fraction (articles and products);
- density (articles and products);
- duration of use (products);
- frequency of use for chronic, acute, and intermediate (products);
- product mass used (products);
- article surface area (articles);
- chemical migration rate to saliva (articles);
- area mouthed (articles); and
- use environment volume (articles and products).

Low-, medium-, and high-intensity use exposure scenarios correspond to the use of reported statistics, or single values. When different values are reported for low, medium, and high, the corresponding statistics are the reported minimum for the low-intensity use scenarios, calculated average from maximum and minimum for the medium-intensity use scenarios and reported maximum for the high-intensity use scenarios. Each input parameter listed above was parameterized according to the article-specific data found via systematic review. If article-specific data were not available, CEM default parameters were used, or an assumption based on article use descriptions by manufactures always leaning on the health protective values. For example, for all scenarios, the near-field modeling option was selected to account for a small personal breathing zone around the user during product use in which concentrations are higher, rather than employing a single well-mixed room. A near-field volume of 1 $m^3$ was selected. See Section 2.1 for weight fraction selection and Section 2.2.3 for parameterization details in the *Consumer and Indoor Dust Exposure Assessment for Dicyclohexyl Phthalate (DCHP)* (U.S. EPA, 2025c).

#### 4.1.2.1.2 Dermal Exposure Routes Modeling Approaches

The dermal dose of DCHP associated with use of both liquid products and solid articles was calculated in a spreadsheet. See the *Consumer Exposure Analysis for Dicyclohexyl Phthalate (DCHP)* (U.S. EPA, 2025d) for details. For solid articles and liquid products, EPA first estimated the aqueous permeability coefficient using CEM equations. Next, the Agency relied on U.S. EPA (2004b) that characterizes dermal uptake for aqueous organic compounds. The approach provides an upper bound of dermal absorption of DCHP and likely results in some overestimations (see Section 4.1.2.3 discussion on limitations, strengths, and confidence). For each product or article, high-, medium-, and low-exposure scenarios were developed. Values for duration of dermal contact and area of exposed skin were determined based on the reasonably expected use for each item. In addition, high, medium, and low estimates for dermal exposures using a flux-limited approach were calculated and applied in the

corresponding exposure scenario. Key parameters for the dermal model are discussed in Section 2.3 of (U.S. EPA, 2025c).

#### 4.1.2.2 Consumer Exposure Dose Results

This section summarizes the dose estimates from inhalation, ingestion, and dermal exposure to DCHP in consumer products and articles. Detailed tables of the dose results for acute, intermediate, and chronic exposures are available in *Consumer Risk Calculator for Dicyclohexyl Phthalate (DCHP)* (U.S. EPA, 2025e). Modeling dose results for acute, intermediate, and chronic exposures and data patterns are described in Section 3 in the *Consumer and Indoor Dust Exposure Assessment for Dicyclohexyl Phthalate (DCHP)* (U.S. EPA, 2025c). Generally, dermal exposures were overall highest followed by inhalation across scenarios, COUs and life stages. The range of inhalation doses for each scenario and life stage covered several orders of magnitude due to the wide range of DCHP content (weight fractions) for adhesives, wide range of article exposure durations, and various skin contact surface area options for the low, medium, and high scenarios. The dermal dose range was smaller for all scenarios driven primarily by exposure durations and frequencies.

The spread of values estimated for each product or article reflects the aggregate effects of variability and uncertainty in key modeling parameters for each item; acute dose rate for some products and articles covers a larger range than others primarily due to a wider distribution of DCHP weight fraction values and behavioral factors such as duration of use or contact time and mass of product used as described in Section 2 in (U.S. EPA, 2025c). Key differences in exposures among life stages include designation as a product user or bystander, behavioral differences such as hand to mouth contact times and time spent on the floor, and dermal contact expected from touching specific articles that may not be appropriate for some life stages.

#### 4.1.2.3 Weight of Scientific Evidence Conclusions for Consumer Exposure

Key sources of uncertainty for evaluating exposure to DCHP in consumer goods and strategies to address those uncertainties are described in detail in Section 5.1 of *Consumer and Indoor Dust Exposure Assessment for Dicyclohexyl Phthalate (DCHP)* (U.S. EPA, 2025c). Generally, designation of robust confidence suggests thorough understanding of the scientific evidence and uncertainties. The supporting weight of scientific evidence outweighs the uncertainties to the point where it is unlikely that the uncertainties could have a significant effect on the exposure estimate. The designation of moderate confidence suggests some understanding of the scientific evidence and uncertainties. More specifically, the supporting scientific evidence weighed against the uncertainties is reasonably adequate to characterize exposure estimates. The designation of slight confidence is assigned when the weight of scientific evidence may not be adequate to characterize the scenario as well as when the assessor is making the best scientific assessment possible in the absence of complete information and there are additional uncertainties that may need to be considered. Although the uncertainty for some of the scenarios and parameters ranges from moderate to robust the overall confidence to use the results for risk characterization ranges from moderate to robust, depending on COU scenario. The basis for the moderate to robust confidence in the overall exposure estimates is a balance between using parameters that will represent various populations use patterns and lean on protective assumptions that are not excessive or unreasonable.

The exposure assessment of chemicals from consumer products and articles has inherent challenges due to many sources of uncertainty in the analysis, including variations in product formulation, patterns of consumer use, frequency, duration, and application methods. Variability in environmental conditions may also alter physical or chemical behavior of the product or article. Table 4-7 summarizes the overall uncertainty per COU and provides a discussion of rationale used to assign the overall uncertainty. The

subsections ahead of the table describe sources of uncertainty for several parameters used in consumer exposure modeling that apply across COUs and provide an in depth understanding of sources of uncertainty and limitations and strengths within the analysis. The confidence to use the results for risk characterization ranges from moderate to robust (see Table 4-7).

***Product Formulation and Composition***

Variability in the formulation of consumer products—including changes in ingredients, concentrations, and chemical forms—can introduce uncertainty in exposure assessments. In addition, data were limited for weight fractions of DCHP in consumer goods. EPA obtained DCHP weight fractions in various products and articles from material safety sheets, databases, and existing literature (see Section 2.1 in the Consumer Assessment for DCHP (U.S. EPA, 2025c)). Where possible, the Agency obtained multiple values for weight fractions for similar products or articles. The lowest value was used in the low exposure scenario, the highest value in the high exposure scenario, and the average of all values in the medium exposure scenario. EPA decreased uncertainty in exposure and subsequent risk estimates in the high-, medium-, and low-intensity use scenarios by capturing the weight fraction variability and obtaining a better characterization of the products and articles varying composition within one COU. Overall weight fraction confidence is *moderate* for products/articles with one or multiple sources but insufficient description on how the concentrations were obtained. *Robust* for products/articles with one or more (preferrable) than one source with sufficient description on how the concentrations were obtained, and *slight* for articles with only one source with unconfirmed content or little understanding on how the information was produced.

***Product Use Patterns***

Consumer use patterns, such as frequency of use, duration of use, and methods of application, are expected to differ. Where possible, high, medium, and low default values from CEM 3.2's prepopulated scenarios were selected for mass of product used, duration of use, and frequency of use. In instances where no prepopulated scenario was appropriate for a specific product, low, medium, and high values for each of these parameters were estimated based on the manufacturers' product descriptions. EPA decreased uncertainty by selecting use pattern inputs that represent product and article use descriptions and furthermore capture the range of possible use patterns in the high- to low-intensity use scenarios. Exposure and risk estimates are considered representative of product use patterns and well characterized. There is *robust* overall confidence for most product use patterns.

***Article Use Patterns***

For inhalation and ingestion exposures to articles, the high-, medium-, and low-intensity use scenario default values from CEM 3.2's prepopulated scenarios were selected for indoor use environment/room volume, interzone ventilation, and surface layer thickness. For dermal exposures, article use patterns such as frequency of use and skin contact area are expected to have a range of low to high use intensities. For articles, which do not use duration of use as an input in CEM, professional judgment was used to select the duration of use/article contact duration for the low, medium, and high exposure scenario levels for most articles, except carpet tiles and vinyl flooring. Carpet tiles and vinyl flooring contact duration values were taken from EPA's Standard Operating Procedures for Residential Pesticide Exposure Assessment for the high exposure level (2 hours; time spent on floor surfaces) (U.S. EPA, 2012c). ConsExpo (U.S. EPA, 2012c) for the medium exposure level (1 hour; time a child spends crawling on treated floors), and professional judgment for the low exposure level (0.5 hour). There are more uncertainties in the assumptions and professional judgment for contact duration inputs for articles, and hence EPA has *moderate* confidence in those inputs.

***Article Surface Area***
The surface area of an article directly affects the potential for DCHP emissions to the environment. For each article modeled for inhalation exposure, low, medium, and high estimates for surface area were calculated (see Section 2 in (U.S. EPA, 2025c)). Overall, confidence in surface area is *robust* for articles because there is a good understanding of the dimensions of articles and their presence in indoor environments.

***Human Behavior***
CEM 3.2 has three different human activity patterns: stay-at-home, part-time out-of-the home (daycare, school, or work), and full-time, out-of-the-home. The activity patterns were developed based on the Consolidated Human Activity Database (CHAD). For all products and articles modeled, the stay-at-home activity pattern was selected as it is the most protective assumption.

***Inhalation and Ingestion Modeling Tool***
Confidence in the model used considers whether the model has been peer reviewed, as well as whether it is being applied in a manner appropriate to its design and objective. The model used, CEM 3.2, has been peer reviewed (ERG, 2016), is publicly available, and has been applied in the manner intended by estimating exposures associated with uses of household products and/or articles. This also considers the default values data source(s) such as building and room volumes, interzonal ventilation rates, and air exchange rates. Overall confidence in the proper use of CEM and the consumer exposure estimates results modeled is *robust*.

***Dermal Modeling for DCHP***
Experimental dermal data were identified via the systematic review process to characterize consumer dermal exposures to liquids or mixtures and formulations containing DCHP (see Section 2.3.1 in (U.S. EPA, 2025c). EPA has moderate understanding of the scientific evidence and the uncertainties. The identification of uncertainties within the dermal approach is reasonably adequate to characterize exposure estimates. The Agency has a *moderate* confidence in the dermal exposure to liquid and solid products or articles modeling approach.

A source of uncertainty regarding the dermal absorption of DCHP from products or formulations stems from the varying concentrations and co-formulants that exist in products or formulations containing DCHP. For purposes of this risk evaluation, EPA assumes that the absorptive flux of DCHP serves as an upper bound of chemical into and through the skin for dermal contact with all liquid products or formulations and solid products/articles. Dermal contact with products or formulations that have lower concentrations of DCHP might exhibit lower rates of flux since there is less material available for absorption. Conversely, co-formulants or materials within the products or formulations may lead to enhanced dermal absorption, even at lower concentrations. Therefore, it is uncertain whether the products or formulations containing DCHP would result in decreased or increased dermal absorption. Based on the available dermal absorption data for DCHP, EPA has made assumptions that result in exposure assessments that are the most human health protective in nature.

Lastly, EPA notes that there is uncertainty with respect to the modeling of dermal absorption of DCHP from solid matrices or articles and liquid products and formulations. Because there were no available data related to the dermal absorption of DCHP from solid matrices or articles and liquid products, EPA has assumed that dermal absorption of DCHP from solid objects would be limited by aqueous solubility of DCHP. Therefore, to determine the maximum steady-state aqueous flux of DCHP, EPA utilized CEM (U.S. EPA, 2023b) to first estimate the steady-state aqueous permeability coefficient of DCHP. The estimation of the steady-state aqueous permeability coefficient within CEM (U.S. EPA, 2023b) is based

on a quantitative structure-activity relationship (QSAR) model presented by ten Berge (2009), which considers chemicals with log $K_{OW}$ ranging from −3.70 to 5.49 and molecular weights ranging from 18 to 584.6. The molecular weight of DCHP falls within the range suggested by ten Berge (2009), as does the log $K_{OW}$ of DCHP. Therefore, there is a low to medium (due to assumptions used in migration of DCHP from solid to aqueous media) uncertainty regarding the accuracy of the QSAR model used to predict the steady-state aqueous permeability coefficient for DCHP.

**Table 4-7. Weight of Scientific Evidence Summary per Consumer Condition of Use**

| Consumer COU Category and Subcategory | Weight of Scientific Evidence | Overall Confidence |
|---|---|---|
| Adhesives and sealants | Two different scenarios were assessed under this COU for products with differing use patterns for which each scenario had a varying number of identified product examples (in parentheses): adhesives for small repairs (2) and automotive adhesives (3). The 2 scenarios and the products within capture the variability in product formulation and are represented in the high-, medium-, and low-intensity use estimates. The overall confidence in this COU inhalation exposure estimate is robust because the CEM default parameters represent actual use patterns and location of use.<br><br>For dermal exposure EPA used a dermal flux approach; moderate confidence was selected for this approach because uncertainty in the partitioning from product to skin and subsequent dermal absorption is not well characterized or confirmed with experimental results. However, other parameters like frequency and duration of use, and surface area in contact are well understood and representative, making the overall confidence in a health protective estimate moderate. | Inhalation – Robust<br><br>Dermal – Moderate |
| Other articles with routine direct contact during normal use including rubber articles; plastic articles (hard) | One scenario was assessed under this COU. The scenario considered multiple articles and routine dermal contact with similar use patterns. The scenario for small articles of routine dermal contact was assessed for dermal exposures only because inhalation and ingestion would have low exposure potential due to the small surface area of the articles. The articles with routine contact scenario considered multiple input parameters used in the high-, medium-, and low-intensity use scenarios.<br><br>The dermal absorption estimate assumes that dermal absorption of DCHP from solid objects would be limited by the aqueous solubility of DCHP. EPA has moderate confidence in the aspects of the exposure estimate for solid articles because of the uncertainty in the assumption of partitioning from solid to liquid, and because subsequent dermal absorption is not well characterized. However, other parameters, such as frequency and duration of use as well as surface area in contact, are well understood and representative, resulting in an overall confidence of moderate in a health protective estimate. | Dermal – Moderate |
| Other; Other consumer articles that contain dicyclohexyl phthalate from: inks, toner, and colorants; paints and coatings; adhesives and sealants (*e.g.*, paper products, textiles, products using cellulose film, etc.) | Two different scenarios were assessed under this COU for articles with differing use patterns. The scenarios of outdoor seating (single article in use), and small articles with potential for routine contact (multiple articles) were evaluated. These two scenarios were assessed for dermal exposures. Dermal absorption estimates assumed that dermal absorption of DCHP from solid objects would be limited by the aqueous solubility of DCHP. EPA has moderate confidence in the aspects of the exposure estimate for solid articles because of the uncertainty in the assumption of partitioning from solid to liquid, and because subsequent dermal absorption is not well characterized. However, other parameters such as frequency and duration of use, and surface area in contact, are well understood and representative, resulting in an overall confidence of moderate in a health protective estimate. | Dermal – Moderate |

### 4.1.3 General Population Exposures to Environmental Releases

General population exposures occur when DCHP is released into the environment and the environmental media becomes a pathway for exposure. As described in the *Environmental Release and Occupational Exposure Assessment for Dicyclohexyl Phthalate (DCHP)* (U.S. EPA, 2025s), releases of DCHP are expected in air, water, and disposal to landfills. Figure 4-2 provides a graphic representation of where and in which media DCHP is estimated to be found due to environmental releases and the corresponding route of exposure for the general population.

EPA began its DCHP exposure assessment using a screening level approach that relies on conservative assumptions. Conservative assumptions, including default input parameters for modeling environmental media concentrations, help to characterize exposure resulting from the upper end of the expected distribution. Because EPA did not identify facility-reported releases in databases typically relied upon to inform the release assessment for DCHP, this exposure assessment relies upon EPAiestimated releases that do not include actual location data for DCHP releases. Details on the use of screening level analyses in exposure assessment can be found in EPA's *Guidelines for Human Exposure Assessment* (U.S. EPA, 2019b).

EPA evaluated the reasonably available information for releases of DCHP from facilities that use, manufacture, or process DCHP under industrial and/or commercial COUs detailed in the *Environmental Release and Occupational Exposure Assessment for Dicyclohexyl Phthalate (DCHP)* (U.S. EPA, 2025s). As described in Section 3.3, using the release estimates, EPA modeled predicted concentrations of DCHP in surface water, sediment, drinking water, and ambient air in the United States. Table 3-7 summarizes the high-end DCHP concentrations in environmental media from environmental releases. The reason for assessing different pathways qualitatively or quantitatively is discussed briefly in Section 3.3 and additional detail can be found in *Environmental Media, General Population, and Environmental Exposure Assessment for Dicyclohexyl Phthalate (DCHP)* (U.S. EPA, 2025p).

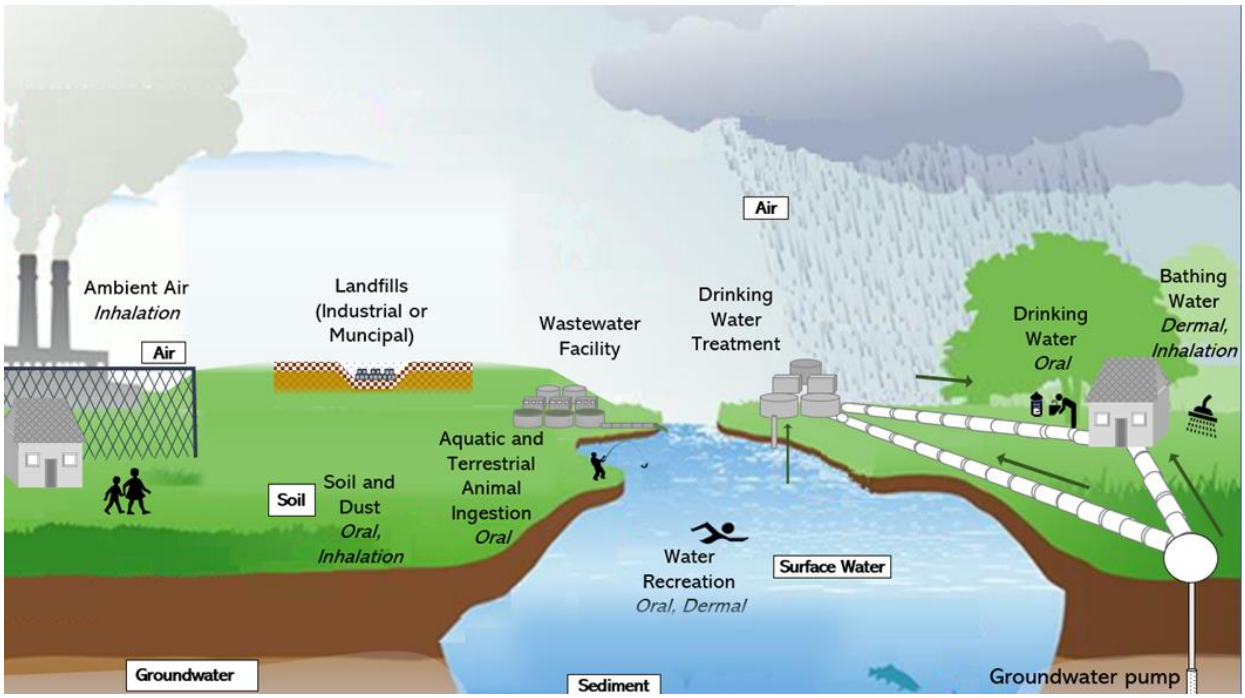


**Figure 4-2. Potential Human Exposure Pathways to DCHP Environmental Releases for the General Population**

Potential routes of exposure are shown in italics under each potential pathway of exposure.

High-end estimates of DCHP concentration in the various environmental media presented in Table 3-7 and in the *Environmental Media, General Population, and Environmental Exposure Assessment for Dicyclohexyl Phthalate (DCHP)* (U.S. EPA, 2025p) were used for screening level purposes in the general population exposure assessment. EPA's *Guidelines for Human Exposure Assessment* (U.S. EPA, 2019b) defines high-end exposure estimates as a "plausible estimate of individual exposure for those individuals at the upper end of an exposure distribution, the intent of which is to convey an estimate of exposure in the upper range of the distribution while avoiding estimates that are beyond the true distribution." If risk is not found for these individuals with high-end exposure, no risk is anticipated for central tendency exposures, which is defined as "an estimate of individuals in the middle of the distribution." Therefore, if EPA found no risk for an individual identified as having the potential for the highest exposure associated with a COU for a given pathway of exposure, then that pathway was determined not to be a pathway of concern and not pursued further. If any pathways were identified as a pathway of concern for the general population, further exposure assessments for that pathway would be conducted to include higher tiers of modeling when available, refinement of exposure estimates, and exposure estimates for additional subpopulations and OES/COUs.

Identifying individuals at the upper end of an exposure distribution included consideration of high-end exposure scenarios defined as those associated with the industrial and commercial releases from a COU and OES that resulted in the highest environmental media concentrations. As described in Section 3.3, EPA focused on estimating high-end concentrations of DCHP from the largest estimated releases for the purpose of its screening level assessment for environmental and general population exposures. This means that the Agency considered the environmental concentration of DCHP in a given environmental medium resulting from the OES that had the highest release compared to any other OES for the same releasing media. Release estimates from OES resulting in lower environmental media concentrations were not considered for this screening level assessment. Additionally, individuals with the greatest intake rate of DCHP per body weight were considered to be those at the upper end of the exposure.

Table 4-8 summarizes the high-end exposure scenarios that were considered in the screening level analysis, including the life stage assessed as the most potentially exposed population based on intake rate and body weight. Table 4-8 also indicates which pathways were evaluated quantitatively or qualitatively. Exposure was assessed quantitatively only when environmental media concentrations were quantified for the appropriate exposure scenario. For example, exposure from groundwater resulting from DCHP release to the environment via biosolids or landfills was not quantitatively assessed because environmental releases from biosolids and landfills were not quantified. Due to the high confidence in the biodegradation rates and physical and chemical data, there is robust confidence that DCHP in soils will not be mobile and will have low persistence potential. There is robust confidence that DCHP is unlikely to be present in landfill leachates. However, exposure was still assessed qualitatively for exposures potentially resulting from biosolids and landfills. Further details on the screening level approach and exposure scenarios evaluated by EPA for the general population are provided in the *Environmental Media, General Population, and Environmental Exposure Assessment for Dicyclohexyl Phthalate (DCHP)* (U.S. EPA, 2025p). Selected OESs represent those resulting in the highest modeled environmental media concentrations for the purpose of a screening level analysis. A crosswalk between OESs and COUs is presented in Section 3.1.1.1.

**Table 4-8. Exposure Scenarios Assessed in General Population Screening Level Analysis**

| OES | Exposure Pathway | Exposure Route | Exposure Scenario | Life Stage | Analysis (Quantitative or Qualitative) [a] |
|---|---|---|---|---|---|
| All | Biosolids | No specific exposure scenarios were assessed for qualitative assessments | | | Qualitative |
| All | Landfills | No specific exposure scenarios were assessed for qualitative assessments | | | Qualitative |
| Application of paints and coatings; PVC plastics compounding | Surface Water | Dermal | Dermal exposure to DCHP in surface water during swimming | Adults, youths, and children | Quantitative |
| | | Oral | Incidental ingestion of DCHP in surface water during swimming | Adults, youths, and children | Quantitative |
| Application of paints and coatings; PVC plastics compounding | Drinking Water | Oral | Ingestion of drinking water sourced from surface water | Adults, youths, and children | Quantitative |
| Application of paints and coatings; PVC plastics compounding | Fish Ingestion | Oral | Ingestion of fish for General Population | Adults and children | Quantitative |
| | | | Ingestion of fish for subsistence fishers | Adult | Quantitative |
| | | | Ingestion of fish for Tribal populations | Adult | Quantitative |
| Application of paints and coatings-no engineering controls | Ambient Air | Inhalation | Inhalation of DCHP in ambient air resulting from industrial releases | All | Quantitative |

EPA also considered urinary biomonitoring data, from CDC's NHANES (see Section 11 of EPA's *Environmental Media, General Population, and Environmental Exposure Assessment for Dicyclohexyl Phthalate (DCHP)* (U.S. EPA, 2025p)). The Agency analyzed urinary data for MCHP (mono-cyclohexyl phthalate, a metabolite of DCHP) measured in the 1999 to 2010 NHANES cycle. Low detection rates and limited variability in data precluded any meaningful statistical analyses. CDC stopped collecting urinary data for MCHP after 2010. Furthermore, EPA's systematic review process did not identify any suitable alternative sources of DCHP biomonitoring data fit for use in this risk evaluation Those studies were not considered because they used NHANES data, had very low (<30%) detection levels, evaluated very specific study populations (*e.g.,* a cohort examining specific health concerns), or were not measured in the United States. Given the lack of recent urinary biomonitoring data, EPA did not conduct reverse dosimetry to calculate daily intake values for DCHP.

#### 4.1.3.1 General Population Screening Level Exposure Assessment Results

***Land Pathway***

EPA evaluated general population exposures via the land pathway (*i.e.,* application of biosolids, landfills) qualitatively. Due to low water solubility (1.48 mg/L) and affinity for sorption to soil and organic constituents in soil (log $K_{OC}$ = 4.47), DCHP is unlikely to migrate to groundwater via runoff after land application of biosolids. Additionally, the half-life of 8.1 to 13.8 days in aerobic soils (U.S. EPA, 2025ac) indicates that DCHP will have low persistence potential in the aerobic environments associated with freshly applied biosolids. Because the physical and chemical properties of DCHP indicate that it is unlikely to migrate from land-applied biosolids to groundwater via runoff, EPA did not model groundwater concentrations resulting from land application of biosolids.

Although there are no measured data on DCHP in landfill leachates, the potential to leach from landfills into nearby groundwater or surface water systems is limited. Interpretation of the high-quality physical and chemical property data indicates that DCHP is expected to have a high affinity to particulate (log $K_{OC}$ = 4.47) and organic media (log $K_{OW}$ = 4.82). This will cause significant retardation in groundwater and limit leaching to groundwater. Because of its high hydrophobicity and high affinity for soil sorption, it is unlikely that DCHP will migrate from landfills via groundwater infiltration or surface runoff. Therefore, EPA concludes that further assessment of DCHP in landfill leachate is not needed.

***Surface Water Pathway – Incidental Ingestion and Dermal Contact from Swimming***

EPA conducted modeling of releases to surface water at the point of release (*i.e.*, in the immediate water body receiving the effluent) to estimate the resulting environmental media concentrations from TSCA COUs. EPA conducted modeling with the U.S. EPA's Variable Volume Water Model with Point Source Calculator tool (VVWM-PSC) to estimate concentrations of DCHP within surface water and to estimate settled sediment in the benthic region of streams. Releases associated with the Application of paints and coatings OES resulted in the highest total water column concentrations, with 30Q5 water concentrations of 19,990 µg/L without wastewater treatment and 6,277 µg/L when run under an assumption of 71.2 percent wastewater treatment removal efficiency (Table 4-9). Both treated and untreated scenarios were assessed due to uncertainty about the prevalence of wastewater treatment from discharging facilities and to demonstrate the hypothetical disparity in exposures between treated and untreated effluent in the generic release scenarios. COUs mapped to this OES are shown in Table 3-1. Although there is some uncertainty about the portion of the release estimate within the OES that may reasonably be expected to be discharged to surface water, it is presented as a high-end screening analysis for general population exposure.

As discussed in Section 3.3.1.1, there is slight confidence in the surface water concentrations estimated for the Application of paints and coatings OES. EPA assessed the PVC plastics compounding OES that had water only releases, which in turn led to greater confidence in the surface water concentration estimates. In addition to these modeled concentrations, the monitored concentrations from NWQMC (2021) were included for comparison. The monitored water column concentration are roughly four to six orders of magnitude less than the high-end modeled counterparts. These water column concentrations were used to estimate the ADR from dermal exposure and incidental ingestion of DCHP while swimming for adults (2+ years), youths (11–15 years), and children (6–10 years). Detailed results for all exposures can be found in *Environmental Media, General Population, and Environmental Exposure Assessment for Dicyclohexyl Phthalate (DCHP)* (U.S. EPA, 2025p). In this section, exposure scenarios leading to the highest modeled dose for the various OESs using the modeled water column concentrations are shown in Table 4-9.

Using the total acute dose based on the highest modeled 95th percentile, the MOEs exceed the benchmark of 30 for all scenarios associated with the PVC plastics compounding OES. For Application of paints and coatings OES, scenarios where the modeled releases are paired with the median and 75th percentile flow are below the benchmark of 30. However, EPA had slight confidence in the exposure estimates for the Application of paints and coatings OES because releases were modeled as discharging to multiple environment media where there is insufficient information to determine the fraction going to each of the media types. Additionally, surface water concentrations for Application of paints and coatings estimated using P50 and P75 flow exceeded the high-end of the range of the water solubility (1.48 mg/L) reported in *Physical Chemistry and Fate and Transport Assessment for Dicyclohexyl Phthalate* (U.S. EPA, 2025ac) by 100 to 1,000 percent, which is an unlikely scenario. Surface water concentrations estimated using P50 flow for the PVC plastics compound OES exceeded the low-end range of the water solubility (0.03 mg/L). All modeled surface water concentrations exceeded the

highest monitored value of 14 ng/L. Based on the conservative modeling parameters for surface water concentration and exposure factors parameters, risk for non-cancer health effects for incidental ingestion through swimming is not expected.

***Surface Water Pathway – Drinking Water***

For the drinking water pathway, EPA used modeled surface water concentrations to estimate drinking water exposures. As described in Section 2, because of its high hydrophobicity and high affinity for soil sorption, it is unlikely that DCHP will migrate from landfills via groundwater infiltration. Therefore, exposure in this assessment is focused on drinking water sourced from surface water. Similar to the assessment of incidental ingestion and dermal contact from swimming described above, for screening level purposes, EPA assessed the Application of paints and coatings OES and PVC plastics compounding OES COUs mapped to these OES are shown in Table 3-1. Because of relevance to the exposure route, acute drinking water exposures were derived from the 30Q5 flow concentrations, whereas chronic drinking water exposures were derived from the harmonic mean flow concentrations. As described above and in Section 3.3, surface water concentrations modeled using releases associated with the Application of paints and coatings OES represent an upper bound based on many conservative assumptions—including all of the estimated total release going to surface water, high releases paired with low flow assumptions (P50), and no treatment of wastewater before release to the environment.

ADR and ADD values from drinking water exposure to DBP were calculated for various age groups but the most exposed life stage, infants (birth to <1 year), is shown below. Detailed results for all exposures can be found in *Environmental Media, General Population, and Environmental Exposure Assessment for Dicyclohexyl Phthalate (DCHP)* (U.S. EPA, 2025p). Exposure scenarios leading to the highest modeled dose are shown in Table 4-9; note that acute doses are presented as they are greater than chronic doses.

For the purpose of a screening level assessment, EPA used an MOE approach using high-end exposure estimates to determine if exposure pathways were pathways of concern for potential non-cancer risks. Using the total acute dose based on the highest modeled 95th percentile, the MOEs are greater than the benchmark of 30 for all scenarios associated with PVC plastics compounding OES. For Application of paints and coatings OES, only scenarios where the modeled releases are paired with the lower flow (P50) are below the benchmark of 30. EPA had slight confidence in the exposure estimates for the Application of paints and coatings OES because releases were modeled as discharging to multiple environment media where there is insufficient information to determine the fraction going to each of the media types. EPA had greater confidence in the surface water concentrations associated with PVC plastics compounding OES.

This assessment assumed that concentrations at the point of intake for the drinking water system are equal to the concentrations in the receiving water body at the point of release, where treated effluent is being discharged from a facility. In reality, some distance between the point of release and a drinking water intake would be expected, providing space and time for additional reductions in water column concentrations via degradation, partitioning, and dilution. Some form of additional treatment would typically be expected for surface water at a drinking water treatment plant, including coagulation, flocculation, and sedimentation, and/or filtration. This treatment would likely result in even greater reductions in DCHP concentrations prior to releasing finished drinking water to customers. Based on the conservative modeling parameters for drinking water concentration and exposure factor parameters, risk for non-cancer health effects for drinking water ingestion is not expected for any OES and corresponding COU.

**Table 4-9. Summary of the Highest Doses in the General Population through Surface and Drinking Water Exposure**

| OES [a] | Water Column Concentrations | Incidental Dermal Surface Water [b] | | Incidental Ingestion [c] | | Drinking Water [d] | |
|---|---|---|---|---|---|---|---|
| | 30Q5 Conc. (µg/L) | $ADR_{POT}$ (mg/kg-day) | Acute MOE (Benchmark MOE = 30) | $ADR_{POT}$ (mg/kg-day) | Acute MOE (Benchmark MOE = 30) | $ADR_{POT}$ (mg/kg-day) | Acute MOE (Benchmark MOE = 30) |
| Application of paints and coatings (P50) *without wastewater treatment* | 19,990 [f] | 1.07E−01 | 22 | 1.75E−01 | 14 | 2.82E00 | 1 |
| Application of paints and coatings (P50) w*ith wastewater treatment* | 5,757 [f] | Not assessed | Not assessed | Not assessed | Not assessed | 8.13E−01 | 3 |
| Application of paints and coating (P75) w*ithout wastewater treatment* | 3,030 [f] | 1.62E−02 | 148 | 2.66E−02 | 90 | 4.28E−01 | 6 |
| Plastic compounding (P50) *without wastewater treatment* | 204 | 1.09E−03 | 2,198 | 1.79E−03 | 1,341 | 2.88E−02 | 83 |
| Highest monitored surface water [e] | 0.014 | 7.49E−08 | 32,000,000 | 1.23E−07 | 20,000,000 | 1.98E−06 | 1,200,000 |

ADR = acute dose rate; MOE = margin of exposure; OES = occupational exposure scenario; 30Q5 = 30 consecutive days of lowest flow (on average) over a 5-year period
[a] Table 3-1 provides a crosswalk of industrial and commercial COUs to OESs.
[b] Most exposed age group: Adults (21+ years)
[c] Most exposed age group: Youth (11–15 years)
[d] Most exposed age group: Infant (birth to <1 year)
[e] Keil et al. (2011) reported the highest monitored surface water concentration. This is a single maximum value from the study and does not correspond to either the 30Q5 or harmonic mean concentrations. However, it was used in both instances to compare exposure estimates based on modeled and monitored surface water concentrations.
[f] Exceeds the water solubility range reported in the *Physical Chemistry and Fate and Transport Assessment for Dicyclohexyl Phthalate (DCHP)* (U.S. EPA, 2025ac) of 0.030–1.48 mg/L

### *Fish Ingestion*

The key parameters to estimate human exposure to DCHP via fish ingestion are the surface water concentration, bioaccumulation factor (BAF), and fish ingestion rate. Surface water concentrations for DCHP associated with a particular COU were modeled using VVWM-PSC as described in Section 3.3.1.1. The harmonic mean flow and resulting estimated concentrations in surface water and fish tissue were applied to calculate exposure via fish ingestion because the harmonic mean flow is considered representative of long-term DCHP concentrations that would enter fish tissue over time. The details on the BAF, which considers the animal's uptake of a chemical from both diet and the water column, can be found in Section 8 of the *Environmental Media, General Population, and Environmental Exposure Assessment for Dicyclohexyl Phthalate (DCHP)* (U.S. EPA, 2025p).

EPA evaluated exposure to DCHP through fish ingestion for populations and age groups that had the highest fish ingestion rate per kg of body weight—including for adults and young toddlers in the general population, adult subsistence fishers, and adult Tribal populations. Children were not considered for reasons explained Section 7 of the *Environmental Media, General Population, and Environmental*

*Exposure Assessment for Dicyclohexyl Phthalate (DCHP)* (U.S. EPA, 2025p). Only the fish ingestion rate changes for across the different populations; the surface water concentration and BAF remain the same. ADR and ADD values from fish ingestion exposure to DCHP were calculated for various populations and age groups and can be found in *Environmental Media, General Population, and Environmental Exposure Assessment for Dicyclohexyl Phthalate (DCHP)* (U.S. EPA, 2025p)

For the screening level analysis, EPA used DCHP's range of water solubility and modeled surface water concentrations from two OESs to estimate DCHP concentrations in fish tissue. These were Application of paints and coatings and Plastics compounding where environmental releases are estimated for multiple media types and for water only, respectively. Both OESs had the highest modeled surface water concentrations. Table 4-10 shows only results for the tribal populations as they represent the highest exposure because of their elevated fish ingestion rates compared to the general population and subsistence fisher population. Tribal population exposures were estimated based on current mean (U.S. EPA, 2011a) and current 95th percentile (Polissar et al., 2016) fish ingestion rate. Current ingestion rate refers to the present-day consumption levels that are suppressed by contamination, degradation, or loss of access. Heritage rates existed prior to non-indigenous settlement on tribal fishers' resources and changes to culture and lifeways. Therefore, current ingestion rates are considered more representative of contemporary rates of fish consumption and are presented below. Heritage rates are discussed in further detail in *Environmental Media, General Population, and Environmental Exposure Assessment for Dicyclohexyl Phthalate (DCHP)* (U.S. EPA, 2025p).

OESs releasing to multiple media types, including Application of paints and coatings, had high uncertainties associated with the modeled surface water concentrations when considering (1) the use of generic scenarios to estimate releases, (2) pairing with unknown receiving water body flows, and (3) the lack of data to apportion releases to specific media types. The modeled surface water concentrations based on the Application of paints and coatings also exceeded the water solubility limit by up to three orders of magnitude. These reasons led to slight confidence in the surface water concentrations and subsequent exposure and risk estimates associated with Application of paints and coatings. Therefore, exposure and risk estimates for the multimedia OESs were not used to characterize risks from fish ingestion.

For Plastics compounding, risk estimates are below the benchmark (MOE 17) at only the P50 flow rate and 95th percentile tribal ingestion rate. EPA does not consider the exposure estimates used to derive the risk estimate as a realistic scenario, though. The scenario compounds multiple conservative assumptions, most notably the use of a high-end, 95th percentile release volume occuring to water bodies with low flow rates (*i.e.,* P50). This scenario also assumes that fish are exposed at the outfall of the release at these sustained high concentrations with no assumptions of dilution. The water concentrations used for the P50 flow rate scenario also exceeds the lower bound of the water solubility limit by an order of magnitude. At the central tendency release and same P50 flow for the receiving water body, estimated water concentrations (0.04 ug/L) are only slightly higher than the lower bound of the water solubility limit of 0.03 mg/L, and risk estimates are above the benchmark (MOE 80). Moreover, DCHP has not been readily measured or monitored in aquatic organisms and has low potential for bioaccumulation, biomagnification, and uptake based on a bioconcentration factor (BCF) of 708 and a BAF of 67 L/kg (U.S. EPA, 2025ac). For these reasons, EPA has only slight confidence in the risk estimates for the Plastics compounding OES at the P50 flow rate and 95th percentile ingestion rate for tribal populations. Plastics compounding, which resulted in the highest modeled surface water concentration among all OESs with water-specific releases, did not result in risk estimates below benchmark where confidence is greater than slight for surface water concentrations that are do not exceed water solubility. EPA

therefore concludes that fish ingestion is not expected to be a pathway of concern for tribal populations for all OESs with water-only releases.

**Table 4-10. Fish Ingestion for Adults in Tribal Populations Summary**

| Calculation Method | Current Mean Ingestion Rate (Benchmark MOE = 30) | | Current 95th Percentile Ingestion Rate (Benchmark MOE = 30) | |
|---|---|---|---|---|
| | ADR/ADD (mg/kg-day) | Acute/Chronic MOE[a] | ADR/ADD (mg/kg-day) | Acute/Chronic MOE[a] |
| Water solubility limit<br>1.48 and 0.03 mg/L for upper and lower bound | 9 (upper)<br>442 (lower) | 2.68E–01 (upper)<br>5.43E–03 (lower) | 2 (upper)<br>110 (lower) | 1.08 (upper)<br>2.19E–02 (lower) |
| Plastics compounding (generic scenario for water-only release, HE, without wastewater treatment)<br>1.97E02, 3.85E01, 3.45E–01 mg/L for P50, P75, P90 flow | 67 (P50 flow)<br>345 (P75 flow)<br>38,455 (P90 flow) | 3.56E–02 (P50 flow)<br>6.96E–03 (P75 flow)<br>6.24E–05 (P90 flow) | 17 (P50 flow)<br>85 (P75 flow)<br>9,526 (P90 flow) | 1.44E–01 (P50 flow)<br>2.81E–02 (P75 flow)<br>2.52E–04 (P90 flow) |
| Plastics compounding (generic scenario for water-only release, CT, without wastewater treatment)<br>4.10E01 for P50 flow | 324 | 7.40E–03 | 80 | 2.99E–02 |
| Application of paints and coatings (generic scenario for multimedia releases, HE, without wastewater treatment)<br>1.16E04, 1.82E03, 7.10E01 mg/L for P50, P75, P90 flow | 1 (P50 flow)<br>7 (P75 flow)<br>188 (P90 flow) | 2.10 (P50 flow)<br>3.29E–01 (P75 flow)<br>1.28E–02 (P90 flow) | 0 (P50 flow)<br>2 (P75 flow)<br>47 (P90 flow) | 8.47 (P50 flow)<br>1.33 (P75 flow)<br>5.15E–02 (P90 flow) |

ADR = acute dose rate; ADD = average daily dose; MOE = margin of exposure
[a] Acute and chronic MOEs are identical because the exposure estimates and point of departure (POD) do not change between acute and chronic.

***Ambient Air Pathway***

The ambient air exposure assessment utilized a previously peer-reviewed screening level analysis to evaluate exposures to the general population in close proximity to releasing facilities, including fenceline communities. The approach used is described in EPA's *Draft TSCA Screening Level Approach for Assessing Ambient Air and Water Exposures to Fenceline Communities (Version 1.0)* (U.S. EPA, 2022b).

EPA used the Integrated Indoor/Outdoor Air Calculator (IIOAC) Model to estimate the high-end (95th percentile) and mean (50th percentile) daily average concentration across the modeled distribution of DCHP concentrations in ambient air to assess general population exposures at three distances from the release point (100, 100–1,000, and 1,000 m). The daily average concentration is the average of 24 consecutive hourly modeled concentrations within each day modeled in IIOAC across 5 years of meteorological data modeled within IIOAC as described in the IIOAC users guide (U.S. EPA, 2019f). The annual average is a rolling 365-day average of all daily average concentrations across 5 years of meteorological data modeled within IIOAC. EPA also modeled the high-end (95th percentile) and mean rolling annual average wet, dry, and total deposition rates of DCHP from the ambient air at three distances from the releasing facility (*i.e.*, 100, 100–1,000, and 1,000 m).

The Agency used the highest EPA-estimated daily releases (fugitive and stack) across all COUs from the *Environmental Media, General Population, and Environmental Exposure Assessment for*

*Dicyclohexyl Phthalate (DCHP)* (U.S. EPA, 2025p) as direct inputs to the IIOAC Model to estimate concentrations and deposition rates. The highest daily estimated releases were used to represent a high-end release value for acute, short-term exposures and risk estimates. EPA used the maximum 95th percentile modeled concentrations and deposition rates across a series of exposure scenarios modeled within IIOAC, considering particle size, operating scenario, and urban/rural topography, to characterize exposures and derive risk estimates. The 95th percentile values were used to capture the high-end exposure scenario to better represent a peak concentration rather than a central tendency average concentration for acute exposures.

Calculations for general population exposure to ambient air via inhalation and ingestion from air to soil deposition for life stages expected to be highly exposed based on exposure factors can be found in the *Ambient Air Exposure Assessment for Dicyclohexyl Phthalate (DCHP)* (U.S. EPA, 2025a). Inhalation exposure to DCHP from ambient air is expected to be much higher than exposure to DCHP via soil ingestion resulting from air to soil deposition and is therefore presented below for the screening level analysis.

The maximum EPA-estimated daily fugitive and stack release of DCHP was 46.8 kg/site-day. This value was categorized under the Use of paints and coatings – no engineering controls OES with an unknown media of release (could be releases to air, land, water, or incineration, or any combination and could be either fugitive, stack, or any combination). Because the release type is unknown, under the methodology used, EPA assumed the entire release was either all fugitive or all stack releases for this assessment and separately models the entire release as each type. The Agency recognizes taking this either/or approach to release type means the modeled concentrations are not additive (as they cannot occur at the same time). However, for this screening level assessment, the Agency assumes the releases occurred at the same time to determine an upper bound "total exposure" to DCHP attributable to both fugitive and stack releases. Although this captures the highest release of each type possible, it may overestimate total exposure of the general population to DCHP.

The highest 95th percentile modeled daily average concentration used to derive acute non-cancer risk estimates for fugitive releases was 86.24 µg/m$^3$ and for stack releases was 4.00 µg/m$^3$. These concentrations occurred at 100 m from the releasing facility and together result in a total exposure concentration from facility releases of 90.25 µg/m$^3$.

The highest 95th percentile modeled annual average concentration used to derive chronic risk estimates for fugitive releases was 83.87 µg/m$^3$ and for stack releases was 3.42 µg/m$^3$. These concentrations occurred at 100 m from the releasing facility and together result in a total exposure from facility releases of 87.29 µg/m$^3$.

Table 4-11 summarizes the total exposures and the associated risk estimates (MOEs) calculated using the inhalation human equivalent concentration (HEC) described in Section 4.2.2. The HEC is derived in the *Non-Cancer Human Health Hazard Assessment for Dicyclohexyl Phthalate (DCHP) (*U.S. EPA, 2025x*)* and based on an 80 kg adult. Based on the 95th percentile air concentrations, MOEs for general population exposure through inhalation of ambient air are 144 for acute and 149 for chronic (compared to a benchmark of 30) for an adult. Because the HEC was derived for adults, MOEs for other life stages were not calculated. However, considering similar or smaller inhalation rates for younger life stages and greatest body weight difference of a factor of 16.7 between an adult (80 kg) and newborn (4.8 kg) based on EPA's *Exposure Factors Handbook: 2011 Edition* (U.S. EPA, 2011b), MOEs for all life stages will still exceed the benchmark based on the estimates for adults.

The risk estimates described in the preceding paragraph are derived from a highly conservative exposure scenario where such exposures to both fugitive and stack releases cannot physically occur at the same time based on assumptions made around the releases and total exposure. Even under this highly conservative exposure scenario, the derived risk estimates are well above relative benchmarks for non-cancer health effects. Therefore, EPA concludes exposure to DCHP via the ambient air pathway, inhalation route is not a concern for the general population for the Use of paints and coatings – no engineering controls OES. Because MOEs were not below the benchmark for the Use of paints and coatings – no engineering controls OES, which resulted in the highest exposure scenario, no other OESs and their corresponding COUs (Table 3-1) are expected to result in risk estimates below the benchmark. These risk estimates are derived from a highly conservative exposure scenario where such exposures to both fugitive and stack releases cannot physically occur at the same time based on assumptions made around releases. Even under this highly conservative exposure scenario, the derived risk estimates are well above relative benchmarks for non-cancer health effects (greater than an order of magnitude). Thus, EPA concludes exposure to DCHP via the inhalation of ambient air is not a concern for the general population.

**Table 4-11. General Population Ambient Air Exposure Summary**

| OES [a] | Acute (Daily Average) [b] | | Chronic (Annual Average) [b] | |
|---|---|---|---|---|
| | Air Concentration [c] (µg/m$^3$) | MOE | Air Concentration [c] (µg/m$^3$) | MOE |
| Use of paints and coatings – no engineering controls | 90.25 | 144 | 87.29 | 149 |

OES = occupational exposure scenario; MOE = margin of exposure
[a] Table 3-1 provides a crosswalk of industrial and commercial COUs to OESs.
[b] EPA assumes the general population is continuously exposed (*i.e.*, 24 hours per day, 365 days per year) to outdoor ambient air concentrations.
[c] Air concentrations are reported for the high-end (95th percentile) modeled value at 100 m from the emitting facility and stack plus fugitive releases combined.

Based on the 95th percentile total annual particle deposition rate for DCHP, the MOE for the Oral human equivalent dose (HED) is 7,176,670. Again, even under this highly conservative exposure scenario, the derived risk estimate is five orders of magnitude greater than the benchmark MOE of 30. Therefore, EPA concludes that soil ingestion resulting from air to soil deposition is not a pathway of concern for the general population

#### 4.1.3.2 Overall Confidence in General Population Screening Level Exposure Assessment

The weight of scientific evidence supporting the general population exposure to environmental releases estimate is decided based on the strengths, limitations, and uncertainties associated with the exposure estimates, which are discussed in detail for ambient air, surface water, drinking water, and fish ingestion in the *Environmental Media, General Population, and Environmental Exposure Assessment for Dicyclohexyl Phthalate (DCHP)* (U.S. EPA, 2025p). EPA summarized its weight of scientific evidence using confidence descriptors: robust, moderate, slight, or indeterminate. The Agency used general considerations (*i.e.*, relevance, data quality, representativeness, consistency, variability, uncertainties) as well as chemical-specific considerations for its weight of scientific evidence conclusions.

EPA determined robust confidence through its qualitative assessment of biosolids and landfills that general population exposure is not expected based on the high-quality biodegradation rates and physical and chemical properties suggesting that DCHP will have limited persistence potential and mobility in soils receiving biosolids and is unlikely to be present in landfill leachates and migrate through

groundwater. For its quantitative assessment, the Agency modeled exposure due to various general population and environmental release exposure scenarios resulting from different pathways of exposure. Exposure assessments used high-end inputs for the purpose of risk screening to provide upper-bound exposure estimates and associated risks. When available, monitoring data were compared to modeled estimates to evaluate overlap, magnitude, and trends in the *Environmental Media, General Population, and Environmental Exposure Assessment for Dicyclohexyl Phthalate (DCHP)* (U.S. EPA, 2025p). The Agency has robust confidence that EPA-estimated releases and exposure scenarios used are appropriately conservative for a screening level analysis. Therefore, the Agency has robust confidence that no exposure scenarios will lead to greater doses than presented in this risk evaluation. Furthermore, many of the acute dose rates or average daily doses from a single exposure scenario exceed the total daily intake values estimated in Section 4.1.3.1 using NHANES data—adding further confidence that the exposure estimates capture high-end exposure scenarios and are appropriately conservative. Despite moderate confidence in the estimated values themselves, confidence in exposure estimates capturing upper-bound exposure scenarios was robust given the conservative assumptions used for the estimates.

### 4.1.4 Human Milk Exposures

Infants are a potentially susceptible subpopulation because of their higher exposure per body weight, immature metabolic systems, and the potential for chemical toxicants to disrupt sensitive developmental processes—among other reasons. Reasonably available information from studies of experimental animal models also indicates that DCHP is a developmental toxicant (U.S. EPA, 2025x). EPA considered exposure and hazard information, as well as pharmacokinetic models, to determine the most scientifically supportable appropriate approach to evaluate infant exposure to DCHP from human milk ingestion (U.S. EPA, 2025p).

EPA identified two studies from Germany that measured DCHP concentrations in human milk. Neither of the studies characterized the possibility of occupational exposure to DCHP. No U.S. biomonitoring studies were identified. It is important to note that biomonitoring data do not distinguish between exposure routes or pathways and do not allow for source apportionment. In other words, biomonitoring data reflect total infant exposure through human milk ingestion and the contribution of specific TSCA COUs to overall exposure cannot be determined.

Furthermore, no human health studies have evaluated only lactational exposure from quantified levels of DCHP in milk. Uncertainties in the toxic moiety for DCHP and the limited half-life data of its metabolites in the human body that are both sensitive and specific also precluded modeling human milk concentrations by COUs. However, EPA has robust confidence that not modeling human milk concentrations is still protective of a nursing infant because multigenerational studies were evaluated to derive the hazard values. The multigenerational studies observed the effects on offspring across at least three generations resulting from maternal exposure during lactation, gestation, and other exposure periods. The hazard values are thus expected to protect a nursing infant's greater susceptibility during this unique life stage whether due to sensitivity or greater exposure per body weight. Further discussion of the human milk pathway is provided in *Environmental Media, General Population, and Environmental Exposure Assessment for Dicyclohexyl Phthalate (DCHP)* (U.S. EPA, 2025p).

### 4.1.5 Aggregate and Sentinel Exposure

TSCA section 6(b)(4)(F)(ii) (15 U.S.C. 2605(b)(4)(F)(ii)) requires EPA, in conducting a risk evaluation, to describe whether aggregate and sentinel exposures under the COUs were considered and the basis for their consideration.

EPA defines aggregate exposure as "the combined exposures to an individual from a chemical substance across multiple routes and across multiple pathways (40 CFR 702.33)." For the DCHP risk evaluation, the Agency considered aggregate risk across all routes of exposure for each individual consumer and occupational COU evaluated for acute, intermediate, and chronic exposure durations. EPA did not consider aggregate exposure for the general population exposed to environmental releases. As described in Section 4.1.3, the Agency employed a risk screen approach for the general population exposure assessment. Based on results from the risk screen, no pathways of concern (*i.e.,* ambient air, surface water, drinking water, fish ingestion) to DCHP exposure were identified for the generation population.

EPA did not consider aggregate exposure scenarios across COUs because the Agency did not find any evidence to support such an aggregate analysis, such as statistics of populations using certain products represented across COUs or workers performing tasks across COUs. However, EPA considered combined exposure across all routes of exposure for each individual occupational and consumer COU to calculate aggregate risks (Sections 4.3.2 and 4.3.3).

EPA defines sentinel exposure as "the exposure to a chemical substance that represents the plausible upper bound of exposure relative to all other exposures within a broad category of similar or related exposures (40 CFR 702.33)." In terms of this risk evaluation, the Agency considered sentinel exposures by considering risks to populations who may have upper bound exposures; for example, workers and ONUs who perform activities with higher exposure potential or consumers who have higher exposure potential or certain physical factors like body weight or skin surface area exposed. The Agency characterized high-end exposures in evaluating exposure using both monitoring data and modeling approaches. Where statistical data are available, EPA typically uses the 95th percentile value of the available dataset to characterize high-end exposure for a given COU. For general population and consumer exposures, the Agency occasionally characterized sentinel exposure through a "high-intensity use" category based on elevated consumption rates, breathing rates, or user-specific factors.

## 4.2 Summary of Human Health Hazards

### 4.2.1 Background

This section briefly summarizes the non-cancer and cancer human health hazards of DCHP (Section 4.2.2 and 4.2.3). Additional information on the non-cancer and cancer human health hazards of DCHP are provided in the *Non-Cancer Human Health Hazard Assessment for Dicyclohexyl Phthalate (DCHP)* (U.S. EPA, 2025x) and *Cancer Human Health Hazard Assessment for Di(2-ethylhexyl) Phthalate (DEHP), Dibutyl Phthalate (DBP), Butyl Benzyl Phthalate (BBP), Diisobutyl Phthalate (DIBP), and Dicyclohexyl Phthalate (DCHP)* (U.S. EPA, 2025b).

### 4.2.2 Non-Cancer Human Health Hazards of DCHP

EPA identified effects on the developing male reproductive system as the most sensitive and robust non-cancer hazard associated with oral exposure to DCHP in experimental animal models. Existing assessments of DCHP—including (CPSC, 2014, 2011), (Health Canada, 2020; EC/HC, 2015), (ECHA, 2014), and (NICNAS, 2016, 2008)—also consistently identified effects on the developing male reproductive system as a sensitive and robust non-cancer effect following oral exposure to DCHP. EPA also considered epidemiologic evidence qualitatively as part of hazard identification and characterization. However, epidemiologic evidence from the one DCHP study was not considered further for dose-response analysis due to limitations and uncertainties in exposure characterization that are discussed further in the *Non-Cancer Human Health Hazard Assessment for Dicyclohexyl Phthalate (DCHP)* (U.S. EPA, 2025x). Use of epidemiologic evidence qualitatively is consistent with phthalates assessments by Health Canada and the U.S. CPSC.

EPA selected a POD of 10 mg/kg-day (HED of 2.4 mg/kg-day) based on phthalate syndrome-related effects on the developing male reproductive system (decreased fetal testicular testosterone; decreased AGD (anogenital distance); Leydig cell effects; decreased mRNA and/or protein expression of steroidogenic genes; decreased protein expression of INSL3) to estimate non-cancer risks from oral exposure to DCHP for acute, intermediate, and chronic durations of exposure in the risk evaluation of DCHP. The selected POD is the most sensitive no-observed-adverse-effect level (NOAEL) and is further supported by one study reporting a NOAEL of 17 mg/kg-day (Hoshino et al., 2005) and four other studies reporting effects on the developing male reproductive system consistent with a disruption of androgen action and phthalate syndrome in rats at lowest-observed-adverse-effect-levels (LOAELs) ranging from 20 to 33 mg/kg-day (Ahbab et al., 2017; Ahbab and Barlas, 2015; Furr et al., 2014; Ahbab and Barlas, 2013).

The Agency has performed ¾-body weight scaling to yield the HED of 2.4 mg/kg-day. Body weight scaling to the three-quarters power is EPA's default approach for deriving an HED in the absence of more chemical-specific information (*e.g.*, PBPK model or data derived extrapolation factor) for such an extrapolation (U.S. EPA, 2011c). A total uncertainty factor (UF) of 30 was selected for use as the benchmark MOE (based on an interspecies uncertainty factor [$UF_A$] of 3× and an intraspecies uncertainty factor [$UF_H$] of 10×). The $UF_H$ of 10× accounts for variability in toxicokinetics and toxicodynamics within the human population to account for differences in sensitivity. However, data are not available to characterize the magnitude of variability/sensitivity across the human population. Therefore, consistent with agency guidance (U.S. EPA, 2002b), EPA selected a default $UF_H$ of 10×. Consistent with Agency guidance (U.S. EPA, 2011c), the $UF_A$ was reduced from a factor of 10 to 3× because allometric body-weight scaling was used to derive an HED, which accounts for toxicokinetic differences between species. The remaining $UF_A$ of 3× accounts for species differences in toxicodynamics. EPA considered reducing the $UF_A$ further to a value of 1 based on apparent differences in toxicodynamics between rats and humans.

As discussed in Section 3.1.4 of EPA's *Draft Proposed Approach for Cumulative Risk Assessment of High-Priority Phthalates and a Manufacturer-Requested Phthalate under the Toxic Substances Control Act* (U.S. EPA, 2023c), several explant (Lambrot et al., 2009; Hallmark et al., 2007) and xenograft studies (van Den Driesche et al., 2015; Spade et al., 2014; Heger et al., 2012; Mitchell et al., 2012) using human donor fetal testis tissue have been conducted to investigate the antiandrogenicity of mono-2-ethylhexyl phthalate (MEHP; a monoester metabolite of DEHP), DBP, and monobutyl phthalate (MBP; a monoester metabolite of DBP) in a human model. Generally, results from human explant and xenograft studies suggest that human fetal testes are less sensitive than rat testes to the antiandrogenic effects of phthalates, however, effects on Sertoli cells and increased incidence of MNGs have been observed in four human xenograft studies of DBP (van Den Driesche et al., 2015; Spade et al., 2014; Heger et al., 2012; Mitchell et al., 2012). As discussed in EPA's draft approach document (U.S. EPA, 2023c), the available human explant and xenograft studies have limitations and uncertainties, which preclude definitive conclusions related to species differences in sensitivity. For example, key limitations and uncertainties of the human explant and xenograft studies include the following: small sample size; human testis tissue was collected from donors of variable age and by variable non-standardized methods; and most of the testis tissue was taken from fetuses older than 14 weeks, which is outside of the critical window of development (*i.e.*, gestational weeks 8 to 14 in humans). Therefore, EPA did not further reduce the $UF_A$ to a value of 1.

Overall, based on the strengths, limitations, and uncertainties discussed in the *Non-Cancer Human Health Hazard Assessment for Dicyclohexyl Phthalate (DCHP)* (U.S. EPA, 2025x), *EPA has robust overall confidence in the* selected *POD based on adverse effects on the developing male reproductive*

*system* (*i.e.*, phthalate syndrome, which results from decreased fetal testicular testosterone). *This POD was used to characterize risk from exposure to DCHP for acute, intermediate, and chronic exposure scenarios.*

The applicability and relevance of this POD for all exposure durations (acute, intermediate, and chronic) is described in the *Non-Cancer Human Health Hazard Assessment for Dicyclohexyl Phthalate (DCHP)* (U.S. EPA, 2025x). For purposes of assessing non-cancer risks, the selected POD is considered most applicable to females of reproductive age, pregnant women, male infants, and male children. Use of this POD to assess risk for other age groups (*e.g.*, adult males, and the elderly) is considered to be conservative and appropriate for a screening level assessment for these other age groups.

No data are available for the dermal or inhalation routes that are suitable for deriving route-specific PODs. Therefore, EPA used the acute/intermediate/chronic oral POD to evaluate risks from dermal exposure to DCHP. Differences between oral and dermal absorption are accounted for in dermal exposure estimates in the risk evaluation for DCHP. For the inhalation route, EPA extrapolated the oral HED to an inhalation HEC per EPA's *Methods for Derivation Of Inhalation Reference Concentrations and Application of Inhalation Dosimetry* (U.S. EPA, 1994) using the updated human body weight and breathing rate relevant to continuous exposure of an individual at rest provided in EPA's *Exposure Factors Handbook: 2011 Edition* (U.S. EPA, 2011b). The oral HED and inhalation HEC values selected by EPA to estimate non-cancer risk from acute/intermediate/chronic exposure to DCHP in the risk evaluation of DCHP are summarized in Table 4-12.

**Table 4-12. Non-Cancer HECs and HEDs Used to Estimate Risks**

| Exposure Scenario | Target Organ System | Species | Duration | POD (mg/kg-day) | Effect at LOAEL | HED [a] (mg/kg-day) | HEC [a] (mg/m$^3$) [ppm] | Benchmark MOE [b] | Reference (TSCA Study Quality) |
|---|---|---|---|---|---|---|---|---|---|
| Acute, intermed., chronic | Developing male reproductive system | Rat | 10 days during gestation | NOAEL = 10 [c] | Phthalate syndrome-related effects (*e.g.*, ↓ fetal testicular testosterone; ↓ AGD; Leydig cell effects; ↓ mRNA and/or protein expression of steroidogenic genes; ↓INSL3) | 2.4 | 13 [0.95] | $UF_A$ = 3<br>$UF_H$ = 10<br>*Total UF=30* | (Li et al., 2016) (Medium) |

HEC = human equivalent concentration; HED = human equivalent dose; MOE = margin of exposure; NOAEL = no-observed-adverse-effect level; LOAEL = lowest-observed-adverse-effect level; POD = point of departure; UF = uncertainty factor

[a] HED and HEC values were calculated based on the most sensitive NOAEL of 10 mg/kg-day.

[b] EPA used allometric body weight scaling to the ¾-power to derive the HED. Consistent with EPA Guidance (U.S. EPA, 2011c), the interspecies uncertainty factor ($UF_A$), was reduced from 10 to 3 to account remaining uncertainty associated with interspecies differences in toxicodynamics. The Agency used a default intraspecies ($UF_H$) of 10 to account for variation in sensitivity within human populations.

[c] Statistically significant effects at 10 mg/kg-day are limited to fetal Leydig cell effects, decreased expression of genes and proteins involved in steroidogenesis, and decreased protein expression of INSL3 (all of which are not considered adverse in isolation). The remaining effects listed reached statistical significance at higher doses.

### 4.2.3 Cancer Human Health Hazards of DCHP

DCHP has not been evaluated for carcinogenicity in any 2-year cancer bioassay. EPA therefore evaluated the utility of read-across approaches to assess potential cancer hazards of DCHP based on cancer bioassays and mode of action (MOA) information available for other phthalates being evaluated under TSCA, as discussed in the *Cancer Human Health Hazard Assessment for Di(2-ethylhexyl) Phthalate (DEHP), Dibutyl Phthalate (DBP), Butyl Benzyl Phthalate (BBP), Diisobutyl Phthalate (DIBP), and Dicyclohexyl Phthalate (DCHP)* (U.S. EPA, 2025b).

EPA used elements of the Rethinking Chronic Toxicity and Carcinogenicity Assessment for Agrochemicals Project (ReCAAP) weight of evidence framework (Hilton et al., 2022) to determine the need for carcinogenicity studies for DCHP. The framework takes into consideration multiple lines of evidence to support decision making for the chemical(s) of interest—including information pertaining to nomenclature, physical and chemical properties; exposure and use patterns; absorption, distribution, metabolism, and excretion (ADME) properties; and toxicological data (*e.g.*, genetic toxicity, acute toxicity, subchronic toxicity, hormone perturbation, immunotoxicity, and MOA). The framework was developed by a workgroup comprising scientists from academia, government, non-governmental organizations, and industry stakeholders. Recently, the Organisation for Economic Co-operation and Development (OECD) developed several Integrated Approach to Testing and Assessment (IATA) case studies demonstrating applicability of the weight of evidence framework (OECD, 2024).

As part of this weight of evidence approach, human health hazard profiles for DCHP were evaluated and compared to profiles for five read-across chemicals, including DBP, BBP, DEHP, DINP, and DIDP (also referred to as "read-across phthalates" in this risk evaluation). Overall, based on the weight of scientific evidence, EPA has concluded that the non-cancer POD for DCHP based on effects on the

developing male reproductive system consistent with a disruption of androgen action and phthalate syndrome that was selected for characterizing risk from acute, intermediate, and chronic exposure to DCHP is appropriate for use in human health risk assessment and is protective of human health, including for PESS. Furthermore, as discussed in the cancer human health hazard assessment (U.S. EPA, 2025b), *EPA concludes that potential carcinogenicity of DCHP is not a significant remaining source of uncertainty in the quantitative and qualitative risk characterization, despite the lack of carcinogenicity bioassays for DCHP*. Furthermore, these conclusions are based on several key weight of scientific evidence considerations that are discussed in the following paragraph.

First, DCHP is toxicologically similar to DBP, DBP, DEHP, DINP, and DIBP and can induce antiandrogenic effects and disrupt fetal testicular testosterone biosynthesis in rats leading to a spectrum of effects on the developing male reproductive system consistent with phthalate syndrome. Second, for the five read-across phthalates, effects on the developing male reproductive system consistent with phthalate syndrome was the most sensitive and robust endpoint for deriving PODs for use in characterizing risk for acute, intermediate, and chronic exposure scenarios. The only exception to this was for DINP, in which chronic non-cancer liver effects were identified as a more sensitive outcome than developmental toxicity for deriving a chronic POD. Finally, although cancer classifications for the five read-across phthalates vary, in no case was cancer found to be a risk driver (U.S. EPA, 2025b).

## 4.3 Human Health Risk Characterization

### 4.3.1 Risk Assessment Approach

The exposure scenarios, populations of interest, and toxicological endpoints used for evaluating risks from acute, short-term/intermediate, and chronic/lifetime exposures are summarized in Table 4-13.

**Table 4-13. Exposure Scenarios, Populations of Interest, and Hazard Values**

| | |
|---|---|
| **Population of Interest and Exposure Scenario** | **Workers**<br>Male and female adolescents and adults (16+ years) and females of reproductive age directly working with DCHP under light activity (breathing rate of 1.25 $m^3$/h) (for further details see (U.S. EPA, 2025s))<br>Exposure Durations<br>• *Acute* – 8 hours for a single work day<br>• *Intermediate* – 8 hours per work day for 22 days per 30-day period<br>• *Chronic* – 8 hours per work day for 250 days per year for 31 or 40 working years<br>Exposure Routes<br>• Inhalation and dermal |
| | **Occupational Non-Users**<br>Male and female adolescents and adults (16+ years old) indirectly exposed to DCHP within the same work area as workers (breathing rate of 1.25 $m^3$/h) (for further details see (U.S. EPA, 2025s))<br>Exposure Durations<br>• *Acute, Intermediate, and Chronic* – same as workers<br>Exposure Routes<br>• Inhalation, dermal (mist and dust deposited on surfaces) |
| | **Consumers**<br>Male and female infants (<1 year), toddlers (1–2 years), children (3–5 years and 6–10 years), young teens (11–15 years), teenagers (16–20 years) and adults (21+ years) exposed to DCHP through product or article use (for further details see (U.S. EPA, 2025c))<br>Exposure Durations<br>• *Acute* – 1 day exposure<br>• *Intermediate* – 30 days per year<br>• *Chronic* – 365 days per year |

| | |
|---|---|
| **Population of Interest and Exposure Scenario** | Exposure Routes<br>• Inhalation, dermal, and oral |
| | **Bystanders**<br>Male and female infants (<1 year), toddlers (1–2 years), and children (3–5 years and 6–10 years) incidentally exposed to DCHP through product use (for further details see (U.S. EPA, 2025c))<br>Exposure Durations<br>• *Acute* – 1 day exposure<br>• *Intermediate* – 30 days per year<br>• *Chronic* – 365 days per year<br>Exposure Routes<br>• Inhalation |
| | **General Population**<br>Male and female infants, children, youth, and adults exposed to DCHP through drinking water, surface water, ambient air, and fish ingestion (for further details see (U.S. EPA, 2025p))<br>Exposure Durations<br>• *Acute* – Exposed to DCHP continuously for a 24-hour period<br>• *Chronic* – Exposed to DCHP continuously for up to 78 years<br>Exposure Routes<br>• Inhalation, dermal, and oral (depending on exposure scenario) |
| | **National Population**<br>Children aged 3–5, 6–11 years, and 11 to <16 years; male and female adults 16+ years; and females of reproductive age (16–49 years of age) exposed to BBP, DBP, DEHP, DIBP, and DINP through all exposure pathways and routes as measured through urinary biomonitoring (*i.e.*, NHANES) (for further details see (U.S. EPA, 2025ai))<br>Exposure Durations<br>• Durations not easily characterized in urinary biomonitoring studies<br>• Likely between acute and intermediate as phthalates have elimination half-lives on the order of several hours and are quickly excreted from the body in urine. Spot urine samples, as collected through NHANES, are representative of relatively recent exposures.<br>Exposure Routes<br>• NHANES urinary biomonitoring data provides an estimate of aggregate exposure (*i.e.*, exposure through oral, inhalation, and dermal routes) |
| **Health Effects, Concentration and Time Duration** | **Non-cancer Acute/Intermediate/Chronic Value**<br>Sensitive health effect: Developmental toxicity (*i.e.*, effects on the developing male reproductive system including decreased fetal testicular testosterone; decreased AGD; Leydig cell effects; decreased mRNA and/or protein expression of steroidogenic genes; decreased protein expression of INSL3) (for further details see (U.S. EPA, 2025x))<br>HEC Daily, continuous = 13 mg/m$^3$ (0.95 ppm)<br>HED Daily = 2.4 mg/kg-day; dermal and oral<br>Total UF (benchmark MOE) = 30 ($UF_A$ = 3; $UF_H$ = 10)<br><br>**Hazard Relative Potency**<br>Relative potency factors (RPFs) for BBP, DBP, DCHP, DEHP, DIBP, and DINP were derived based on reduced fetal testicular testosterone. DBP was selected as the index chemical (for further details see (U.S. EPA, 2025ai)).<br>$RPF_{DEHP}$ = 0.84<br>$RPF_{DBP}$ = 1 (index chemical)<br>$RPF_{BBP}$ = 0.52<br>$RPF_{DIBP}$ = 053<br>$RPF_{DCHP}$ = 1.66<br>$RPF_{DINP}$ = 0.21<br>Index chemical (DBP) POD = HED Daily = 2.1 mg/kg-day<br>Total UF (benchmark MOE) = 30 ($UF_A$ = 3; $UF_H$ = 10) |

#### 4.3.1.1 Estimation of Non-Cancer Risks from Exposure to DCHP

EPA used a margin of exposure (MOE) approach to identify potential non-cancer risks for individual exposure routes (*i.e.*, oral, dermal, inhalation). The MOE is the ratio of the non-cancer POD divided by a human exposure dose. Acute, short-term, and chronic MOEs for non-cancer inhalation and dermal risks were calculated using Equation 4-1.

**Equation 4-1. Margin of Exposure Calculation**

$$MOE = \frac{Non - Cancer\ Hazard\ Value\ (POD)}{Human\ Exposure}$$

Where:

| | | |
|---|---|---|
| *MOE* | = | Margin of exposure for acute, intermediate, or chronic risk comparison (unitless) |
| *Non-Cancer Hazard Value (POD)* | = | HEC (mg/m$^3$) or HED (mg/kg-day) |
| *Human Exposure* | = | Exposure estimate (mg/m$^3$ or mg/kg-day) |

MOE risk estimates may be interpreted in relation to benchmark MOEs. Benchmark MOEs are typically the total UF for each non-cancer POD. The MOE estimate is interpreted as a human health risk of concern if the MOE estimate is less than the benchmark MOE (*i.e.*, the total UF). On the other hand, if the MOE estimate is equal to or exceeds the benchmark MOE, the risk is not considered to be of concern and mitigation is not needed. Typically, the larger the MOE, the more unlikely it is that a non-cancer adverse effect occurs relative to the benchmark. When determining whether a chemical substance presents unreasonable risk to human health or the environment, calculated risk estimates are not "bright-line" indicators of unreasonable risk, and EPA has the discretion to consider other risk-related factors in addition to risks identified in the risk characterization.

#### 4.3.1.2 Estimation of Non-Cancer Aggregate Risks from Exposure to DCHP

As described in Section 4.1.5, EPA considered aggregate risk from exposure to DCHP across all routes of exposure for each individual consumer and occupational COU evaluated for acute, intermediate, and chronic exposure durations. To identify potential non-cancer risks for aggregate exposure scenarios for workers (Section 4.3.2) and consumers (Section 4.3.3), EPA used the total MOE approach (U.S. EPA, 2001). For the total MOE approach, MOEs for each exposure route of interest in the aggregate scenario must first be calculated. The total MOE for the aggregate scenario can then be calculated using Equation 4-2.

**Equation 4-2. Total Margin of Exposure Calculation**

$$Total\ MOE = \frac{1}{\frac{1}{MOE_{Oral}} + \frac{1}{MOE_{Dermal}} + \frac{1}{MOE_{Inhalation}} \ldots}$$

Where:

| | | |
|---|---|---|
| *Total MOE* | = | Margin of exposure for aggregate scenario (unitless) |
| $MOE_{Oral}$ | = | Margin of exposure for oral route (unitless) |
| $MOE_{Dermal}$ | = | Margin of exposure for dermal route (unitless) |
| $MOE_{Inhalation}$ | = | Margin of exposure for inhalation route (unitless) |

Total MOE risk estimates may be interpreted in relation to benchmark MOEs, as described in Section 4.3.1.1.

### 4.3.2 Risk Estimates for Workers

This section summarizes risk estimates for workers from inhalation and dermal exposures, as well as aggregated exposures to DCHP from individual DCHP COUs across routes. In this section, risks are calculated for all exposed workers based on the DCHP-derived PODs described in Section 4.2.2. Subsequently in Section 4.4.4, those same risks for female workers of reproductive age exposed to DCHP at the highest levels (acute durations) are calculated using the more robust relative potency factors (RPFs) described in Section 4.4.1 and added to estimates of national non-attributable exposure of five toxicologically similar phthalates for an estimate of cumulative risk.

Risk estimates for workers from inhalation and dermal exposures, as well as aggregated exposures, are shown in Table 4-15. This section provides discussion and characterization of risk estimates for workers, including females of reproductive age and ONUs, for the various OESs and COUs.

***Manufacturing***

For the manufacture of DCHP, inhalation exposure from dust generation is expected to be the dominant route of exposure. MOEs for high-end acute, intermediate, and chronic inhalation exposure ranged from 3.5 to 5.6 for average adult workers and females of reproductive age, while high-end dermal MOEs for the same populations and exposure scenarios ranged from 532 to 845 (benchmark = 30). The central tendency MOEs for the same populations and exposure scenarios ranged from 36 to 58 for inhalation exposure and 1,064 to 1,689 for dermal exposure (benchmark = 30). Aggregation of inhalation and dermal exposures led to negligible differences in risk when compared to risk estimates from inhalation exposure alone. The MOEs presented in this paragraph are with no use of personal protective equipment (PPE). Section 4.3.2.4 and Table 4-15 provides more information on PPE that could be used to raise the MOEs above the benchmark MOE.

EPA estimated worker inhalation exposures using the PNOR Model for dust exposures (U.S. EPA, 2021b). For inhalation exposure to PNOR, EPA determined the 50th and 95th percentiles of the surrogate dust monitoring data taken from facilities with NAIC codes starting with 325 (Chemical Manufacturing). EPA multiplied these dust concentrations by the industry provided maximum DCHP concentration manufactured (*i.e.*, 100%) to estimate DCHP particulate concentrations in the air. EPA assumed that the concentration of DCHP in the dust in the air is the same the material. Therefore, the differences in the central tendency and high-end dust concentrations led to significant differences between the central tendency and high-end risk estimates.

Although the PNOR (*i.e.*, dust) concentration data provides a reliable range of dust concentrations that a worker may experience in the chemicals industry, the composition of workplace dust is uncertain. The exposure and risk estimates are based on the assumption that the concentration of DCHP in workplace dust is the same as the concentration of DCHP manufactured. However, it is likely that workplace dust contains a variety of constituents that do not contain any DCHP in addition to particles from manufactured DCHP. The constituents that do not contain DCHP would dilute the overall concentration of DCHP in the dust, and the concentration of DCHP in workplace dust is likely less than the concentration of DCHP in the final product. Due to this uncertainty in DCHP concentration in workplace dust, central tendency values of exposure are expected to be most reflective of worker exposures within the COUs covered under the Manufacturing OES (*i.e.*, Manufacturing COU: Domestic manufacturing).

***Import and Repackaging***
For the import of DCHP, inhalation exposure from dust generation is expected to be the dominant route of exposure. MOEs for high-end acute, intermediate, and chronic inhalation exposure ranged from 5.8 to 9.3 for average adult workers and females of reproductive age, while high-end dermal MOEs for the same populations and exposure scenarios ranged from 532 to 845 (benchmark = 30). The central tendency MOEs for the same populations and exposure scenarios ranged from 134 to 259 for inhalation exposure and 1,064 to 2,031 for dermal exposure (benchmark = 30). Aggregation of inhalation and dermal exposures led to negligible differences in risk when compared to risk estimates from inhalation exposure alone. The MOEs presented in this paragraph are with no use of PPE. Section 4.3.2.4 and Table 4-15 provides more information on PPE that could be used to raise the MOEs above the benchmark MOE.

EPA estimated worker inhalation exposures using the PNOR Model for dust exposures (U.S. EPA, 2021b). For inhalation exposure to PNOR, EPA determined the 50th and 95th percentiles of the surrogate dust monitoring data taken from facilities with NAIC codes starting with 45 (Wholesale and Retail Trade). EPA multiplied these dust concentrations by the industry provided maximum DCHP concentration imported (*i.e.*, 100%) to estimate DCHP particulate concentrations in the air. EPA assumed that the concentration of DCHP in the dust in the air is the same the material. Therefore, the differences in the central tendency and high-end dust concentrations led to significant differences between the central tendency and high-end risk estimates.

Although the PNOR (*i.e.*, dust) concentration data provides a reliable range of dust concentrations that a worker may experience in the wholesale and retail trade industry, the composition of workplace dust is uncertain. The exposure and risk estimates are based on the assumption that the concentration of DCHP in workplace dust is the same as the concentration of imported DCHP. However, it is likely that workplace dust contains a variety of constituents that do not contain any DCHP in addition to particles from imported DCHP. The constituents that do not contain DCHP would dilute the overall concentration of DCHP in the dust, and the concentration of DCHP in workplace dust is likely less than the concentration of DCHP in the imported product. Due to this uncertainty in DCHP concentration in workplace dust, central tendency values of exposure are expected to be most reflective of worker exposures within the COUs covered under the Import and repackaging OES (*i.e.*, Manufacture COU: Importing; Processing COU: Repackaging [*e.g.*, laboratory chemicals]).

***Incorporation into Adhesives and Sealants***
For the incorporation of DCHP into adhesives and sealants, inhalation exposure from dust generation is expected to be the dominant route of exposure. MOEs for high-end acute, intermediate, and chronic inhalation exposure ranged from 3.5 to 5.6 for average adult workers and females of reproductive age, while high-end dermal MOEs for the same populations and exposure scenarios ranged from 532 to 845 (benchmark = 30). The central tendency MOEs for the same populations and exposure scenarios ranged from 36 to 58 for inhalation exposure and 1,064 to 1,689 for dermal exposure (benchmark = 30). Aggregation of inhalation and dermal exposures led to negligible differences in risk when compared to risk estimates from inhalation exposure alone. The MOEs presented in this paragraph are with no use of PPE. Section 4.3.2.4 and Table 4-15 provides more information on PPE that could be used to raise the MOEs above the benchmark MOE.

EPA estimated worker inhalation exposures using the PNOR Model for dust exposures (U.S. EPA, 2021b). For inhalation exposure to PNOR, EPA determined the 50th and 95th percentiles of the surrogate dust monitoring data taken from facilities with NAIC codes starting with 325 (Chemical Manufacturing). EPA multiplied these dust concentrations by the industry-provided maximum potential

DCHP concentration in the raw material (*i.e.,* 100%) to estimate DCHP particulate concentrations in the air. EPA assumed that the concentration of DCHP in the dust in the air is the same the material. Therefore, the differences in the central tendency and high-end dust concentrations led to significant differences between the central tendency and high-end risk estimates.

Although the PNOR (*i.e.,* dust) concentration data provides a reliable range of dust concentrations that a worker may experience in the chemical manufacturing industry, the composition of workplace dust is uncertain. The exposure and risk estimates are based on the assumption that the concentration of DCHP in workplace dust is the same as the concentration of DCHP in the raw material. However, it is likely that workplace dust contains a variety of constituents that do not contain any DCHP in addition to particles from DCHP-containing raw materials. The constituents that do not contain DCHP would dilute the overall concentration of DCHP in the dust, and the concentration of DCHP in workplace dust is likely less than the concentration of DCHP in the raw material. Due to this uncertainty in DCHP concentration in workplace dust, central tendency values of exposure are expected to be most reflective of worker exposures within the COUs covered under the Incorporation into adhesives and sealants OES (*i.e.,* Processing COUs: Plasticizer in adhesive manufacturing; Adhesive and sealant chemicals in adhesive manufacturing; Stabilizing agent in adhesive manufacturing).

***Incorporation into Paints and Coatings***

For the incorporation of DCHP into paints and coatings, inhalation exposure from dust generation is expected to be the dominant route of exposure. MOEs for high-end acute, intermediate, and chronic inhalation exposure ranged from 3.5 to 5.6 for average adult workers and females of reproductive age, while high-end dermal MOEs for the same populations and exposure scenarios ranged from 532 to 845 (benchmark = 30). The central tendency MOEs for the same populations and exposure scenarios ranged from 36 to 58 for inhalation exposure and 1,064 to 1,689 for dermal exposure (benchmark = 30). Aggregation of inhalation and dermal exposures led to negligible differences in risk when compared to risk estimates from inhalation exposure alone. The MOEs presented here do not include use of PPE. Section 4.3.2.4 and Table 4-15 provides more information on PPE that could be used to raise the MOEs above the benchmark MOE.

EPA estimated worker inhalation exposures using the PNOR Model for dust exposures (U.S. EPA, 2021b). For inhalation exposure to PNOR, EPA determined the 50th and 95th percentiles of the surrogate dust monitoring data taken from facilities with NAIC codes starting with 325 (Chemical Manufacturing). EPA multiplied these dust concentrations by the industry provided maximum potential DCHP concentration in the raw material (*i.e.,* 100%) to estimate DCHP particulate concentrations in the air. EPA assumed that the concentration of DCHP in the dust in the air is the same the material. Therefore, the differences in the central tendency and high-end dust concentrations led to significant differences between the central tendency and high-end risk estimates.

Although the PNOR (*i.e.,* dust) concentration data provides a reliable range of dust concentrations that a worker may experience in the chemical manufacturing industry, the composition of workplace dust is uncertain. The exposure and risk estimates are based on the assumption that the concentration of DCHP in workplace dust is the same as the concentration of DCHP in the raw material. However, it is likely that workplace dust contains a variety of constituents that do not contain any DCHP in addition to particles from DCHP-containing raw materials. The constituents that do not contain DCHP would dilute the overall concentration of DCHP in the dust, and the concentration of DCHP in workplace dust is likely less than the concentration of DCHP in the raw material. Due to this uncertainty in DCHP concentration in workplace dust, central tendency values of exposure are expected to be most reflective of worker exposures within the COUs covered under the Incorporation into paints and coatings OES

(*i.e.*, Processing COUs: Plasticizer in paint and coating manufacturing; Stabilizing agent in paint and coating manufacturing).

***Incorporation into Other Formulations, Mixtures, or Reaction Products***
For the incorporation of DCHP into other formulations, mixtures, or reaction products, inhalation exposure from dust generation is expected to be the dominant route of exposure. MOEs for high-end acute, intermediate, and chronic inhalation exposure ranged from 3.5 to 5.6 for average adult workers and females of reproductive age, while high-end dermal MOEs for the same populations and exposure scenarios ranged from 532 to 845 (benchmark = 30). The central tendency MOEs for the same populations and exposure scenarios ranged from 36 to 58 for inhalation exposure and 1,064 to 1,689 for dermal exposure (benchmark = 30). Aggregation of inhalation and dermal exposures led to negligible differences in risk when compared to risk estimates from inhalation exposure alone. The MOEs presented in this paragraph are with no use of PPE. Section 4.3.2.4 and Table 4-15 provides more information on PPE that could be used to raise the MOEs above the benchmark MOE.

EPA estimated worker inhalation exposures using the PNOR Model for dust exposures (U.S. EPA, 2021b). For inhalation exposure to PNOR, EPA determined the 50th and 95th percentiles of the surrogate dust monitoring data taken from facilities with NAICS codes starting with 325 (Chemical Manufacturing). EPA multiplied these dust concentrations by the industry provided maximum potential DCHP concentration in the raw material (*i.e.,* 100%) to estimate DCHP particulate concentrations in the air. EPA assumed that the concentration of DCHP in the dust in the air is the same the material. Therefore, the differences in the central tendency and high-end dust concentrations led to significant differences between the central tendency and high-end risk estimates.

Although the PNOR (*i.e.*, dust) concentration data provides a reliable range of dust concentrations that a worker may experience in the chemical manufacturing industry, the composition of workplace dust is uncertain. The exposure and risk estimates are based on the assumption that the concentration of DCHP in workplace dust is the same as the concentration of DCHP in the raw material. However, it is likely that workplace dust contains a variety of constituents that do not contain any DCHP in addition to particles from DCHP-containing raw materials. The constituents that do not contain DCHP would dilute the overall concentration of DCHP in the dust, and the concentration of DCHP in workplace dust is likely less than the concentration of DCHP in the raw material. Due to this uncertainty in DCHP concentration in workplace dust, central tendency values of exposure are expected to be most reflective of worker exposures within the COUs covered under the Incorporation into other formulations, mixtures, or reaction products OES (*i.e.*, Processing COU: Stabilizing agent in asphalt paving, roofing, and coating materials manufacturing).

***PVC Plastics Compounding***
For PVC plastics compounding, inhalation exposure from dust generation is expected to be the dominant route of exposure. MOEs for high-end acute, intermediate, and chronic inhalation exposure ranged from 3.7 to 6.0 for average adult workers and females of reproductive age, while high-end dermal MOEs ranged from 532 to 845 (benchmark = 30). For central tendency, MOEs for the same population and exposure scenarios ranged from 76 to 137 for inhalation exposure and 1,064 to 1,894 for dermal exposures (benchmark = 30). Aggregation of inhalation and dermal exposures led to negligible differences in risk when compared to risk estimates from inhalation exposure alone. The MOEs presented in this paragraph are with no use of PPE. Section 4.3.2.4 and Table 4-15 provides more information on PPE that could be used to raise the MOEs above the benchmark MOE.

EPA estimated worker inhalation exposures using the PNOR Model for dust exposures (U.S. EPA, 2021b). For inhalation exposure to PNOR, EPA determined the 50th and 95th percentiles of the surrogate dust monitoring data taken from facilities with NAIC codes starting with 326 (Plastics and Rubber Manufacturing). EPA multiplied these dust concentrations by the industry provided maximum potential DCHP concentration in the raw additive material (*i.e.*, 100%) to estimate DCHP particulate concentrations in the air. EPA assumed that the concentration of DCHP in the dust in the air is the same the material. Therefore, the differences in the central tendency and high-end dust concentrations led to significant differences between the central tendency and high-end risk estimates.

Although the PNOR (*i.e.*, dust) concentration data provides a reliable range of dust concentrations that a worker may experience in the compounding industry, the composition of workplace dust is uncertain. The exposure and risk estimates assume that the concentration of DCHP in workplace dust is the same as the concentration of DCHP in the raw material. However, it is likely that workplace dust contains a variety of constituents that do not contain any DCHP in addition to particles from DCHP-containing raw materials. The constituents that do not contain DCHP would dilute the overall concentration of DCHP in the dust, and the concentration of DCHP in workplace dust is likely less than the concentration of DCHP in the raw material. Due to the uncertainty of DCHP concentrations in workplace dust, central tendency values of exposure are expected to be most reflective of worker exposures within the COUs covered under the PVC plastics compounding OES (*i.e.*, Processing COUs: Plasticizer in plastic material and resin manufacturing; Plastics product manufacturing; Stabilizing agent in plastics product manufacturing).

***Non-PVC Material Compounding***

For non-PVC material compounding, inhalation exposure from dust generation is expected to be the dominant route of exposure. MOEs for high-end acute, intermediate, and chronic inhalation exposure ranged from 6.2 to 9.9 for average adult workers and females of reproductive age, while high-end dermal MOEs ranged from 532 to 845 (benchmark = 30). For central tendency, MOEs for the same population and exposure scenarios ranged from 126 to 217 for inhalation exposure and 1,064 to 1,805 for dermal exposures (benchmark = 30). Aggregation of inhalation and dermal exposures led to negligible differences in risk when compared to risk estimates from inhalation exposure alone. The MOEs presented in this paragraph are with no use of PPE. Section 4.3.2.4 and Table 4-15 provides more information on PPE that could be used to raise the MOEs above the benchmark MOE.

EPA estimated worker inhalation exposures using the PNOR Model for dust exposures (U.S. EPA, 2021b). For inhalation exposure to PNOR, EPA determined the 50th and 95th percentiles of the surrogate dust monitoring data taken from facilities with NAIC codes starting with 326 (Plastics and Rubber Manufacturing). EPA multiplied these dust concentrations by the industry provided maximum potential DCHP concentration in the raw additive material (*i.e.*, 60%) to estimate DCHP particulate concentrations in the air. EPA assumed that the concentration of DCHP in the dust in the air is the same the material. Therefore, the differences in the central tendency and high-end dust concentrations led to significant differences between the central tendency and high-end risk estimates.

Although the PNOR (*i.e.*, dust) concentration data provides a reliable range of dust concentrations that a worker may experience in the compounding industry, the composition of workplace dust is uncertain. The exposure and risk estimates assume that the concentration of DCHP in workplace dust is the same as the concentration of DCHP in the raw material. However, it is likely that workplace dust contains a variety of constituents that do not contain any DCHP in addition to particles from DCHP-containing raw materials. The constituents that do not contain DCHP would dilute the overall concentration of DCHP in the dust, and the concentration of DCHP in workplace dust is likely less than the concentration of DCHP

in the raw material. Due to the uncertainty of DCHP concentrations in workplace dust, central tendency values of exposure are expected to be most reflective of worker exposures within the COUs covered under the Non-PVC material compounding OES (*i.e.*, Processing COUs: Plasticizer in in plastic material and resin manufacturing; Plastics product manufacturing; Rubber product manufacturing; Stabilizing agent in plastics product manufacturing).

***PVC Plastics Converting***

For PVC plastics converting, inhalation exposure from dust generation is expected to be the dominant route of exposure. MOEs for high-end acute, intermediate, and chronic inhalation exposure ranged from 8.2 to 13 for average adult workers and females of reproductive age, while high-end dermal MOEs ranged from 532 to 845 (benchmark = 30). For central tendency, MOEs for the same population and exposure scenarios ranged from 168 to 309 for inhalation exposure and 1,064 to 1,929 for dermal exposures (benchmark = 30). Aggregation of inhalation and dermal exposures led to negligible differences in risk when compared to risk estimates from inhalation exposure alone. The MOEs presented in this paragraph are with no use of PPE. Section 4.3.2.4 and Table 4-15 provides more information on PPE that could be used to raise the MOEs above the benchmark MOE.

EPA estimated worker inhalation exposures using the PNOR Model for dust exposures (U.S. EPA, 2021b). For inhalation exposure to PNOR, EPA determined the 50th and 95th percentiles of the surrogate dust monitoring data taken from facilities with NAIC codes starting with 326 (Plastics and Rubber Manufacturing). EPA multiplied these dust concentrations by the industry provided maximum potential DCHP concentration in PVC plastic (*i.e.*, 45%) to estimate DCHP particulate concentrations in the air. EPA assumed that the concentration of DCHP in the dust in the air is the same the material. Therefore, the differences in the central tendency and high-end dust concentrations led to differences between the central tendency and high-end risk estimates.

Although the PNOR (*i.e.*, dust) concentration data provides a reliable range of dust concentrations that a worker may experience in the converting industry, the composition of workplace dust is uncertain. The exposure and risk estimates assume that the concentration of DCHP in workplace dust is the same as the concentration of DCHP in the PVC plastic. However, it is likely that workplace dust contains a variety of constituents that do not contain any DCHP in addition to particles from DCHP-containing PVC plastics. The constituents that do not contain DCHP would dilute the overall concentration of DCHP in the dust, and the concentration of DCHP in workplace dust is likely less than the concentration of DCHP in the PVC plastic. Due to the uncertainty of DCHP concentrations in workplace dust, central tendency values of exposure are expected to be most reflective of worker exposures within the COUs covered under the PVC plastics converting OES (*i.e.*, Processing COU: Plasticizer in plastics product manufacturing).

***Non-PVC Material Converting***

For non-PVC material converting, inhalation exposure from dust generation is expected to be the dominant route of exposure. MOEs for high-end acute, intermediate, and chronic inhalation exposure ranged from 18 to 30 for average adult workers and females of reproductive age, while high-end dermal MOEs ranged from 532 to 845 (benchmark = 30). For central tendency, MOEs for the same population and exposure scenarios ranged from 378 to 696 for inhalation exposure and 1,064 to 1,929 for dermal exposures (benchmark = 30). Aggregation of inhalation and dermal exposures led to negligible differences in risk when compared to risk estimates from inhalation exposure alone. The MOEs presented in this paragraph are with no use of PPE. Section 4.3.2.4 and Table 4-15 provides more information on PPE that could be used to raise the MOEs above the benchmark MOE.

EPA estimated worker inhalation exposures using the PNOR Model for dust exposures (U.S. EPA, 2021b). For inhalation exposure to PNOR, The Agency determined the 50th and 95th percentiles of the surrogate dust monitoring data taken from facilities with NAIC codes starting with 326 (Plastics and Rubber Manufacturing). EPA multiplied these dust concentrations by the industry provided maximum potential DCHP concentration in non-PVC material (*i.e.,* 20%) to estimate DCHP particulate concentrations in the air. EPA assumed that the concentration of DCHP in the dust in the air is the same the material. Therefore, the differences in the central tendency and high-end dust concentrations led to differences between the central tendency and high-end risk estimates.

Although the PNOR (*i.e.,* dust) concentration data provides a reliable range of dust concentrations that a worker may experience in the converting industry, the composition of workplace dust is uncertain. The exposure and risk estimates assume that the concentration of DCHP in workplace dust is the same as the concentration of DCHP in the non-PVC material. However, it is likely that workplace dust contains a variety of constituents that do not contain any DCHP in addition to particles from DCHP-containing non-PVC materials. The constituents that do not contain DCHP would dilute the overall concentration of DCHP in the dust, and the concentration of DCHP in workplace dust is likely less than the concentration of DCHP in the non-PVC material. Due to the uncertainty of DCHP concentrations in workplace dust, central tendency values of exposure are expected to be most reflective of worker exposures within the COUs covered under the Non-PVC Material Converting OES (*i.e.*, Processing COUs: Plasticizer in plastics product manufacturing; Rubber product manufacturing).

***Application of Adhesives and Sealants***

The applications of adhesives and sealants were assessed for solid and liquid products containing DCHP. The majority of DCHP-containing adhesive and sealant products identified exist in solid form and inhalation exposure from dust generation is expected to be the dominant route of exposure for solid adhesive and sealant products, though dermal exposures to solid adhesive and sealant products containing DCHP were also considered. There were a few liquid adhesive and sealant products containing DCHP identified; however, liquid adhesive and sealant products containing DCHP are extremely viscous and are better classified as "paste-like" materials. The literature and product data do not indicate the potential for spray coating of DCHP-containing adhesive and sealant products; therefore, inhalation exposures from the use of liquid adhesive and sealant chemicals containing DCHP are expected to be *de minimis* since there are no mists generated during use, and the vapor pressure of DCHP is very low. Consequently, EPA assumed negligible inhalation exposure from the use of liquid adhesive and sealant products containing DCHP and only assessed dermal exposures for liquid adhesive and sealant use. Risk values associated with the use of liquid adhesive and sealant products containing DCHP are covered under the Application of adhesives and sealants – liquids OES (*i.e.,* Industrial COUs: Adhesives and sealants (transportation equipment manufacturing; computer and electronic product manufacturing) and Commercial COUs: Adhesives and sealants). See Appendix F of the *Environmental Release and Occupational Exposure Assessment for Dicyclohexyl Phthalate (DCHP)* (U.S. EPA, 2025s) for product details.

MOEs for high-end acute, intermediate, and chronic inhalation exposure ranged from 6.4 to 10 for average adult workers and females of reproductive age, while high-end dermal MOEs ranged from 532 to 845 (benchmark = 30). For central tendency, MOEs for the same population and exposure scenarios ranged from 116 to 201 for inhalation exposure and 1,064 to 1,821 for dermal exposures (benchmark = 30). For dust exposure from solid products, the aggregation of inhalation and dermal exposures led to negligible differences in risk when compared to risk estimates from inhalation exposure alone. The use of liquid adhesive and sealant products is not expected to produce an inhalation exposure and therefore dermal exposure to the liquid is expected to be the dominant route of exposure. For liquid adhesive and

sealant products, the high-end and central tendency dermal MOEs ranged from 532 to 845 and 1,064 to 1,821, respectively (benchmark = 30). The MOEs presented in this paragraph are with no use of PPE. Section 4.3.2.4 and Table 4-15 provides more information on PPE that could be used to raise the MOEs above the benchmark MOE.

EPA estimated worker inhalation exposures to dust from solid products using the PNOR Model for dust exposures (U.S. EPA, 2021b). The application of adhesives and sealants does not fall under a specific NAICS Code; therefore, EPA used the entire PNOR model dataset to estimate DCHP particulate concentrations in the air during the use of solid DCHP-containing adhesive and sealant products. EPA determined the 50th and 95th percentiles of the surrogate dust monitoring data and multiplied these dust concentrations by the maximum potential DCHP concentration in solid adhesive and sealant products (*i.e.*, 55%) to estimate DCHP particulate concentrations in the air. EPA assumed that the concentration of DCHP in the dust in the air is the same the material. Therefore, the differences in the central tendency and high-end dust concentrations led to differences between the central tendency and high-end risk estimates.

Although the PNOR (*i.e.*, dust) concentration data provides a reliable range of dust concentrations that a worker may experience in a variety of industries, the composition of workplace dust is uncertain. The exposure and risk estimates assume that the concentration of DCHP in workplace dust is the same as the concentration of DCHP in the adhesive or sealant material. However, it is likely that workplace dust contains a variety of constituents that do not contain any DCHP in addition to particles from solid DCHP-containing adhesive and sealant products. The constituents that do not contain DCHP would dilute the overall concentration of DCHP in the dust, and the concentration of DCHP in workplace dust is likely less than the concentration of DCHP in solid adhesive and sealant products. Due to the uncertainty of DCHP concentrations in workplace dust, central tendency values of exposure are expected to be most reflective of worker exposures within the COUs covered under the Application of adhesives and sealants – solids OES (*i.e.*, Industrial COUs: Adhesives and sealants (Transportation equipment manufacturing; Computer and electronic product manufacturing) and Commercial COUs: Adhesives and sealants).

***Application of Paints and Coatings***

The applications of paints and coatings were assessed for solid and liquid products containing DCHP. For the liquid and solid paint and coating products containing DCHP, inhalation exposure is expected to be the dominant route of exposure. For liquids, inhalation exposure is expected to occur primarily from mist during spray application of the product, and for solids, inhalation exposure is expected to primarily occur from dust release of the solid product prior to mixing with other components. Therefore, EPA distinguished exposure estimates between *liquid spray* and *solid dust* exposure from the application of paint and coating products containing DCHP. MOEs for high-end acute, intermediate, and chronic inhalation exposure from the *liquid spray application scenario* ranged from 2.0 to 3.2 for average adult workers and females of reproductive age, while high-end dermal MOEs ranged from 532 to 845 (benchmark = 30). For central tendency of the *liquid spray application scenario*, MOEs for the same populations and exposure scenarios ranged from 41 to 66 for inhalation exposures and 1,064 to 1,689 for dermal exposures (benchmark = 30). MOEs for high-end acute, intermediate, and chronic inhalation exposure from the *solid dust scenario* ranged from 3.5 to 5.7 for average adult workers and females of reproductive age, while high-end dermal MOEs ranged from 532 to 845 (benchmark = 30). For central tendency of the *solid dust scenario*, MOEs for the same populations and exposure scenarios ranged from 62 to 100 for inhalation exposure and 1,064 to 1,689 for dermal exposure (benchmark = 30). Aggregation of inhalation and dermal exposures led to small differences in MOEs when compared to MOE estimates from dominant exposure route alone. The MOEs presented in this paragraph are with no

use of PPE. Section 4.3.2.4 and Table 4-15 provides more information on PPE that could be used to raise the MOEs above the benchmark MOE.

For the Application of paint and coatings – liquids exposure scenario, EPA relied on mist monitoring data from the ESD on Coating Application via Spray-Painting in the Automotive Refinishing Industry (OECD, 2011a), which showed that the central tendency (*i.e.,* 50th percentile) of mist concentrations from automotive refinishing was 3.38 mg/m$^3$ and the high-end (*i.e.,* 95th percentile) was 22.1 mg/m$^3$. These mist concentration data were derived from a variety of industrial and commercial automotive refinishing scenarios (*e.g.,* different gun types and booth configurations), but all scenarios considered in the ESD commonly used the spray application of auto refinishing coatings. While the tasks evaluated for mist concentrations varied in time, with the 95th percentile of spray times among tasks being 141 minutes, EPA assumed that these mist concentrations may be persistent in an environment where spraying occurs throughout all or most of the work day. The more highly pressurized spray guns generally lead to higher inhalation exposure levels, and less pressurized spray guns generally lead to lower inhalation exposure levels. The same trend is expected for dermal exposure. Specifically, high-pressure spray applications are more likely to lead to higher levels of dermal exposure, and low-pressure spray guns are more likely to lead to lower levels of dermal exposure. However, there are a variety of factors other than spray equipment type that affect exposure levels, such as spray booth ventilation configuration, product concentration, and spray duration. High-end levels of exposure represent scenarios where one or more factors are contributing to unusually elevated exposure levels, whereas central tendency levels of exposure represent more typical levels of exposure for scenarios where there are few factors contributing to increased exposure. There is uncertainty regarding the particular combination of factors that would lead to high-end levels of exposure.

The range of exposure estimates shown in Table 4-15 for Application of paints and coatings – liquids are potentially reflective of industrial or commercial operations where paints and coatings are applied using spray methods (*i.e.,* Industrial COU: Paints and coatings; and Commercial COU: Paints and coatings). As described in the section above, EPA assumed that task-based mist concentrations may be persistent throughout the entirety of a work day, which is realistic but on the conservative end of expected exposure duration for spray coating scenarios. The central tendency estimates of the spray application scenario represent the midpoint of available product concentrations and the mist concentration from the 50th percentile of the data presented in the ESD on Coating Application via Spray-Painting in the Automotive Refinishing Industry (OECD, 2011a), and these levels of exposure are expected to be typical for standard working conditions where workers are spray applying paint and coating products containing DCHP for up to 8 hours per day. However, it is noted that there are several factors that affect exposure levels related to the spray application of paint and coating chemicals—including spray equipment type, spray booth ventilation configuration, product concentration, and spray duration.

High-end levels of exposure may occur if one or more of these factors contribute to elevated levels of exposure; however, there is uncertainty regarding the conditions associated with high-end exposures. Because the high-end risk estimates are based on high-end mist concentration levels, high-end product concentration, and high-end exposure duration, the high-end risk values presented in Table 4-15 for Application of paints and coatings – liquids may overestimate exposures for typical working conditions. However, EPA does expect high-pressure spray application of paint and coating products containing DCHP based on the available product information. Specifically, EPA identified one product (Carboline, 2019b) that is intended for high-pressure spray application and the concentration of DCHP in the product is listed as up to 2.5 percent. For an 8-hour work day spent spraying with a paint/coating product containing 2.5 percent DCHP, mist levels exceeding 12.8 mg/m$^3$ (*i.e.,* 91st percentile of the distribution

of mist monitoring data) would result in risk values below the benchmark MOE. Although most worker exposures to DCHP through spray application of paints and coatings are expected to be closer to the central tendency exposure values for this COU, a confluence of a subset of variables (*e.g.*, low ventilation, high-pressure spray, *etc.*) would result in risk below the benchmark. While most workers are not expected to experience elevated exposures (*i.e.*, greater than 90th percentile of mist concentration data for an 8-hour period) on a daily basis, it is considered plausible and expected for such exposures to occur in an acute one-day scenario.

For any liquid paint and coating products that are applied using non-spray methods (*i.e.*, Industrial COUs: Inks, toner, and colorant products [*e.g.*, screen printing ink]; Cellulose film production; Paints and coatings; and Commercial COUs: Inks, toner, and colorant products [*e.g.*, screen printing ink]; Paints and coatings), inhalation exposures are expected to be *de minimis* because mists or dusts are not generated during application and the vapor pressure of DCHP is extremely low at room temperature. However, workers may be exposed through the dermal route under non-spray application scenarios. Therefore, exposures associated with the non-spray application of liquid paint and coating products containing DCHP are characterized by the range of dermal risk values only, which are shown in Table 4-15 for Application of paints and coatings – liquids.

For the Application of paints and coatings – solids exposure scenario, EPA estimated worker inhalation exposures to dust from solid products using the PNOR Model for dust exposures (U.S. EPA, 2021b). The application of paints and coatings does not fall under a specific NAICS Code; therefore, EPA used the entire PNOR model dataset to estimate DCHP particulate concentrations in the air during the use of solid DCHP-containing paint and coating products. EPA determined the 50th and 95th percentiles of the surrogate dust monitoring data and multiplied these dust concentrations by the maximum potential DCHP concentration in the solid paint and coating component (*i.e.*, 100%) to estimate DCHP particulate concentrations in the air. EPA assumed that the concentration of DCHP in the dust in the air is the same the material. Also, the value of 100 percent was used as an upper bound for concentration and there was no attempt to refine the upper limit since the MOEs for occupational exposures were above the benchmark for application of paints and coatings (solids). Therefore, the differences in the central tendency and high-end dust concentrations led to differences between the central tendency and high-end risk estimates.

Although the PNOR (*i.e.*, dust) concentration data provides a reliable range of dust concentrations that a worker may experience in a variety of industries, the composition of workplace dust is uncertain. The exposure and risk estimates assume that the concentration of DCHP in workplace dust is the same as the concentration of DCHP in the solid paint and coating component. However, it is likely that workplace dust contains a variety of constituents that do not contain any DCHP in addition to particles from solid DCHP-containing paint and coating products. The constituents that do not contain DCHP would dilute the overall concentration of DCHP in the dust, and the concentration of DCHP in workplace dust is likely less than the concentration of DCHP in solid paint and coating products. Due to the uncertainty of DCHP concentrations in workplace dust, central tendency values of exposure are expected to be most reflective of worker exposures within the COUs covered under the Application of paints and coatings – solids OES (*i.e.*, Industrial COUs: Inks, toner, and colorant products [*e.g.*, screen printing ink]; Cellulose film production; Paints and coatings; and Commercial COUs: Inks, toner, and colorant products [*e.g.*, screen printing ink]; Paints and coatings).

***Use of Laboratory Chemicals***

The use of laboratory chemicals was assessed for solid and liquid products containing DCHP. Inhalation exposure from dust generation is expected to be the dominant route of exposure for solid laboratory

chemicals. MOEs for high-end acute, intermediate, and chronic inhalation exposure ranged from 6.4 to 10 for average adult workers and females of reproductive age, while high-end dermal MOEs ranged from 532 to 845 (benchmark = 30). For central tendency, MOEs for the same population and exposure scenarios ranged from 91 to 157 for inhalation exposure and 1,064 to 1,797 for dermal exposures (benchmark = 30). For dust exposure, the aggregation of inhalation and dermal exposures led to negligible differences in risk when compared to risk estimates from inhalation exposure alone. The use of liquid laboratory chemicals is not expected to produce an inhalation exposure and therefore dermal exposure to the liquid is expected to be the dominant route of exposure. For liquid laboratory chemicals, the high-end and central tendency dermal MOEs ranged from 532 to 845 and 1,064 to 1,797, respectively (benchmark = 30). The MOEs presented in this paragraph are with no use of PPE. Section 4.3.2.4 and Table 4-15 provides more information on PPE that could be used to raise the MOEs above the benchmark MOE.

EPA assessed worker inhalation exposures to dust from solid laboratory chemicals. The literature and product data do not indicate the potential for the generation of mists during the use of liquid lab chemicals. Therefore, inhalation exposures from the use of liquid DCHP-containing lab chemicals containing DCHP are expected to be *de minimis* because there are no mists generated during use and the vapor pressure of DCHP is very low. Consequently, EPA assumed negligible inhalation exposure from the use of liquid lab chemicals and only assessed dermal exposures for liquid laboratory chemical use.

EPA estimated worker inhalation exposures to dust from solid laboratory chemicals using the PNOR Model for dust exposures (U.S. EPA, 2021b). For inhalation exposure to PNOR, EPA determined the 50th and 95th percentiles of the surrogate dust monitoring data taken from facilities with NAIC codes starting with 54 (Professional, Scientific, and Technical Services). EPA determined the 50th and 95th percentiles of the surrogate dust monitoring data and multiplied these dust concentrations by the industry provided maximum potential DCHP concentration in lab chemicals (*i.e.,* 100%) to estimate DCHP particulate concentrations in the air. EPA assumed that the concentration of DCHP in the dust in the air is the same the material. Therefore, the differences in the central tendency and high-end dust concentrations led to differences between the central tendency and high-end risk estimates.

Although the PNOR (*i.e.,* dust) concentration data provides a reliable range of dust concentrations that a worker may experience in the laboratory services industry, the composition of workplace dust is uncertain. The exposure and risk estimates assume that the concentration of DCHP in workplace dust is the same as the concentration of DCHP in the laboratory chemicals. However, it is likely that workplace dust contains a variety of constituents that do not contain any DCHP in addition to particles from solid DCHP-containing laboratory chemicals. The constituents that do not contain DCHP would dilute the overall concentration of DCHP in the dust, and the concentration of DCHP in workplace dust is likely less than the concentration of DCHP in solid laboratory chemicals. Due to the uncertainty of DCHP concentrations in workplace dust, central tendency values of exposure are expected to be most reflective of worker exposures within the COUs covered under the Use of lab chemicals OES (*i.e.,* Commercial COU: Laboratory chemical).

***Fabrication or Use of Final Products or Articles***

For fabrication or use of final products or articles, inhalation exposure from dust generation is expected to be the dominant route of exposure. MOEs for high-end acute, intermediate, and chronic inhalation exposure ranged from 21 to 35 for average adult workers and females of reproductive age, whereas high-end dermal MOEs for the same populations and exposure scenarios ranged from 532 to 845 (benchmark = 30). For central tendency, MOEs for the same population and exposure scenarios ranged from 193 to 311 for inhalation exposure and 1,064 to 1,689 for dermal exposures (benchmark = 30).

Aggregation of inhalation and dermal exposures led to negligible differences in risk when compared to risk estimates from inhalation exposure alone. The MOEs presented in this paragraph are with no use of PPE. Section 4.3.2.4 and Table 4-15 provides more information on PPE that could be used to raise the MOEs above the benchmark MOE.

EPA estimated worker inhalation exposures using the PNOR Model for dust exposures (U.S. EPA, 2021b). For inhalation exposure to PNOR, EPA determined the 50th and 95th percentiles of the surrogate dust monitoring data taken from facilities with NAIC codes starting with 337 (Furniture and Related Product Manufacturing). EPA multiplied these dust concentrations by the maximum DCHP concentration in PVC (*i.e.*, 45%) to estimate DCHP particulate concentrations in the air. EPA assumed that the concentration of DCHP in the dust in the air is the same the material. Therefore, the differences in the central tendency and high-end dust concentrations led to significant differences between the central tendency and high-end risk estimates.

Although the PNOR (*i.e.*, dust) concentration data provides a reliable range of dust concentrations that a worker may experience in the end use and fabrication industries, the composition of workplace dust is uncertain. The exposure and risk estimates assume that the concentration of DCHP in workplace dust is the same as the concentration of DCHP in the PVC material. However, it is likely that workplace dust contains a variety of constituents that do not contain any DCHP in addition to particles from DCHP-containing products or articles. The constituents that do not contain DCHP would dilute the overall concentration of DCHP in the dust, and the concentration of DCHP in workplace dust is likely less than the concentration of DCHP in final products and articles. Due to the uncertainty of DCHP concentrations in workplace dust, central tendency values of exposure are expected to be most reflective of worker exposures within the COUs covered under the Fabrication or use of final products or articles OES (*i.e.*, Industrial COU: Other articles with routine direct contact during normal use including rubber articles; plastic articles (hard) (*e.g.*, transportation equipment manufacturing); and Commercial COUs: Building/construction materials not covered elsewhere; Other articles with routine direct contact during normal use including rubber articles; Plastic articles [hard]).

***Recycling and Waste Handling, Treatment, and Disposal***

The approaches for the Recycling OES and the Waste handling, treatment and disposal OES are identical and therefore consolidated here. For both OESs, the inhalation exposure from dust generation is expected to be the dominant route of exposure. MOEs for high-end acute, intermediate, and chronic inhalation exposure ranged from 11 to 18 for average adult workers and females of reproductive age, while high-end dermal MOEs for the same populations and exposure scenarios ranged from 532 to 845 (benchmark = 30) for both OESs. The central tendency MOEs for the same populations and exposure scenarios ranged from 161 to 291 for inhalation exposure and 1,064 to 1,894 for dermal exposure for both OES (benchmark = 30). Aggregation of inhalation and dermal exposures led to negligible differences in risk when compared to risk estimates from inhalation exposure alone. The MOEs presented in this paragraph are with no use of PPE. Section 4.3.2.4 and Table 4-15 provides more information on PPE that could be used to raise the MOEs above the benchmark MOE.

EPA estimated worker inhalation exposures using the PNOR Model for dust exposures (U.S. EPA, 2021b). For inhalation exposure to PNOR, EPA determined the 50th and 95th percentiles of the surrogate dust monitoring data taken from facilities with NAIC codes starting with 56 (Administrative and Support and Waste Management and Remediation Services). EPA multiplied these dust concentrations by the industry provided maximum DCHP concentration in PVC (*i.e.*, 45%) to estimate DCHP particulate concentrations in the air. PVC concentration was used for this estimate because it is expected to be the predominant type of waste containing DCHP that is recycled or disposed of. EPA

assumed that the concentration of DCHP in the dust in the air is the same the material. Therefore, the differences in the central tendency and high-end dust concentrations led to significant differences between the central tendency and high-end risk estimates.

Although the PNOR (*i.e.,* dust) concentration data provides a reliable range of dust concentrations that a worker may experience in the recycling and disposal industry, the composition of workplace dust is uncertain. The exposure and risk estimates are based on the assumption that the concentration of DCHP in workplace dust is the same as the concentration of DCHP in PVC plastics. However, it is likely that workplace dust contains a variety of constituents that do not contain any DCHP in addition to particles from DCHP-containing products or articles. The constituents that do not contain DCHP would dilute the overall concentration of DCHP in the dust, and the concentration of DCHP in workplace dust is likely less than the concentration of DCHP in recycled or disposed products or articles. Therefore, central tendency values of exposure are expected to be more reflective of worker exposures within the COUs covered under the Recycling and the Disposal OESs (*i.e.*, Processing COU: Recycling; and Disposal COU: Disposal).

***Distribution in Commerce***

For purposes of assessment in this risk evaluation, distribution in commerce consists of the transportation associated with the moving of DCHP or DCHP-containing products and/or articles between sites manufacturing, processing, and use COUs, or the transportation of DCHP containing wastes to recycling sites or for final disposal. EPA expects all the DCHP or DCHP-containing products and/or articles to be transported in closed system or otherwise to be transported in a form (*e.g.,* articles containing DCHP) such that there is negligible potential for releases except during an incident. Therefore, no occupational exposures are reasonably expected to occur, and no separate assessment was performed for estimating releases and exposures from distribution in commerce.

#### 4.3.2.1 Risk Estimates for ONUs

ONUs may be exposed to dust, vapors or mists that enter their breathing zone while working in locations near where DCHP handling occurs. For inhalation exposure, in absence of data specific to ONU exposure, EPA assumes that worker central tendency exposure is representative of ONU exposure. Also, dermal exposure to ONUs were assessed for scenarios where there may be dust or mist generation since it is possible that in some situations an ONU may inadvertently contact a surface that has been contaminated by dust or mist containing DCHP. Dermal exposure to ONUs is represented by incidental skin contact equal to the surface area of one palm.

#### 4.3.2.2 Overall Confidence in Worker Risk Estimates for Individual DCHP COUs

As described in Section 4.1.1.5, EPA has moderate confidence in the assessed occupational inhalation and dermal exposures (Table 4-5) and robust confidence in the non-cancer POD selected to characterize risk from acute, intermediate, and chronic duration exposures to DCHP (Section 4.2). Overall, the Agency has moderate confidence in the risk estimates calculated for worker inhalation and dermal exposure scenarios. Sources of uncertainty associated with the occupational COUs are discussed above in Section 4.3.2.

#### 4.3.2.3 Consideration of Personal Protective Equipment (PPE)

OSHA and 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 PPE. The hierarchy of controls prioritizes the most effective measures, which eliminate or substitute the harmful chemical (*e.g.,* use a different

process, substitute with a less hazardous material), thereby preventing or reducing exposure potential. Following elimination and substitution, the hierarchy recommends engineering controls to isolate employees from the hazard, followed by administrative controls or changes in work practices to reduce exposure potential (*e.g.*, source enclosure, local exhaust ventilation systems). Administrative controls are policies and procedures instituted and overseen by the employer to protect worker exposures. OSHA and NIOSH recommend the use of PPE (*e.g.*, respirators, gloves) as the last means of control, when the other control measures cannot reduce workplace exposure to an acceptable level.

#### 4.3.2.3.1 Respiratory Protection

OSHA's Respiratory Protection Standard (29 CFR 1910.134) requires employers in certain industries to address workplace hazards by implementing engineering control measures and, if these are not feasible, providing respirators that are applicable and suitable for the purpose intended. Respirator selection provisions are provided in section 1910.134(d) and require that appropriate respirators be selected based on the respiratory hazard(s) to which the worker will be exposed, in addition to workplace and user factors that affect respirator performance and reliability. Assigned protection factors (APFs) are provided in Table 1 under section 1910.134(d)(3)(i)(A) (see below in Table 4-14) and refer to the level of respiratory protection that a respirator or class of respirators is expected to provide to employees when the employer implements a respiratory protection program according to the requirements of OSHA's Respiratory Protection Standard.

Workers are required to use respirators that meet or exceed the required level of protection listed in Table 4-14. 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 4-14. 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) | | | | | |

#### 4.3.2.4 Occupational Risk Estimates and Effect of PPE

Table 4-15 presents the acute duration risk estimates for all worker populations and the corresponding personal protection equipment (PPE) that would result in an acute worker MOE above the benchmark MOE. For occupational risk estimates, female workers of reproductive age are the most sensitive exposed population with the lowest worker MOEs. Furthermore, the acute exposure duration results in the lowest worker MOEs for this population. Risk estimates for all populations, durations, and health effects for all the COUs/OES are included in the *Risk Calculator for Occupational Exposures for*

*Dicyclohexyl Phthalate (DCHP)* (U.S. EPA, 2025ad). Additionally, the risk calculator contains MOE calculations and PPE information for all the OES.

Table 4-15 includes three main sections according to the route of exposure: inhalation, dermal, and aggregate exposure. Assigned protection factors (APF) are the workplace level of respiratory protection that a respirator or class of respirators is expected to provide to employees when implemented as part of a continuous, effective respiratory protection program that includes training, fit testing, maintenance and use requirements. For inhalation, typical respirator APF values of 5, 10, 25, 50, 1,000, and 10,000 were compared to the calculated MOE and the benchmark MOE to determine the level of APF that could be used to bring MOEs above the benchmark MOE. Similarly for aggregate exposures, the protection factor that could be used to bring MOEs above the benchmark are also shown. The appropriateness of any protection factor that demonstrates exposures resulting in a worker MOE above the benchmark MOE may require additional considerations (*e.g.*, chemical-specific form, formulation, exposure scenario, etc.). The presented protection factors simply represent a value by which corresponding PPE may theoretically increase the estimated worker MOE above the benchmark MOE. The practicality and feasibility of implementing any PPE corresponding to a protection factor is part of a larger evaluation of effective occupational control strategies and will be further discussed in any forthcoming risk management actions. Such an evaluation should take into consideration the hierarchy of hazard control options. The hierarchy of controls from most to least effective are elimination, substitution, engineering controls, administrative controls, and personal protective equipment.

For inhalation, based on the risk characterization in Section 4.3.2, the central tendency exposure estimates are expected to be most reflective of worker inhalation exposures for all the OES except the Application of Paints and Coatings (liquid) scenario where both the central and high-end exposure estimates may potentially be reflective of worker inhalation exposures. Table 4-15 shows that using PPE for inhalation scenarios when the MOEs are below the benchmark MOE, may decrease inhalation exposure levels such that the resulting MOE values are above the benchmark MOE of 30.

**Table 4-15. Occupational Risk Summary Table for DCHP**

| Life Cycle Stage/ Category | Subcategory | OES | Worker Pop. | Expos. Level | Inhalation Risk Estimates (Benchmark MOE = 30) | | | | Dermal Risk Estimates (Benchmark MOE = 30) | | | Aggregate Risk Estimates (Benchmark MOE = 30) | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Acute | Intermed. | Chronic | APF [a] | Acute | Intermed. | Chronic | Acute | Intermed. | Chronic | APF [a] |
| Manufacturing – Domestic Manufacturing | Domestic manufacturing | Manufacturing | Average Adult Worker | CT | 40 | 55 | 58 | N/A | 1,064 | 1,451 | 1,553 | 39 | 53 | 56 | N/A |
| | | | | HE | **3.8** | **5.2** | **5.6** | APF 10 | 532 | 725 | 776 | **3.8** | **5.2** | **5.6** | APF 10 |
| | | | Females of Repro. Age | CT | 36 | 49 | 53 | N/A | 1,157 | 1,578 | 1,689 | 35 | 48 | 51 | N/A |
| | | | | HE | **3.5** | **4.7** | **5.1** | APF 10 | 579 | 789 | 845 | **3.5** | **4.7** | **5.0** | APF 10 |
| | | | ONU [b] | CT | 40 | 55 | 58 | N/A | 2,126 | 2,899 | 3,104 | 39 | 54 | 57 | N/A |
| Manufacturing – Importing | Importing | Import and repackaging | Average Adult Worker | CT | 148 | 201 | 259 | N/A | 1,064 | 1,451 | 1,867 | 130 | 177 | 228 | N/A |
| | | | | HE | **6.4** | **8.7** | **9.3** | APF 5 | 532 | 725 | 776 | **6.3** | **8.6** | **9.2** | APF 5 |
| | | | Females of Repro. Age | CT | 134 | 182 | 235 | N/A | 1,157 | 1,578 | 2,031 | 120 | 163 | 210 | N/A |
| Processing – Repackaging | Repackaging (*e.g.*, laboratory chemicals) | | | HE | **5.8** | **7.9** | **8.5** | APF 10 | 579 | 789 | 845 | **5.7** | **7.8** | **8.4** | APF 10 |
| | | | ONU [b] | CT | 148 | 201 | 259 | N/A | 2,126 | 2,899 | 3,731 | 138 | 188 | 242 | N/A |
| Processing – Processing – incorporation into formulation, mixture, or reaction product | Plasticizer in: – adhesive manufacturing | Incorporation into adhesives and sealants | Average Adult Worker | CT | 40 | 55 | 58 | N/A | 1,064 | 1,451 | 1,553 | 39 | 53 | 56 | N/A |
| | Adhesive and sealant chemicals in: – adhesive manufacturing | | | HE | **3.8** | **5.2** | **5.6** | APF 10 | 532 | 725 | 776 | **3.8** | **5.2** | **5.6** | APF 10 |
| | Stabilizing agent in: – adhesive manufacturing | | Females of Repro. Age | CT | 36 | 49 | 53 | N/A | 1,157 | 1,578 | 1,689 | 35 | 48 | 51 | N/A |
| | | | | HE | **3.5** | **4.7** | **5.1** | APF 10 | 579 | 789 | 845 | **3.5** | **4.7** | **5.0** | APF 10 |
| | | | ONU [b] | CT | 40 | 55 | 58 | N/A | 2,126 | 2,899 | 3,104 | 39 | 54 | 57 | N/A |

| Life Cycle Stage/ Category | Subcategory | OES | Worker Pop. | Expos. Level | Inhalation Risk Estimates (Benchmark MOE = 30) | | | | Dermal Risk Estimates (Benchmark MOE = 30) | | | Aggregate Risk Estimates (Benchmark MOE = 30) | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Acute | Intermed. | Chronic | APF [a] | Acute | Intermed. | Chronic | Acute | Intermed. | Chronic | APF [a] |
| Processing – Processing – incorporation into formulation, mixture, or reaction product | Plasticizer in: – paint and coating manufacturing – printing ink manufacturing | Incorporation into paints and coatings | Average Adult Worker | CT | 40 | 55 | 58 | N/A | 1,064 | 1,451 | 1,553 | 39 | 53 | 56 | N/A |
| | Stabilizing agent in: – Paint and coating manufacturing | | | HE | **3.8** | **5.2** | **5.6** | APF 10 | 532 | 725 | 776 | **3.8** | **5.2** | **5.6** | APF 10 |
| | | | Females of Repro. Age | CT | 36 | 49 | 53 | N/A | 1,157 | 1,578 | 1,689 | 35 | 48 | 51 | N/A |
| | | | | HE | **3.5** | **4.7** | **5.1** | APF 10 | 579 | 789 | 845 | **3.5** | **4.7** | **5.0** | APF 10 |
| | | | ONU [b] | CT | 40 | 55 | 58 | N/A | 2,126 | 2,899 | 3,104 | 39 | 54 | 57 | N/A |
| Processing – Processing – incorporation into formulation, mixture, or reaction product | Stabilizing agent in: – asphalt paving, roofing, and coating materials manufacturing | Incorporation into other formulations, mixtures, or reaction products | Average Adult Worker | CT | 40 | 55 | 58 | N/A | 1,064 | 1,451 | 1,553 | 39 | 53 | 56 | N/A |
| | | | | HE | **3.8** | **5.2** | **5.6** | APF 10 | 532 | 725 | 776 | **3.8** | **5.2** | **5.6** | APF 10 |
| | | | Females of Repro. Age | CT | 36 | 49 | 53 | N/A | 1,157 | 1,578 | 1,689 | 35 | 48 | 51 | N/A |
| | | | | HE | **3.5** | **4.7** | **5.1** | APF 10 | 579 | 789 | 845 | **3.5** | **4.7** | **5.0** | APF 10 |
| | | | ONU [b] | CT | 40 | 55 | 58 | N/A | 2,126 | 2,899 | 3,104 | 39 | 54 | 57 | N/A |
| Processing – Processing – incorporation into formulation, mixture, or reaction product | Plasticizer in: – plastic material and resin manufacturing – plastics product manufacturing | PVC plastics compounding | Average Adult Worker | CT | 83 | 114 | 137 | N/A | 1,064 | 1,451 | 1,741 | 77 | 106 | 127 | N/A |
| | | | | HE | **4.1** | **5.6** | **6.0** | APF 10 | 532 | 725 | 776 | **4.1** | **5.5** | **5.9** | APF 10 |
| | Stabilizing agent in: – plastics product manufacturing | | Females of Repro. Age | CT | 76 | 103 | 124 | N/A | 1,157 | 1,578 | 1,894 | 71 | 97 | 116 | N/A |
| | | | | HE | **3.7** | **5.0** | **5.4** | APF 10 | 579 | 789 | 845 | **3.7** | **5.0** | **5.4** | APF 10 |
| | | | ONU [b] | CT | 83 | 114 | 137 | N/A | 2,126 | 2,899 | 3,480 | 80 | 110 | 131 | N/A |

| Life Cycle Stage/ Category | Subcategory | OES | Worker Pop. | Expos. Level | Inhalation Risk Estimates (Benchmark MOE = 30) | | | | Dermal Risk Estimates (Benchmark MOE = 30) | | | Aggregate Risk Estimates (Benchmark MOE = 30) | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Acute | Intermed. | Chronic | APF [a] | Acute | Intermed. | Chronic | Acute | Intermed. | Chronic | APF [a] |
| Processing – Processing – incorporation into article | Plasticizer in: – Plastics product manufacturing | PVC plastics converting | Average Adult Worker | CT | 186 | 253 | 309 | N/A | 1,064 | 1,451 | 1,773 | 158 | 215 | 263 | N/A |
| | | | | HE | **9.1** | **12** | **13** | APF 5 | 532 | 725 | 776 | **8.9** | **12** | **13** | APF 5 |
| | | | Females of Repro. Age | CT | 168 | 229 | 280 | N/A | 1,157 | 1,578 | 1,929 | 147 | 200 | 244 | N/A |
| | | | | HE | **8.2** | **11** | **12** | APF 5 | 579 | 789 | 845 | **8.1** | **11** | **12** | APF 5 |
| | | | ONU [b] | CT | 186 | 253 | 309 | N/A | 2,126 | 2,899 | 3,543 | 171 | 233 | 284 | N/A |
| Processing – Processing – incorporation into formulation, mixture, or reaction product | Plasticizer in: – plastics product manufacturing – rubber product manufacturing – plastic material and resin manufacturing | Non-PVC material compounding | Average Adult Worker | CT | 139 | 190 | 217 | N/A | 1,064 | 1,451 | 1,659 | 123 | 168 | 192 | N/A |
| | | | | HE | **6.8** | **9.3** | **9.9** | APF 5 | 532 | 725 | 776 | **6.7** | **9.2** | **9.8** | APF 5 |
| | | | Females of Repro. Age | CT | 126 | 172 | 196 | N/A | 1,157 | 1,578 | 1,805 | 114 | 155 | 177 | N/A |
| | Stabilizing agent in: – Plastics product manufacturing | | | HE | **6.2** | **8.4** | **9.0** | APF 5 | 579 | 789 | 845 | **6.1** | **8.3** | **8.9** | APF 10 |
| | | | ONU [b] | CT | 139 | 190 | 217 | N/A | 2,126 | 2,899 | 3,316 | 131 | 178 | 204 | N/A |
| Processing – Processing – incorporation into article | Plasticizer in: – plastics product manufacturing – rubber product manufacturing | Non-PVC material converting | Average Adult Worker | CT | 417 | 569 | 696 | N/A | 1,064 | 1,451 | 1,773 | 300 | 409 | 500 | N/A |
| | | | | HE | **20** | **28** | 30 | APF 5 | 532 | 725 | 776 | **20** | **27** | **29** | APF 5 |
| | | | Females of Repro. Age | CT | 378 | 515 | 630 | N/A | 1,157 | 1,578 | 1,929 | 285 | 388 | 475 | N/A |
| | | | | HE | **18** | **25** | **27** | APF 5 | 579 | 789 | 845 | **18** | **24** | **26** | APF 5 |
| | | | ONU [b] | CT | 417 | 569 | 696 | N/A | 2,126 | 2,899 | 3,543 | 349 | 476 | 581 | N/A |

| Life Cycle Stage/ Category | Subcategory | OES | Worker Pop. | Expos. Level | Inhalation Risk Estimates (Benchmark MOE = 30) | | | | Dermal Risk Estimates (Benchmark MOE = 30) | | | Aggregate Risk Estimates (Benchmark MOE = 30) | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Acute | Intermed. | Chronic | APF [a] | Acute | Intermed. | Chronic | Acute | Intermed. | Chronic | APF [a] |
| Industrial Use – Finishing agent | Cellulose film production | Application of paints and coatings – liquids | Average Adult Worker | CT | 45 | 62 | 66 | N/A | 1,064 | 1,451 | 1,553 | 44 | 59 | 64 | N/A |
| Industrial Use – Inks, toner, and colorant products | Inks, toner, and colorant products (*e.g.*, screen printing ink) | | | HE | **2.2** | **3.0** | **3.2** | APF 25 | 532 | 725 | 776 | **2.2** | **2.9** | **3.2** | APF 25 |
| | | | Females of Repro. Age | CT | 41 | 56 | 60 | N/A | 1,157 | 1,578 | 1,689 | 40 | 54 | 58 | N/A |
| Commercial Use – Inks, toner, and colorant products | Inks, toner, and colorant products (*e.g.*, screen printing ink) | | | HE | **2.0** | **2.7** | **2.9** | APF 25 | 579 | 789 | 845 | **2.0** | **2.7** | **2.9** | APF 25 |
| | | | ONU [b] | CT | 45 | 62 | 66 | N/A | 2,126 | 2,899 | 3,104 | 45 | 61 | 65 | N/A |
| Industrial Use – Paints and coatings | Paints and coatings | | | | | | | | | | | | | | |
| Commercial Use – Paints and coatings | Paints and coatings | | | | | | | | | | | | | | |
| Industrial Use – Finishing agent | Cellulose film production | Application of paints and coatings – solids | Average Adult Worker | CT | 69 | 94 | 100 | N/A | 1,064 | 1,451 | 1,553 | 64 | 88 | 94 | N/A |
| Industrial Use – Inks, toner, and colorant products | Inks, toner, and colorant products (*e.g.*, screen printing ink) | | | HE | **3.9** | **5.3** | **5.7** | APF 10 | 532 | 725 | 776 | **3.9** | **5.3** | **5.7** | APF 10 |
| Commercial Use – Inks, toner, and colorant products | Inks, toner, and colorant products (*e.g.*, screen printing ink) | | Females of Repro. Age | CT | 62 | 85 | 91 | N/A | 1,157 | 1,578 | 1,689 | 59 | 80 | 86 | N/A |
| | | | | HE | **3.5** | **4.8** | **5.2** | APF 10 | 579 | 789 | 845 | **3.5** | **4.8** | **5.1** | APF 10 |
| Industrial Use – Paints and coatings | Paints and coatings | | ONU [b] | CT | 69 | 94 | 100 | N/A | 2,126 | 2,899 | 3,104 | 66 | 91 | 97 | N/A |
| Commercial Use – Paints and coatings | Paints and coatings | | | | | | | | | | | | | | |

| Life Cycle Stage/ Category | Subcategory | OES | Worker Pop. | Expos. Level | Inhalation Risk Estimates (Benchmark MOE = 30) | | | | Dermal Risk Estimates (Benchmark MOE = 30) | | | Aggregate Risk Estimates (Benchmark MOE = 30) | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Acute | Intermed. | Chronic | APF [a] | Acute | Intermed. | Chronic | Acute | Intermed. | Chronic | APF [a] |
| Industrial Uses – Adhesives and sealants | Adhesives and sealants (*e.g.*, computer and electronic product manufact.; transportation equipment manufact.) | Application of adhesives and sealants – liquids | Average Adult Worker | CT | N/A | N/A | N/A | N/A | 1,064 | 1,451 | 1,674 | 1,064 | 1,451 | 1,674 | N/A |
| | | | | HE | N/A | N/A | N/A | N/A | 532 | 725 | 776 | 532 | 725 | 776 | N/A |
| | | | Females of Repro. Age | CT | N/A | N/A | N/A | N/A | 1,157 | 1,578 | 1,821 | 1,157 | 1,578 | 1,821 | N/A |
| Commercial uses – Adhesives and sealants | Adhesives and sealants | | | HE | N/A | N/A | N/A | N/A | 579 | 789 | 845 | 579 | 789 | 845 | N/A |
| | | | ONU | CT | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| Industrial Uses – Adhesives and sealants | Adhesives and sealants in – computer and electronic product manufact.; transportation equipment manufact. | Application of adhesives and sealants – solids | Average Adult Worker | CT | 128 | 175 | 201 | N/A | 1,064 | 1,451 | 1,674 | 114 | 156 | 180 | N/A |
| | | | | HE | **7.1** | **9.7** | **10** | APF 5 | 532 | 725 | 776 | **7.0** | **9.6** | **10** | APF 5 |
| | | | Females of Repro. Age | CT | 116 | 158 | 182 | N/A | 1,157 | 1,578 | 1,821 | 105 | 144 | 166 | N/A |
| Commercial Uses – Adhesives and sealants | Adhesives and sealants | | | HE | **6.4** | **8.8** | **9.4** | APF 5 | 579 | 789 | 845 | **6.4** | **8.7** | **9.3** | APF 5 |
| | | | ONU [b] | CT | 128 | 175 | 201 | N/A | 2,126 | 2,899 | 3,345 | 121 | 165 | 190 | N/A |
| Commercial Use – Laboratory chemicals | Laboratory chemicals | Use of laboratory chemicals – liquid | Average Adult Worker | CT | N/A | N/A | N/A | N/A | 1,064 | 1,451 | 1,652 | 1,064 | 1,451 | 1,652 | N/A |
| | | | | HE | N/A | N/A | N/A | N/A | 532 | 725 | 776 | 532 | 725 | 776 | N/A |
| | | | Females of Repro. Age | CT | N/A | N/A | N/A | N/A | 1,157 | 1,578 | 1,797 | 1,157 | 1,578 | 1,797 | N/A |
| | | | | HE | N/A | N/A | N/A | N/A | 579 | 789 | 845 | 579 | 789 | 845 | N/A |
| | | | ONU | CT | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |

| Life Cycle Stage/ Category | Subcategory | OES | Worker Pop. | Expos. Level | Inhalation Risk Estimates (Benchmark MOE = 30) | | | | Dermal Risk Estimates (Benchmark MOE = 30) | | | Aggregate Risk Estimates (Benchmark MOE = 30) | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Acute | Intermed. | Chronic | APF [a] | Acute | Intermed. | Chronic | Acute | Intermed. | Chronic | APF [a] |
| Commercial Use – Laboratory chemicals | Laboratory chemicals | Use of laboratory chemicals – solid | Average Adult Worker | CT | 101 | 138 | 157 | N/A | 1,064 | 1,451 | 1,652 | 92 | 126 | 143 | N/A |
| | | | | HE | **7.1** | **9.7** | **10** | APF 5 | 532 | 725 | 776 | **7.0** | **9.6** | **10** | APF 5 |
| | | | Females of Repro. Age | CT | 91 | 125 | 142 | N/A | 1,157 | 1,578 | 1,797 | 85 | 116 | 132 | N/A |
| | | | | HE | **6.4** | **8.8** | **9.4** | APF 5 | 579 | 789 | 845 | **6.4** | **8.7** | **9.3** | APF 5 |
| | | | ONU [b] | CT | 101 | 138 | 157 | N/A | 2,126 | 2,899 | 3,302 | 96 | 132 | 150 | N/A |
| Industrial Use – Other articles with routine direct contact during normal use including rubber articles; plastic articles (hard) | Other articles with routine direct contact during normal use including rubber articles; plastic articles (hard) (*e.g.*, transportation equipment manufact.) | Fabrication or use of final products or articles | Average Adult Worker | CT | 213 | 291 | 311 | N/A | 1,064 | 1,451 | 1,553 | 178 | 242 | 259 | N/A |
| | | | | HE | **24** | 32 | 35 | APF 5 | 532 | 725 | 776 | **23** | 31 | 33 | APF 5 |
| | | | Females of Repro. Age | CT | 193 | 263 | 282 | N/A | 1,157 | 1,578 | 1,689 | 166 | 226 | 242 | N/A |
| Commercial Use – Building/ construction materials not covered elsewhere | Building/ construction materials not covered elsewhere | | | HE | **21** | **29** | 31 | APF 5 | 579 | 789 | 845 | **21** | **28** | 30 | APF 5 |
| Commercial Use – Other articles with routine direct contact during normal use including rubber articles; plastic articles (hard) | Other articles with routine direct contact during normal use including rubber articles; plastic articles (hard) | | ONU [b] | CT | 213 | 291 | 311 | N/A | 2,126 | 2,899 | 3,104 | 194 | 264 | 283 | N/A |

| Life Cycle Stage/ Category | Subcategory | OES | Worker Pop. | Expos. Level | Inhalation Risk Estimates (Benchmark MOE = 30) | | | | Dermal Risk Estimates (Benchmark MOE = 30) | | | Aggregate Risk Estimates (Benchmark MOE = 30) | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Acute | Intermed. | Chronic | APF [a] | Acute | Intermed. | Chronic | Acute | Intermed. | Chronic | APF [a] |
| Processing – Recycling | Recycling | Recycling | Average Adult Worker | CT | 178 | 242 | 291 | N/A | 1,064 | 1,451 | 1,741 | 152 | 208 | 249 | N/A |
| | | | | HE | **12** | **17** | **18** | APF 5 | 532 | 725 | 776 | **12** | **16** | **17** | APF 5 |
| | | | Females of Repro. Age | CT | 161 | 219 | 263 | N/A | 1,157 | 1,578 | 1,894 | 141 | 193 | 231 | N/A |
| | | | | HE | **11** | **15** | **16** | APF 5 | 579 | 789 | 845 | **11** | **15** | **16** | APF 5 |
| | | | ONU [b] | CT | 178 | 242 | 291 | N/A | 2,126 | 2,899 | 3,480 | 164 | 224 | 269 | N/A |
| Disposal – Disposal | Disposal | Waste handling, treatment and disposal | Average Adult Worker | CT | 178 | 242 | 291 | N/A | 1,064 | 1,451 | 1,741 | 152 | 208 | 249 | N/A |
| | | | | HE | **12** | **17** | **18** | APF 5 | 532 | 725 | 776 | **12** | **16** | **17** | APF 5 |
| | | | Females of Repro. Age | CT | 161 | 219 | 263 | N/A | 1,157 | 1,578 | 1,894 | 141 | 193 | 231 | N/A |
| | | | | HE | **11** | **15** | **16** | APF 5 | 579 | 789 | 845 | **11** | **15** | **16** | APF 5 |
| | | | ONU [b] | CT | 178 | 242 | 291 | N/A | 2,126 | 2,899 | 3,480 | 164 | 224 | 269 | N/A |

[a] This value is the protection factor of PPE required to raise the acute MOE above the benchmark of 30. The assigned protection factors (APF) associated with different types of respirators based on function (air-purifying, powered air purifying, supplied air) and fit (quarter mask, half-mask, full-face piece, helmet/hood, loose-fitting facepiece) are presented above. It should be noted that certain respirators are only applicable to specific types of inhalation exposure. See the OSHA Small Entity Compliance Guide for the Respiratory Protection Standard (accessed December 19, 2025) for detailed descriptions on the respirators corresponding to the APFs in this table.

[b] APF = assigned protection factor; CT = central tendency; Expos. = exposure, HE = high-end; MOE = margin of exposure; Pop. = population; Repro. = reproductive

[c] Benchmark MOE = 30. **Bold** text in a gray shaded cell indicates an MOE is below the benchmark value of 30.

### 4.3.3 Risk Estimates for Consumers

This section summarizes risk estimates for consumers from inhalation, ingestion, and dermal exposures, as well as aggregated exposures, to DCHP from individual DCHP COUs across routes. In this section, risks are calculated for all exposed populations based on the DCHP-derived PODs described in Section 4.2.2. Subsequently in Section 4.4.5, those same risks for consumers that are adults of reproductive age, infants, children, and teenagers exposed to DCHP at the highest levels (acute durations) are calculated using the more robust RPFs described in Section 4.4.1 and added to estimates of national non-attributable exposure of five toxicologically similar phthalates for an estimate of cumulative risk.

Table 4-16 summarizes the dermal, inhalation, ingestion, and aggregate MOEs used to characterize non-cancer risk for acute, intermediate, and chronic exposure to DCHP and presents these values for all life stages for each COU. A screening level assessment for consumers considers high-intensity exposure scenarios that rely on conservative assumptions to assess exposures that would be expected to be on the high end of the expected exposure distribution. The corresponding high-intensity exposure scenario risk estimates are used as a conservative screening approach, see description of each exposure scenario per COU below. MOEs for high-intensity exposure scenarios are shown for all consumer COUs, while MOEs for medium-intensity exposure scenarios are shown only for COUs with high-intensity MOEs below the benchmark of 30 (no scenarios were below the benchmark of 30). Exposure risk estimates were calculated considering product and article user and bystander. Bystanders are people that are not in direct use or application of a product but can be exposed to DCHP by proximity to the use of the product via inhalation of gas-phase emissions or suspended dust. Some product scenarios were assessed for children under 10 years as bystanders and children older than 11 years as users, because the products were not targeted for direct use by young children (<10 years). In instances where a life stage could reasonably be either a product user or bystander, the inputs for a user were selected because that scenario would result in larger exposure doses.

Of note, the risk summary below is based on the most sensitive non-cancer endpoint for all relevant duration scenarios (*i.e.,* developmental toxicity for acute, intermediate, and chronic durations). MOEs for all high-, medium- and low-intensity exposure scenarios for all COUs are provided in the *Consumer Risk Calculator for Dicyclohexyl Phthalate (DCHP)* (U.S. EPA, 2025e).

***COUs with MOEs for High-Intensity Exposure Scenarios Above Benchmark***

All consumer COUs product and article examples resulted in MOEs for high-intensity exposure scenarios ranging from 740 for acute duration dermal exposure to DCHP from outdoor seating for infants (less than one year old) to 950,000 for intermediate duration inhalation of suspended dust from automotive adhesives for adults (21+ years) (Table 4-16). Variability in MOEs for these high-intensity exposure scenarios results from use of different exposure factors for each COU and product or article example that led to different estimates of exposure to DCHP. As described in the *Consumer and Indoor Dust Exposure Assessment for Dicyclohexyl Phthalate (DCHP)* (U.S. EPA, 2025c) and *Non-Cancer Human Health Hazard Assessment for Dicyclohexyl Phthalate (DCHP)* (U.S. EPA, 2025x), EPA has moderate to robust confidence in the exposure estimates and robust confidence in the non-cancer hazard value used to estimate non-cancer risk for these COUs.

***Adhesives and Sealants***

Two different scenarios were assessed under this COU for products with differing use patterns for example, adhesives for small repairs (2 products) and automotive adhesives (2 products). The two scenarios capture the variability in product formulation and use patterns in the high-, medium-, and low-intensity use estimates. The small repairs products are used in small amounts and have very short

working times (<5 minutes), which limits the potential for inhalation exposure. However, if dermal exposure occurs during use it is possible that the product may not be washed off immediately, resulting in exposure. As such, both products were modeled for dermal exposure only. The automotive adhesives products may be used for large repairs to vehicle bodies and were assessed for both inhalation and dermal exposure. The overall confidence in the inhalation exposure estimates for this COU is robust because the CEM default parameters are representative and plausible use patterns and location of use. For dermal exposure, EPA used a dermal flux approach. The Agency has moderate confidence in dermal estimates because of the moderate uncertainty in the partitioning from product to skin. In addition, subsequent dermal absorption is not well characterized or confirmed with experimental results. However, other parameters such as frequency and duration of use, and surface area in contact, are well understood and representative, resulting in an overall confidence of moderate in a health protective estimate. Additionally, EPA has robust overall confidence in the underlying chronic POD based on developmental toxicity (Section 4.2).

Aggregate risk from dermal, ingestion, and inhalation exposures to DCHP for the two scenarios was also considered. All three exposure routes are essentially negligible in their overall contribution to the aggregate since the individual MOE values were significantly higher than the benchmark of 30.

***Other Articles with Routine Direct Contact During Normal Use Including Rubber Articles; Plastic Articles (Hard)***

One scenario was assessed under this COU. It considered multiple articles and routine dermal contact with similar use patterns. The scenario for small articles of routine dermal contact was assessed for dermal exposures only because inhalation and ingestion would have low exposure potential due to the small surface area of the articles and limited time spent in an indoor environment before disposal and mouthing was not an expected behavior based on the generic article examples identified.

The small articles with the potential for semi-routine contact scenario considers some generic example descriptions but not specific products (*e.g.*, labels, nitrocellulose, ethylcellulose, chlorinated rubber, PVAc, PVC). These examples are expected to be used in smaller items and the primary exposure route is through dermal contact when handling the goods. Although DCHP content was not reported or measured in specific products, this scenario was included for dermal exposure calculations, which does not use weight fractions. Dermal contact events are likely short and/or infrequent, but an individual could have appreciable daily contact with multiple items. All acute and chronic MOE values were well above the benchmark of 30. The MOE values increase with increasing age due to changes in inhalation rate to body weight ratios, thus leading to decreasing exposure with increasing age.

Dermal absorption estimates are based on the assumption that dermal absorption of DCHP from solid objects would be limited by aqueous solubility of DCHP. EPA has slight to moderate confidence for solid objects because the high uncertainty in the assumption of partitioning from solid to liquid and subsequent dermal absorption is not well characterized. However, other parameters such as frequency and duration of use, and surface area in contact, are well understood and representative, resulting in an overall confidence of slight to moderate in a health protective estimate. Additionally, EPA has robust overall confidence in the underlying chronic POD based on developmental toxicity (Section 4.2). Although the dermal MOE values for this COU are likely an overestimation, the Agency is confident that these results can be further used to inform risk determination.

***Other; Consumer Articles that Contain Dicyclohexyl Phthalate from: Inks, Toner, and Colorant, Paints and Coatings, Adhesives, and Sealants (e.g., Paper Products, Textiles, Products Using Cellulose Film, etc.)***

Three different scenarios were assessed under this COU for articles with differing use patterns: outdoor seating, small articles with potential for routine contact (multiple non-specific articles), and electronics containing dye adhesive (qualitative discussion). The outdoor seating and small articles scenarios were assessed for dermal exposures only. For the outside seating scenario, based on DCHP's waterproofing and weather resistant properties and the expected use case for outdoor seating, EPA anticipated use of this article occurs outdoors where air exchange rates are large; thus, inhalation exposure is expected to be negligible. Dermal exposures were modeled for a scenario where consumers sit on coated surfaces (*e.g.*, on seats at a sporting event or directly on a terrace). The small articles with the potential for semi-routine contact scenario considers generic examples but no specific items were identified (like labels for cleaning products or arts and crafts materials); instead, EPA used article descriptors like labels and packaging adhesives, foil and cellophane lacquers, and printing inks. These articles are expected to be used in small quantities and the primary exposure route is through dermal contact when handling the goods. Although DCHP content was not reported or measured in specific articles, this scenario was included for dermal exposure calculations that do not use weight fractions. Dermal contact events are likely short and/or infrequent, but an individual could have appreciable daily contact with multiple items. The items are not expected to be mouthed and the likelihood of inhalation exposure is minimal due to their small surface area and limited time spent in an indoor environment before disposal. The electronics containing dye adhesive was qualitatively assessed because it is used in small quantities and contained within the electronic articles; thus, no exposures are expected during potential use of these items. An aggregate analysis for this COU was not performed because all scenarios were assessed for dermal exposures only.

EPA has slight to moderate confidence in some aspects of the exposure estimate for solid articles because of the high uncertainty in the assumption of partitioning from solid to liquid and because subsequent dermal absorption is not well characterized. However, other parameters such as frequency and duration of use and surface area in contact are well understood and representative, resulting in an overall confidence of slight to moderate in a health protective estimate. Additionally, EPA has robust overall confidence in the underlying chronic POD based on developmental toxicity (Section 4.2). Although the dermal MOE values for this COU are likely an overestimation, the Agency is confident that these results can be further used to inform risk determination.

#### 4.3.3.1 Overall Confidence in Consumer Risks

As described in Section 4.1.2.3 and in more detail in the *Consumer and Indoor Dust Exposure Assessment Dicyclohexyl Phthalate (DCHP)* (U.S. EPA, 2025c), EPA has moderate and robust confidence in the assessed inhalation, ingestion, and dermal consumer exposure scenarios, and robust confidence in the acute, intermediate and chronic non-cancer PODs selected to characterize risk from acute, intermediate, and chronic duration exposures to DCHP (see Section 4.2 and (U.S. EPA, 2025c)). The exposure doses used to estimate risk relied on conservative, health protective inputs and parameters that are considered representative of a wide selection of use patterns. Sources of uncertainty associated with all consumer COUs are discussed above in Section 4.3.3.

## Table 4-16. Consumer Risk Summary Table

| Life Cycle Stage: COU: Subcategory | Product or Article | Duration | Exposure Route | Exposure Scenario (H, M, L) [a] | Life Stage (years) (Benchmark MOE = 30) | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Infant (<1 year) | Toddler (1–2 years) | Preschooler (3–5 years) | Middle Childhood (6–10 years) | Young Teen (11–15 years) | Teenagers (16–20 years) | Adult (21+ years) |
| Consumer Uses: Adhesives and sealants: Adhesives and sealants | Adhesives for small repairs | Acute [c] | Dermal | H | – | – | – | – | 16,000 | 17,000 | 16,000 |
| | | | Ingestion | H | – | – | – | – | – | – | – |
| | | | Inhalation | H | – | – | – | – | – | – | – |
| | | | Aggregate | H | – | – | – | – | 16,000 | 17,000 | 16,000 |
| | | Intermed. | – | – | – | – | – | – | – | – | – |
| | | Chronic | Dermal | H | – | – | – | – | 110,000 | 120,000 | 110,000 |
| | | | Ingestion | H | – | – | – | – | – | – | – |
| | | | Inhalation | H | – | – | – | – | – | – | – |
| | | | Aggregate | H | – | – | – | – | 110,000 | 120,000 | 110,000 |
| Consumer Uses: Adhesives and sealants: Adhesives and sealants | Automotive adhesives ([b] = MOE for bystander scenario) | Acute [c] | Dermal | H | – | – | – | – | 11,000 | 12,000 | 11,000 |
| | | | Ingestion | H | – | – | – | – | – | – | – |
| | | | Inhalation | H | 20,000 [b] | 21,000 [b] | 26,000 [b] | 37,000 [b] | 43,000 | 52,000 | 63,000 |
| | | | Aggregate | H | 20,000 [b] | 21,000 [b] | 26,000 [b] | 37,000 [b] | 8,800 | 9,800 | 9,600 |
| | | Intermed. | Dermal | H | – | – | – | – | 170,000 | 180,000 | 170,000 |
| | | | Ingestion | H | – | – | – | – | – | – | – |
| | | | Inhalation | H | 300,000 [b] | 310,000 [b] | 390,000 [b] | 560,000 [b] | 650,000 | 780,000 | 950,000 |
| | | | Aggregate | H | 300,000 [b] | 310,000 [b] | 390,000 [b] | 560,000 [b] | 130,000 | 150,000 | 140,000 |
| | | Chronic | – | – | – | – | – | – | – | – | – |
| Consumer Uses: Other articles with routine direct contact during normal use including rubber articles; plastic articles (hard) | Small articles with potential for semi-routine contact: labels, nitrocellulose; ethylcellulose; chlorinated rubber; PVAc; PVC | Acute [c] | Dermal | H | 2,100 | 2,400 | 2,800 | 3,500 | 4,400 | 4,900 | 4,500 |
| | | | Ingestion | H | – | – | – | – | – | – | – |
| | | | Inhalation | H | – | – | – | – | – | – | – |
| | | | Aggregate | H | 2,100 | 2,400 | 2,800 | 3,500 | 4,400 | 4,900 | 4,500 |
| | | Intermed. | – | – | – | – | – | – | – | – | – |
| | | Chronic | Dermal | H | 2,100 | 2,400 | 2,800 | 3,500 | 4,400 | 4,900 | 4,500 |
| | | | Ingestion | H | – | – | – | – | – | – | – |
| | | | Inhalation | H | – | – | – | – | – | – | – |
| | | | Aggregate | H | 2,100 | 2,400 | 2,800 | 3,500 | 4,400 | 4,900 | 4,500 |

| Life Cycle Stage: COU: Subcategory | Product or Article | Duration | Exposure Route | Exposure Scenario (H, M, L) [a] | Life Stage (years) (Benchmark MOE = 30) | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Infant (<1 year) | Toddler (1–2 years) | Preschooler (3–5 years) | Middle Childhood (6–10 years) | Young Teen (11–15 years) | Teenagers (16–20 years) | Adult (21+ years) |
| Consumer Uses: Consumer articles that contain dicyclohexyl phthalate from: Inks, toner, and colorants; Paints and coatings; Adhesives and sealants (*e.g.*, paper products, textiles, products using cellulose film, etc.) | Outdoor seating | Acute [c] | Dermal | H | 740 | 870 | 1,000 | 1,200 | 1,600 | 1,700 | 1,600 |
| | | | Ingestion | H | – | – | – | – | – | – | – |
| | | | Inhalation | H | – | – | – | – | – | – | – |
| | | | Aggregate | H | 740 | 870 | 1,000 | 1,200 | 1,600 | 1,700 | 1,600 |
| | | Intermed. | – | – | – | – | – | – | – | – | – |
| | | Chronic | Dermal | H | 5,200 | 6,100 | 7,000 | 8,700 | 11,000 | 12,000 | 11,000 |
| | | | Ingestion | H | – | – | – | – | – | – | – |
| | | | Inhalation | H | – | – | – | – | – | – | – |
| | | | Aggregate | H | 5,200 | 6,100 | 7,000 | 8,700 | 11,000 | 12,000 | 11,000 |
| Consumer Uses: Consumer articles that contain dicyclohexyl phthalate from: Inks, toner, and colorants; Paints and coatings; Adhesives and sealants (*e.g.*, paper products, textiles, products using cellulose film, etc.) | Small articles with the potential for semi-routine contact: labels, and packaging adhesives, foil and cellophane lacquers, and printing inks | Acute[c] | Dermal | H | 2,100 | 2,400 | 2,800 | 3,500 | 4,400 | 4,900 | 4,500 |
| | | | Ingestion | H | – | – | – | – | – | – | – |
| | | | Inhalation | H | – | – | – | – | – | – | – |
| | | | Aggregate | H | 2,100 | 2,400 | 2,800 | 3,500 | 4,400 | 4,900 | 4,500 |
| | | Intermed. | – | – | – | – | – | – | – | – | – |
| | | Chronic | Dermal | H | 2,100 | 2,400 | 2,800 | 3,500 | 4,400 | 4,900 | 4,500 |
| | | | Ingestion | H | – | – | – | – | – | – | – |
| | | | Inhalation | H | – | – | – | – | – | – | – |
| | | | Aggregate | H | 2,100 | 2,400 | 2,800 | 3,500 | 4,400 | 4,900 | 4,500 |
| Consumer Uses: Consumer articles that contain dicyclohexyl phthalate from: Inks, toner, and colorants; Paints and coatings; Adhesives and sealants (*e.g.*, paper products, textiles, products using cellulose film, etc.) | Electronics containing dye adhesive | Exposures not expected. Identified in dye attach adhesive used in wirebond packaging for semiconductor devices or in automotive cameras. As the adhesive is used in small quantities and contained within the electronic articles, no exposures are expected during potential use of these items | | | | | | | | | |

[a] Exposure scenario intensities include high (H), medium (M), and low (L).
[b] Bystander scenarios
[c] Scaling by the RPF and application of the index chemical POD provides a more sensitive and robust hazard assessment than the DCHP-specific POD, given its more limited toxicological dataset. Please see Table 4-22 for the RPF analysis values.

### 4.3.4 Risk Estimates for General Population Exposed to DCHP through Environmental Releases

EPA used previously peer-reviewed methodologies to conduct a screening level analyses of general population exposures to DCHP associated with TSCA COUs via the ambient air, ambient water, ambient land, and fish ingestion pathways/routes as described in the *Environmental Media, General Population, and Environmental Exposure Assessment for Dicyclohexyl Phthalate (DCHP)* (U.S. EPA, 2025p) and Section 4.1.3. This assessment focuses on subsets of the general population in close proximity to releasing facilities, including fenceline communities.

EPA evaluated surface water, drinking water, fish ingestion, and ambient air pathways quantitatively. Land pathways (*i.e.,* landfills and application of biosolids) were assessed qualitatively. For pathways assessed quantitatively, high-end estimates of DCHP concentration in the various environmental media were used for screening level purposes. EPA used an MOE approach using high-end exposure estimates to determine whether an exposure pathway had potential non-cancer risks. High-end exposure estimates were defined as those associated with the industrial and commercial releases from a COU and OES that resulted in the highest environmental media concentrations. If there is no risk for an individual identified as having the potential for the highest exposure associated with a COU for a given pathway of exposure, then EPA determined that the pathway was not a pathway of concern and it was not pursued further. If any pathways were identified as a pathway of concern for the general population, further exposure assessments for that pathway would be conducted to include higher tiers of modeling when available and exposure estimates developed for additional subpopulations and COUs.

Risk estimates for the screening analysis for the various pathways assessed quantitatively are described in Section 4.1.3. No estimated MOEs were below the benchmark MOE of 30, for high-end exposure scenarios for ambient air. For surface water and fish ingestion exposure, MOEs were below the benchmark for the Application of paints and coatings OES, which discharges to multiple media types. EPA has only slight confidence in risk estimates for the multimedia OESs in the absence of information to proportion what fraction is released to water, as described further in Section 4.1.3**.** For fish ingestion, MOEs were also below the PVC plastics compounding, but only at concentrations that were estimated using many conservative assumptions such as untreated high-end releases into a low flowing water body with a 95th percentile tribal ingestion rate. Therefore, as described in Section 4.1.3, exposure to DCHP through biosolids, landfills, surface water, drinking water, fish ingestion, ambient air, and soil via deposition from ambient air were not determined to be pathways of concern for any COU listed in Table 3-1.

#### 4.3.4.1 Overall Confidence in General Population Screening Level Exposure Assessment

The weight of scientific evidence supporting the general population exposure estimate is decided based on the strengths, limitations, and uncertainties associated with the exposure estimates, which are discussed in detail for ambient air, surface water, drinking water, and fish ingestion in the *Environmental Media, General Population, and Environmental Exposure Assessment for Dicyclohexyl Phthalate (DCHP)* (U.S. EPA, 2025p). EPA summarized its weight of scientific evidence using confidence descriptors: robust, moderate, slight, or indeterminate. The Agency used general considerations (*i.e.,* relevance, data quality, representativeness, consistency, variability, uncertainties) as well as chemical-specific considerations for its weight of scientific evidence conclusions.

EPA determined robust confidence in its qualitative assessment of biosolids and landfills. For its quantitative assessment, the Agency modeled exposure due to various general population exposure

scenarios resulting from different pathways of exposure. Exposure estimates used high-end inputs for the purpose of risk screening. When available, monitoring data were compared to modeled estimates to evaluate overlap, magnitude, and trends. EPA has robust confidence that modeled releases used are appropriately conservative for a screening level analysis. Therefore, the Agency has robust confidence that no exposure scenarios will lead to greater doses than presented in this evaluation. Despite slight and moderate confidence in the estimated values themselves, confidence in exposure estimates capturing high-end exposure scenarios was robust given that many of the modeled values exceeded those of monitored values.

### 4.3.5 Risk Estimates for Potentially Exposed or Susceptible Subpopulations

EPA considered PESS throughout the exposure assessment and throughout the hazard identification and dose-response analysis supporting the DCHP risk evaluation.

Some population group life stages may be more susceptible to the health effects of DCHP exposure. As discussed in Section 4.2 and in EPA's *Non-Cancer Human Health Hazard Assessment for Dicyclohexyl Phthalate* (U.S. EPA, 2025x) and *Technical Support Document for the Cumulative Risk Analysis of DEHP, DBP, BBP, DIBP, DCHP, and DINP Under TSCA* (also called "CRA TSD") (U.S. EPA, 2025ai), exposure to DCHP causes adverse effects on the developing male reproductive system consistent with a disruption of androgen action and phthalate syndrome in experimental animal models. Therefore, females of reproductive age, pregnant women, male infants, male children, and male adolescents are considered to be susceptible subpopulations. These susceptible life stages were considered throughout the risk evaluation. For example, females of reproductive age were evaluated for occupational exposures to DCHP for each COU (Section 4.3.2). Additionally, infants (<1 year), toddlers (1–2 years), preschoolers (3–5 years), middle school children (6–10 years), young teens (11–15 years), and teenagers (16–20 years) were evaluated for exposure to DCHP through consumer products and articles (Section 4.3.3).

EPA also considered cumulative phthalate exposure and risk for female workers of reproductive age, as well as male children and female consumers of reproductive age. Additionally, the Agency used a value of 10 for the $UF_H$ to account for human variability. The Risk Assessment Forum, in *A Review of the Reference Dose and Reference Concentration Processes*, discusses some of the evidence for choosing the default factor of 10 when data are lacking—including toxicokinetic and toxicodynamic factors as well as greater susceptibility of children and elderly populations (U.S. EPA, 2002b).

The available data suggest that some groups or life stages have greater exposure to DCHP. This includes people exposed to DCHP at work, those who frequently use consumer products and/or articles containing high concentrations of DCHP, those who may have greater intake of DCHP per body weight (*e.g.,* infants, children, adolescents) leading to greater exposure. EPA accounted for these populations with greater exposure in the DCHP risk evaluation as follows:

- EPA evaluated a range of OESs for workers and ONUs, including high-end exposure scenarios for females of reproductive age (a susceptible subpopulation) and average adult workers.
- EPA evaluated a range of consumer exposure scenarios, including high-intensity exposure scenarios for infants and children (susceptible subpopulations). These populations had greater intake per body weight.
- EPA evaluated a range of general population exposure scenarios, including high-end exposure scenarios for infants and children (susceptible subpopulations). These populations had greater intake per body weight.

- EPA evaluated exposure to DCHP through fish ingestion for subsistence fishers and Tribal populations.
- EPA aggregated occupational inhalation and dermal exposures for each COU for females of reproductive age (a susceptible subpopulation) and average adult workers.
- EPA aggregated consumer inhalation, dermal, and oral exposures for each COU for infants and children (susceptible subpopulations).
- EPA evaluated cumulative exposure to BBP, DBP, DEHP, DIBP, and DINP for the U.S. civilian population using NHANES urinary biomonitoring data and reverse dosimetry for females of reproductive age (16–49 years) and male children (3–5, 6–11, and 12–15 years of age).
- For females of reproductive age, black non-Hispanic women had higher, albeit not statistically significantly higher, 95th percentile cumulative exposures to BBP, DBP, DEHP, DIBP, and DINP compared to women of other races (*e.g.,* white non-Hispanic, Mexican America). The 95th percentile cumulative exposure estimate for black non-Hispanic women served as the non-attributable national cumulative exposure estimate used by EPA to evaluate cumulative risk to workers and consumers.

## 4.4 Cumulative Risk Considerations

EPA developed a *Technical Support Document for the Cumulative Risk Analysis of DEHP, DBP, BBP, DIBP, DCHP, and DINP Under TSCA* (U.S. EPA, 2025ai) (CRA TSD) for the CRA of six toxicologically similar phthalates being evaluated under Section 6 of the Toxic Substances Control Act (TSCA): di(2-ethylhexyl) phthalate (DEHP), butyl benzyl phthalate (BBP), dibutyl phthalate (DBP), DCHP, diisobutyl phthalate (DIBP), and diisononyl phthalate (DINP). EPA previously issued a *Draft Proposed Approach for Cumulative Risk Assessment of High-Priority Phthalates and a Manufacturer-Requested Phthalate under the Toxic Substances Control Act* (draft 2023 approach), which outlined an approach for this assessment (U.S. EPA, 2023c). EPA's proposal was subsequently peer reviewed by the SACC in May 2023 (U.S. EPA, 2023f), while EPA's CRA TSD (U.S. EPA, 2025ai) was peer reviewed by the SACC in August 2025 (U.S. EPA, 2025ae). In the 2023 draft approach, EPA identified a cumulative chemical group and PESS [15 U.S.C. section 2605(b)(4)]. Based on toxicological similarity and induced effects on the developing male reproductive system consistent with a disruption of androgen action and phthalate syndrome, EPA proposed a cumulative chemical group of DEHP, BBP, DBP, DCHP, DIBP, and DINP, but not diisodecyl phthalate (DIDP) because it does not disrupt androgen action or cause effects consistent with phthalate syndrome. This approach emphasizes a uniform measure of hazard for sensitive subpopulations, namely females of reproductive age and/or male infants and children, however additional health endpoints are known for broader populations and described in the individual non-cancer human health hazard assessments for DEHP (U.S. EPA, 2025y), DBP (U.S. EPA, 2025w), DIBP (U.S. EPA, 2025z), BBP (U.S. EPA, 2025v), DCHP (U.S. EPA, 2025x), and DINP (U.S. EPA, 2025aa), including hepatic, kidney, and other developmental and reproductive toxicity.

EPA's approach for assessing cumulative risk is described in detail in the CRA TSD (U.S. EPA, 2025ai) and incorporates feedback from the SACC (U.S. EPA, 2023f) on EPA's 2023 draft proposal (U.S. EPA, 2023c), as well as feedback from the SACC received during the August 2025 peer-review meeting of phthalates (U.S. EPA, 2025ae). EPA is focusing its CRA on acute duration exposures of females of reproductive age, male infants, and male children to six toxicologically similar phthalates (*i.e.,* BBP, DBP, DEHP, DCHP, DIBP, and DINP) that induce effects on the developing male reproductive system consistent with a disruption of androgen action and phthalate syndrome. The Agency is further focusing its CRA on acute duration exposures because there is evidence that effects on the developing male reproductive system consistent with a disruption of androgen action can result from a single exposure

during the critical window of development (see Section 1.5 of (U.S. EPA, 2025ai) for further details). To evaluate cumulative risk, EPA is using an RPF approach. RPFs for DEHP, DBP, BBP, DIBP, DCHP, and DINP were developed using a meta-analysis and benchmark dose (BMD) modeling approach based on a uniform measure (*i.e.,* reduced fetal testicular testosterone). EPA is also using NHANES data to supplement, not substitute, evaluations for exposure scenarios for TSCA COUs to provide non-attributable, total exposure for addition to the relevant scenarios presented in the individual risk evaluations.

The analogy of a "risk cup" is used throughout this document to describe cumulative exposure estimates. The risk cup term is used to help conceptualize the contribution of various phthalate exposure routes and pathways to overall cumulative risk estimates and serves primarily as a (risk) communication tool. The term/concept describes exposure estimates where the full cup represents the total exposure that leads to risk (cumulative MOE) and each chemical contributes a specific amount of exposure that adds a finite amount of risk to the cup. A full risk cup indicates that the cumulative MOE has dropped below the benchmark MOE (*i.e.,* total UF), whereas cumulative MOEs above the benchmark indicate that only a percentage of the risk cup is full.

The remainder of the human health CRA for phthalates is organized as follows:

- Section 4.4.1 – Describes the approach used by EPA to derive RPFs for BBP, DBP, DCHP, DEHP, DIBP, and DINP based on reduced fetal testicular testosterone, which are used by EPA as part of the current CRA and to assess exposures to individual phthalates by scaling to an index chemical (RPF analysis). Section 2 of EPA's CRA TSD (U.S. EPA, 2025ai) provides more details.
- Section 4.4.2 – Briefly describes the approach used by EPA to calculate cumulative non-attributable phthalate exposure for the U.S. population using NHANES urinary biomonitoring and reverse dosimetry. Section 4 of EPA's CRA TSD (U.S. EPA, 2025ai) provides additional details.
- Section 4.4.3 – Describes two approaches used by EPA to combine exposures to DCHP from individual consumer and occupational COUs/OES with cumulative non-attributable phthalate exposures from NHANES to estimate cumulative risk. Empirical examples demonstrating application of both approaches are also provided. Section 5 of EPA's CRA TSD (U.S. EPA, 2025ai) provides additional details.
- Sections 4.4.4 through 4.4.6 – Summarize risk estimates for workers, consumers, and the general population based on relative potency assumptions using the two approaches described in Section 4.4.3.

For additional details regarding EPA's CRA, readers are directed to the following TSDs:

- *Technical Support Document for the Cumulative Risk Analysis of Di(2-ethylhexyl) Phthalate (DEHP), Dibutyl Phthalate (DBP), Butyl Benzyl Phthalate (BBP), Diisobutyl Phthalate (DIBP), Dicyclohexyl Phthalate (DCHP), and Diisononyl Phthalate (DINP) Under the Toxic Substances Control Act (TSCA)* (U.S. EPA, 2025ai);
- *Meta-Analysis and Benchmark Dose Modeling of Fetal Testicular Testosterone for Di(2-ethylhexyl) Phthalate (DEHP), Dibutyl Phthalate (DBP), Butyl Benzyl Phthalate (BBP), Diisobutyl Phthalate (DIBP), and Dicyclohexyl Phthalate (DCHP)* (U.S. EPA, 2025u);
- *Draft Proposed Approach for Cumulative Risk Assessment of High-Priority Phthalates and a Manufacturer-Requested Phthalate under the Toxic Substances Control Act* (U.S. EPA, 2023c);

- *Draft Proposed Principles of Cumulative Risk Assessment under the Toxic Substances Control Act* (U.S. EPA, 2023d);
- *Science Advisory Committee on Chemicals meeting minutes and final report, No. 2023-01 – A set of scientific issues being considered by the Environmental Protection Agency regarding: Draft Proposed Principles of Cumulative Risk Assessment (CRA) under the Toxic Substances Control Act and a Draft Proposed Approach for CRA of High-Priority Phthalates and a Manufacturer-Requested Phthalate* (U.S. EPA, 2023f); and
- *Science Advisory Committee on Chemicals (SACC) meeting minutes and final report - Peer Review of the Draft Risk Evaluations of Dibutyl phthalate (DBP), Di(2-ethylhexyl) phthalate (DEHP), and Dicyclohexyl phthalate (DCHP), and the Technical Support Documents for Butylbenzyl phthalate (BBP) and Diisobutyl phthalate (DIBP)* (U.S. EPA, 2025ae).

### 4.4.1 Hazard Relative Potency

This section briefly summarizes the RPF approach used by EPA to evaluate phthalates for cumulative risk. Section 4.4.1.1 provides a brief overview and background for the RPF approach methodology, whereas Section 4.4.1.2 describes the RPFs derived by EPA for BBP, DBP, DCHP, DEHP, DIBP, and DINP based on decreased fetal testicular testosterone. Further details regarding the relative potency analysis conducted by EPA are provided in the following TSDs:

- *Technical Support Document for the Cumulative Risk Analysis of Di(2-ethylhexyl) Phthalate (DEHP), Dibutyl Phthalate (DBP), Butyl Benzyl Phthalate (BBP), Diisobutyl Phthalate (DIBP), Dicyclohexyl Phthalate (DCHP), and Diisononyl Phthalate (DINP) Under the Toxic Substances Control Act (TSCA)* (U.S. EPA, 2025ai); and
- *Meta-Analysis and Benchmark Dose Modeling of Fetal Testicular Testosterone for Di(2-ethylhexyl) Phthalate (DEHP), Dibutyl Phthalate (DBP), Butyl Benzyl Phthalate (BBP), Diisobutyl Phthalate (DIBP), and Dicyclohexyl Phthalate (DCHP)* (U.S. EPA, 2025u).

#### 4.4.1.1 Relative Potency Factor Approach Overview

For the RPF approach, chemicals being evaluated require data that support toxicologic similarity (*e.g.*, components of a mixture share a known or suspected common MOA or share a common apical endpoint/effect) and have dose-response data for the effect of concern over similar exposure ranges (U.S. EPA, 2023a, 2000, 1986). RPF values account for potency differences among chemicals in a mixture and scale the dose of one chemical to an equitoxic dose of another chemical (*i.e.*, the index chemical). The chemical selected as the index chemical is often among the best characterized toxicologically and considered to be representative of the type of toxicity elicited by other components of the mixture. Implementing an RPF approach requires a quantitative dose-response assessment for the index chemical and pertinent data that allow the potency of the mixture components to be meaningfully compared to that of the index chemical. In the RPF approach, RPFs are calculated as the ratio of the potency of the individual component to that of the index chemical using either (1) the response at a fixed dose, or (2) the dose at a fixed response (Equation 4-3).

**Equation 4-3. Calculating RPFs**

$$RPF_i = \frac{BMD_{R-IC}}{BMD_{R-i}}$$

Where:

| | | |
|---|---|---|
| *BMD* | = | Benchmark dose (mg/kg/day) |
| *R* | = | Magnitude of response (*i.e.*, benchmark response) |
| *I* | = | ith chemical |

| | | |
|---|---|---|
| *IC* | = | Index chemical |

After scaling the chemical component doses to the potency of the index chemical, the scaled doses are summed and expressed as index chemical equivalents for the mixture (Equation 4-4).

**Equation 4-4. Calculating Index Chemical Equivalents**

$$Index\ Chemical\ Equivalents_{MIX} = \sum_{i=1}^{n} d_i \times RPF_i$$

Where:

| | | |
|---|---|---|
| *Index chemical equivalents* | = | Dose of the mixture in index chemical equivalents (mg/kg/day) |
| $d_i$ | = | Dose of the *ith* chemical in the mixture (mg/kg/day) |
| $RPF_i$ | = | Relative potency factor of the *ith* chemical in the mixture (unitless) |

Non-cancer risk associated with exposure to an individual chemical, or the mixture can then be assessed by calculating an MOE, which in this case is the ratio of the index chemical's non-cancer hazard value (*e.g.,* the benchmark dose limit [BMDL]) to an estimate of exposure expressed in terms of index chemical equivalents. The MOE is then compared to the benchmark MOE (*i.e.,* the total uncertainty factor associated with the assessment) to characterize risk.

#### 4.4.1.2 Relative Potency Factors

***Derivation of RPFs***

To derive RPFs for DEHP, DBP, BBP, DIBP, DCHP, and DINP, EPA utilized a meta-analysis and BMD modeling approach similar to that used by NASEM (2017) to model decreased fetal testicular testosterone. As described further in EPA's *Meta-Analysis and Benchmark Dose Modeling of Fetal Testicular Testosterone for DEHP, DBP, BBP, DIBP, and DCHP* (U.S. EPA, 2025u), the Agency evaluated benchmark responses (BMRs) of 5, 10, and 40 percent using Metafor Version 4.6.0 and 2.0.0. However, RPFs could not be estimated for BBP at the 5 or 10 percent response levels or for DIBP at the 5 percent response level because BMDs could not be estimated for BBP or DIBP at these response levels due to lack of data at the low-end range of the dose-response curve using Metafor Version 4.6.0. Therefore, for input into the CRA of phthalates, EPA derived RPFs using $BMD_{40}$ estimates, as this was the only response level in which a full set of RPFs could be derived for all phthalates being evaluated (Table 4-17).

There is some uncertainty in the applicability of the selected RPFs for DIBP and BBP at the low response levels (*i.e.,* 5 and 10% changes). However, the lack of variability in calculated RPFs for DEHP (RPFs ranged from 0.82–0.84), DCHP (RPFs ranged from 1.66–1.71), and DINP (RPFs ranged from 0.19–0.21) across response levels, and the fact that the RPF for DIBP was 0.53 at both the 10 and 40 percent response levels, increases EPA's confidence in the selected RPFs for BBP and DIBP. Further, during the August 2025 phthalate peer-review meeting (U.S. EPA, 2025ae), SACC recommended that EPA consider use of the older Metafor Version 2.0.0 BMD modeling results as an alternative to calculate RPFs based on decreased fetal testicular testosterone because Metafor Version 2.0.0 allowed $BMD_5$, $BMD_{10}$, and $BMD_{40}$ estimates to be derived for DEHP, DBP, BBP, DIBP, DCHP, and DINP. As described in Section 2.4 of the CRA TSD (U.S. EPA, 2025ai), RPFs calculated using $BMD_5$ estimates from Metafor Version 2.0.0 were similar (within 5–10% for DEHP, BBP, DCHP, DINP; 20% for DIBP) to the selected RPFs calculated using $BMD_{40}$ estimates from Metafor Version 4.6.0, which further increases EPA's confidence in the selected RPFs.

For input into the CRA of phthalates under TSCA, EPA is using RPFs calculated using $BMD_{40}$ estimates using Metafor Version 4.6.0 shown in Table 4-17.

For further details regarding RPFs derivation, see Section 2 of EPA's CRA TSD (U.S. EPA, 2025ai).

**Table 4-17. Relative Potency Factors Based on Decreased Fetal Testicular Testosterone**

| Phthalate | $BMD_{40}$ (mg/kg-day) | RPF Based on $BMD_{40}$ |
|---|---|---|
| DBP (Index chemical) | 149 | 1 |
| DEHP | 178 | 0.84 |
| DIBP | 279 | 0.53 |
| BBP | 284 | 0.52 |
| DCHP | 90 | 1.66 |
| DINP | 699 | 0.21 |

***Selection of the Index Chemical***

As described further in Section 2 of EPA's *Technical Support Document for the Cumulative Risk Analysis of DEHP, DBP, BBP, DIBP, DCHP, and DINP under TSCA* (U.S. EPA, 2025ai), EPA selected DBP as the index chemical. Notably, the SACC agreed with EPA's selection of DBP as the index chemical during the August 2025 phthalate peer-review meeting (U.S. EPA, 2025ae). DBP has a high-quality toxicological database of studies demonstrating effects on the developing male reproductive system consistent with a disruption of androgen action and phthalate syndrome. Furthermore, studies of DBP demonstrate toxicity representative of all phthalates in the cumulative chemical group and DBP is well characterized for the MOA associated with phthalate syndrome. Finally, compared to other phthalates, including well-studied phthalates such as DEHP, DBP has the most dose-response data available in the low-end range of the dose-response curve where the $BMD_5$ and $BMDL_5$ are derived, which provides a robust and scientifically sound foundation of BMD and BMDL estimates on which the RPF approach is based.

***Index Chemical POD***

As with any risk assessment that relies on BMD analysis, the POD is the lower confidence limit used to mark the beginning of extrapolation to determine risk associated with human exposures. As described further in the non-cancer human health hazards of DEHP (U.S. EPA, 2025y), DBP (U.S. EPA, 2025w), BBP (U.S. EPA, 2025v), DIBP (U.S. EPA, 2025z), DCHP (U.S. EPA, 2025x), and DINP (U.S. EPA, 2025aa) (see Appendices titled "Considerations for Benchmark Response (BMR) Selection for Reduced Fetal Testicular Testosterone" in each hazard assessment), EPA concluded that a BMR of 5 percent is the most appropriate and health protective response level for evaluating decreased fetal testicular testosterone. For the index chemical, DBP, the $BMDL_5$ for the best fitting linear-quadratic model is 9 mg/kg-day for reduced fetal testicular testosterone. Using allometric body weight scaling to the three-quarters power (U.S. EPA, 2011c), EPA extrapolated an HED of 2.1 mg/kg-day to use as the POD for the index chemical in the CRA.

***Selection of the Benchmark MOE***

Consistent with Agency guidance (U.S. EPA, 2022c, 2002b), EPA selected an intraspecies uncertainty factor ($UF_H$) of 10, which accounts for variation in susceptibility across the human population and the possibility that the available data might not be representative of individuals who are most susceptible to

the effect. EPA used allometric body weight scaling to the ¾-power to derive an HED of 2.1 mg/kg-day DBP, which accounts for species differences in toxicokinetics. Consistent with EPA Guidance (U.S. EPA, 2011c), the interspecies uncertainty factor ($UF_A$), was reduced from 10 to 3 to account remaining uncertainty associated with interspecies differences in toxicodynamics. Overall, a total uncertainty factor of 30 was selected for use as the benchmark MOE for the CRA (based on a interspecies uncertainty factor [$UF_A$] of 3 and a intraspecies uncertainty factor [$UF_H$] of 10).

***Weight of Scientific Evidence***

EPA selected an HED of 2.1 mg/kg-day ($BMDL_5$ of 9 mg/kg-day) as the index chemical (DBP) POD. This POD is based on a meta-analysis and BMD modeling of decreased fetal testicular testosterone from eight studies of rats gestationally exposed to DBP. EPA also derived RPFs of 1, 0.84, 0.53, 0.52, 1.66, and 0.21 for DBP (index chemical), DEHP, DIBP, BBP, DCHP, and DINP, respectively, based on a common toxicological outcome (*i.e.*, reduced fetal testicular testosterone). EPA has robust overall confidence in the selected POD for the index chemical (*i.e.*, DBP) and the derived RPFs.

Application of RPF provides a more robust basis for assessing the dose-response to the common hazard endpoint across all assessed phthalates. For DCHP and a subset of the phthalates with a more limited toxicological dataset, scaling by the RPF and application of the index chemical POD provides a more sensitive and robust hazard assessment than the chemical-specific POD. Readers are directed to the *Technical Support Document for the Cumulative Risk Analysis of DEHP, DBP, BBP, DIBP, DCHP, and DINP Under TSCA* (U.S. EPA, 2025ai) for a discussion of the weight of evidence supporting EPA's conclusions.

### 4.4.2 Cumulative Phthalate Exposure: Non-Attributable Cumulative Exposure to DEHP, DBP, BBP, DIBP, and DINP Using NHANES Urinary Biomonitoring and Reverse Dosimetry

This section briefly summarizes EPA's approach and results for estimating non-attributable cumulative exposure to phthalates using NHANES urinary biomonitoring data and reverse dosimetry. Readers are directed to Section 4 of EPA's CRA TSD (U.S. EPA, 2025ai) for additional details.

NHANES is an ongoing exposure assessment of the U.S. population's exposure to environmental chemicals using biomonitoring. CDC's NHANES biomonitoring dataset is a national, statistical representation of the general, non-institutionalized, civilian U.S. population. NHANES dataset provides an estimate of average aggregate exposure to individual phthalates for the U.S. population. However, exposures measured via NHANES cannot be attributed to specific sources, such as TSCA COUs or other sources. Given the short half-lives of phthalates, NHANES cannot capture acute, low frequency exposures. Instead, as concluded by the SACC review of the draft 2023 approach, NHANES provides a "snapshot" or estimate of total, non-attributable phthalate exposure for the U.S. population and relevant subpopulations (U.S. EPA, 2023f). These estimates of total non-attributable exposure can supplement assessments of scenario-specific acute risk in individual risk evaluations.

EPA used urinary phthalate metabolite concentrations for BBP, DBP, DEHP, DIBP, and DINP (but not DCHP) measured in the most recently available NHANES (2017–2018) to estimate the average daily aggregate[5] intake of each phthalate through reverse dosimetry for

- Females of reproductive age (16–49 years);
- Male children (4 to <6 years, used as a proxy for male infants and toddlers);

[5] EPA defines *aggregate exposure* as the "combined exposures to an individual from a single chemical substance across multiple routes and across multiple pathways" (40 CFR section 702.33).

- Male children (6–11 years); and
- Male children (12 to <16 years).

Aggregate daily intake values for each phthalate were then scaled by relative potency using the RPFs in Table 4-18, expressed in terms of index chemical (DBP) equivalents, and summed to estimate cumulative daily intake in terms of index chemical (DBP) equivalents using the approach outlined in Sections 4.4.1 and 4.4.3.

Because EPA is focusing its CRA on acute exposure durations, EPA selected 95th percentile exposure estimates from NHANES to serve as the non-attributable nationally representative exposure estimate for use in its CRA. For females of reproductive age, EPA's analysis indicates that black, non-Hispanic women have slightly higher 95th percentile cumulative phthalate exposure compared to other racial groups; thus, 95th percentile cumulative exposure estimates for black non-Hispanic females of reproductive age was selected for use in the CRA of DCHP (Table 4-18).

The 95th percentile of national cumulative exposure serves as the estimate of non-attributable phthalate exposure for its CRA of DCHP as follows:

- Females of reproductive age (16–49 years, black Non-Hispanic): 5.16 µg/kg-day index chemical (DBP) equivalents. This serves as the non-attributable contribution to worker and consumer females of reproductive age in Section 4.4.4 and Section 4.4.5.
- Males (3–5 years): 10.8 µg/kg-day index chemical (DBP) equivalents. This serves as the non-attributable contribution to consumer male infants (<1 year), toddlers (1–2 years), and preschoolers (3–5 years) in Section 4.4.5. Since NHANES does not include urinary biomonitoring for infants (<1 year) or toddlers (1–2 years), and other national datasets are not available, EPA used biomonitoring data from male children (3 to <6 years) as a proxy for male infants and toddlers.
- Males (6–11 years): 7.35 µg/kg-day index chemical (DBP) equivalents This serves as the non-attributable contribution to consumer male children (6–10 years) in Section 4.4.5.
- Males (12–15 years): 4.36 µg/kg-day index chemical (DBP) equivalents. This serves as the non-attributable contribution to consumer male teenagers (11–15 years) in Section 4.4.5.

#### 4.4.2.1 Weight of Scientific Evidence: Non-Attributable Cumulative Exposure to Phthalates

*Overall, EPA has robust confidence in the derived estimates of non-attributable cumulative exposure from NHANES urinary biomonitoring using reverse dosimetry*. The Agency used urinary biomonitoring data from the CDC's NHANES dataset, which provides a statistical representation of the general, non-institutionalized, civilian U.S. population. To estimate daily intake values from urinary biomonitoring for each phthalate, EPA used reverse dosimetry. The reverse dosimetry approach used by the Agency has been used extensively in the literature and by CPSC (2014) and Health Canada (Health Canada, 2020) to estimate phthalate daily intake values from urinary biomonitoring data. However, given the short half-lives of phthalates, NHANES biomonitoring data are not expected to capture low frequency exposures and may underestimate acute phthalate exposure.

**Table 4-18. Cumulative Phthalate Daily Intake (µg/kg-day) Estimates for Females of Reproductive Age, Male Children, and Male Teenagers from the 2017–2018 NHANES Cycle**

| Population | Percentile | Phthalate | Aggregate Daily Intake (µg/kg-day) | RPF | Aggregate Daily Intake in DBP Equivalents (µg/kg-day) | % Contribution to Cumulative Exposure | Cumulative Daily Intake (DBP Equivalents, µg/kg-day) | Cumulative MOE (POD = 2,100 µg/kg-day) | % Contribution to Risk Cup (Benchmark = 30)[a] |
|---|---|---|---|---|---|---|---|---|---|
| Females (16–49 years; Race: black non-Hispanic; n = 371) | 50 | DBP | 0.10 | 1 | 0.10 | 15.0 | 0.667 | 3,151 | 1.0% |
| | | DEHP | 0.38 | 0.84 | 0.32 | 47.9 | | | |
| | | BBP | 0.04 | 0.52 | 0.02 | 3.1 | | | |
| | | DIBP | 0.15 | 0.53 | 0.08 | 11.9 | | | |
| | | DINP | 0.70 | 0.21 | 0.15 | 22.1 | | | |
| | 95 | DBP | 0.48 | 1 | 0.48 | 9.3 | 5.16 | 407 | 7.4% |
| | | DEHP | 4.28 | 0.84 | 3.60 | 69.7 | | | |
| | | BBP | 0.30 | 0.52 | 0.16 | 3.0 | | | |
| | | DIBP | 0.40 | 0.53 | 0.21 | 4.1 | | | |
| | | DINP | 3.40 | 0.21 | 0.71 | 13.8 | | | |
| Males (3–5 years; n = 267) | 50 | DBP | 0.56 | 1 | 0.560 | 18.4 | 3.04 | 690 | 4.3% |
| | | DEHP | 2.11 | 0.84 | 1.77 | 58.2 | | | |
| | | BBP | 0.22 | 0.52 | 0.114 | 3.76 | | | |
| | | DIBP | 0.57 | 0.53 | 0.302 | 9.93 | | | |
| | | DINP | 1.4 | 0.21 | 0.294 | 9.66 | | | |
| | 95 | DBP | 2.02 | 1 | 2.02 | 18.6 | 10.8 | 194 | 15.5% |
| | | DEHP | 6.44 | 0.84 | 5.41 | 49.9 | | | |
| | | BBP | 2.46 | 0.52 | 1.28 | 11.8 | | | |
| | | DIBP | 2.12 | 0.53 | 1.12 | 10.4 | | | |
| | | DINP | 4.8 | 0.21 | 1.01 | 9.30 | | | |
| Males (6–11 years; n = 553) | 50 | DBP | 0.38 | 1 | 0.380 | 20.1 | 1.89 | 1,111 | 2.7% |
| | | DEHP | 1.24 | 0.84 | 1.04 | 55.1 | | | |
| | | BBP | 0.16 | 0.52 | 0.083 | 4.40 | | | |
| | | DIBP | 0.33 | 0.53 | 0.175 | 9.26 | | | |
| | | DINP | 1 | 0.21 | 0.210 | 11.1 | | | |
| | 95 | DBP | 1.41 | 1 | 1.41 | 19.2 | 7.35 | 286 | 10.5% |
| | | DEHP | 4.68 | 0.84 | 3.93 | 53.5 | | | |

| Population | Percentile | Phthalate | Aggregate Daily Intake (µg/kg-day) | RPF | Aggregate Daily Intake in DBP Equivalents (µg/kg-day) | % Contribution to Cumulative Exposure | Cumulative Daily Intake (DBP Equivalents, µg/kg-day) | Cumulative MOE (POD = 2,100 µg/kg-day) | % Contribution to Risk Cup (Benchmark = 30)[a] |
|---|---|---|---|---|---|---|---|---|---|
| | | BBP | 0.84 | 0.52 | 0.437 | 5.94 | | | |
| | | DIBP | 1.62 | 0.53 | 0.859 | 11.7 | | | |
| | | DINP | 3.4 | 0.21 | 0.714 | 9.71 | | | |
| Males (12–15 years; n = 308) | 50 | DBP | 0.33 | 1 | 0.330 | 27.6 | 1.19 | 1,758 | 1.7% |
| | | DEHP | 0.66 | 0.84 | 0.554 | 46.4 | | | |
| | | BBP | 0.14 | 0.52 | 0.073 | 6.09 | | | |
| | | DIBP | 0.21 | 0.53 | 0.111 | 9.32 | | | |
| | | DINP | 0.6 | 0.21 | 0.126 | 10.5 | | | |
| | 95 | DBP | 0.62 | 1 | 0.620 | 14.2 | 4.36 | 482 | 6.2% |
| | | DEHP | 2.51 | 0.84 | 2.11 | 48.3 | | | |
| | | BBP | 0.64 | 0.52 | 0.333 | 7.63 | | | |
| | | DIBP | 0.59 | 0.53 | 0.313 | 7.17 | | | |
| | | DINP | 4.7 | 0.21 | 0.987 | 22.6 | | | |

[a] A cumulative exposure of 70 µg DBP equivalents/kg-day would result in a cumulative MOE of 30 (*i.e.*, 2,100 µg DBP-equivalents/kg-day ÷ 70 µg DBP equivalents/kg-day = 30), which is equivalent to the benchmark of 30, indicating that the exposure is at the threshold for risk. Therefore, to estimate the percent contribution to the risk cup, the cumulative exposure expressed in DBP equivalents is divided by 70 µg DBP equivalents/kg-day to estimate percent contribution to the risk cup.

### 4.4.3 Estimation of Cumulative Risk

As described in the CRA TSD for phthalates (U.S. EPA, 2025ai), EPA focused its exposure assessment for the CRA for DCHP on evaluation of exposures through individual TSCA consumer and occupational DCHP COUs as well as non-attributable cumulative exposure to BBP, DBP, DEHP, DIBP, and DINP using NHANES urinary biomonitoring data and reverse dosimetry.

As described in the CRA TSD (U.S. EPA, 2025ai), EPA considered two approaches for characterizing cumulative risk to phthalates. During the 2025 peer review meeting of phthalates, SACC concluded that both approaches have strengths and uncertainties, but that the two approaches can complement one another and that EPA should present both approaches and select the most scientifically defensible approach for the final individual risk characterization and decision-making process (U.S. EPA, 2025ae). Based on SACC recommendations, EPA considered both cumulative risk characterization approaches in this risk evaluation.

For the first approach, all phthalate exposures are scaled by relative potency using the RPFs presented in Table 4-17 to express phthalate exposure in terms of index chemical (DBP) equivalents. Exposures from individual DCHP consumer or worker COUs/OES were then combined with non-attributable cumulative exposure (from NHANES) to estimate cumulative exposure and cumulative risk using the index chemical (DBP) POD. Cumulative risk for the first approach was estimated using the four-step process outlined in Section 5.1 of the CRA TSD (U.S. EPA, 2025ai), along with two empirical examples of how EPA calculated cumulative risk using Approach 1. For the second approach, individual phthalate exposures for consumer and occupational COUs are not scaled by RPFs but use the individual phthalate hazard values and combined with non-attributable cumulative exposures estimated using NHANES. Cumulative risk for the second approach was estimated using the four-step process outlined in Section 5.1 of the CRA TSD (U.S. EPA, 2025ai), along with two empirical examples of how EPA calculated cumulative risk using Approach two.

Table 4-19 provides a comparison of similarity and differences between Approaches 1 and 2, whereas Section 4.4.3.1 provides a more in depth discussion of the similarities and differences between the two approaches, as well as a discussion of the strengths, limitations, and uncertainties associated with both approaches, and the approach selected by EPA for estimating cumulative risk in the final risk characterization and for use in decision making.

**Table 4-19. Comparison of CRA Approaches 1 and 2**

| Steps for Calculating the Cumulative Risk | Approach 1 | Approach 2 |
|---|---|---|
| **Step 1:** Exposure estimates for the individual phthalates individual TSCA COUs | Individual exposures scaled by relative potency and expressed in index chemical (DBP) equivalents | Individual exposures not scaled by relative potency |
| **Step 2:** Estimate non-attributable cumulative exposure | No differences between approaches | |
| **Step 3:** Calculate the MOEs for each exposure to the individual phthalate | Individual MOEs calculated using the index chemical (DBP) POD | Individual MOEs calculated using the individual phthalate POD |
| **Step 4:** Calculate the cumulative MOE | No differences between approaches | |

#### 4.4.3.1 Comparison of Two Approaches for Estimating Cumulative Risk

Based on SACC recommendations, EPA considered both cumulative risk characterization approaches in each individual phthlate risk evaluation. To determine which approach is most scientifically defensible for use in the final CRA risk characterization and decision making for each individual phthalate, the Agency considered the strengths, limitations, and uncertainties of underlying dose-response data supporting both approaches for each phthalate included in the CRA. To support transparent and consistent decision making, EPA developed a framework that outlines key considerations used by the Agency to determine the most scientifically defensible approach for the contribution of cumulative risk to the individual risk characterization for each phthalate (Table 4-20). Because non-attributable cumulative exposure and risk from NHANES biomonitoring data are factored into Approaches 1 and 2 in the same manner, non-attributable cumulative exposure and risk from NHANES is not a factor that contributes to differences in cumulative risk estimates between the two approaches. Instead, differences between the two approaches stem from how exposure estimates from each individual phthalate COU are handled.

For Approach 1, exposure estimates from individual consumer or occupational COUs are scaled by relative potency, expressed in index chemical equivalents, and the index chemical POD is used to calculate risk. For Approach 2, exposure estimates from individual consumer or occupational COUs are not scaled by relative potency, and the individual phthalate POD is used to calculate risk for each individual COU, resulting in risk estimates identical to those calculated in the individual phthalate risk assessment. Therefore, there are two primary factors that contribute to how closely cumulative risk estimates align between Approaches 1 and 2: the RPF for each phthalate and the POD selected for each individual phthalate (see Table 4-20).

**Table 4-20. Considerations for Determining Confidence in Cumulative Risk Estimates for CRA Approaches 1 and 2**

| Factor | Consideration |
|---|---|
| Dose-Response Data Supporting RPF Derivation | • Quantity and quality of fetal testicular testosterone dose-response data<br>• Availability of dose-response data in the low-end range of the dose-response curve (*i.e.,* doses below those eliciting a 40% response)<br>• Similarity of candidate RPFs across 5, 10, and 40% response levels (*i.e.,* consideration of the parallelism)<br>• Similarity of BMD results obtained via different approaches (*i.e.,* meta-analysis and/or BMD modeling of individual datasets using EPA's BMDS) |
| Dose-Response Data Supporting the Individual Phthalate POD | • Quantity and quality of dose-response data supporting the POD, whether it be a NOAEL (*i.e.,* BBP, DCHP, and DCHP) or $BMDL_5$ (*i.e.,* DBP, DIBP, and DINP)<br>• For BBP, DCHP, and DEHP, the dose-range between the NOAEL and LOAEL<br>• Comparison of BMD modeling and NOAEL/LOAEL approaches |

As discussed in Section 4 of the CRA TSD (U.S. EPA, 2025ai), application of Approach 1 for DCHP leads to cumulative risk estimates that are approximately 2 to 2.2× more sensitive than risk estimates in the individual DCHP risk evaluation, while application of Approach 2 leads to risk estimates that are approximately 1.1 to 1.2× more sensitive than in the individual DCHP risk evaluation. The reason for the difference in cumulative risk estimates between the two approaches is because the RPF of 1.66 based on reduced fetal testicular testosterone (used in Approach 1) indicates DCHP is 66 percent more potent than DBP. Conversely, the index chemical (DBP) POD of 2.1 mg/kg-day (used in Approach 1) is very similar to the DCHP POD of 2.4 mg/kg-day (used in Approach 2), which indicates DCHP and DBP have similar potency for causing phthalate syndrome-related effects. The strengths, limitations, and

uncertainties of the dose-response data supporting derivation of the DCHP RPF and the DCHP POD is provided below.

***Dose-Response Data Supporting RPF Derivation***

- *Quantity and Quality of Fetal Testicular Testosterone Dose-Response Data:* The RPF of 1.66 was derived based on the ratio of the index chemical (DBP) $BMD_{40}$ to the DCHP $BMD_{40}$ (*i.e.*, 149/90 = 1.66) for reduced fetal testicular testosterone. The DCHP RPF was estimated via meta-analysis and BMD analysis of fetal testicular testosterone data from three studies reported in two high-quality publications (Gray et al., 2021; Furr et al., 2014).
- *Availability of Dose-Response Data in the Low-End Range of the Dose-Response Curve (i.e., Doses Below Those Eliciting a 40% Response):* One source of uncertainty associated with the meta-analysis and BMD analysis of DCHP is that there are limited testosterone data available for DCHP in the low-end range of the dose-response curve. For example, the lowest dose evaluated for DCHP and included in the meta-analysis is 33 mg/kg-day, while $BMD_5$ and $BMDL_5$, $BMD_{10}$ and $BMDL_{10}$, and $BMD_{40}$ and $BMDL_{40}$ estimates from the meta-analysis are 8.4 and 6.0, 17 and 12, and 90 and 63 mg/kg-day, respectively (U.S. EPA, 2025u). This uncertainty is in part lessened by a fourth study not included in the meta-analysis in which pregnant rats were gavaged with 0, 10, 100, and 1,000 mg/kg-day DCHP on GD 12–21 and then testicular testosterone was measured on postnatal day 1 (Li et al., 2016). Because testosterone was not measured in the fetal life stage, the study was not included in the meta-analysis; however, BMD analysis of testicular testosterone data from this study using EPA's BMD Software (Version 25.1) supports $BMD_5$/$BMDL_5$, $BMD_{10}$/$BMDL_{10}$ and $BMD_{40}$/$BMDL_{40}$ estimates of 6.9/1.2, 15/2.6, and 113/24 mg/kg-day, respectively. This study is limited by small sample size (N of 6 per group) and resulting large standard error, which is reflected in large BMD/BMDL ratios of approximately 5–6 and making the BMD results from the Li et al. study not appropriate for deriving a POD for the single chemical assessment. BMD estimates at the 5 and 10 percent response levels are very similar to those estimated for reduced fetal testosterone via meta-analysis (*i.e.*, 8.4 vs. 6.9 mg/kg-day and 17 vs. 15 mg/kg-day at the 5 and 10% response levels, respectively).
- *Similarity of Candidate RPFs Across 5, 10, 40 Percent Response Levels (i.e., Consideration of the Parallelism):* Candidate RPFs for DCHP did not vary significantly at the 5, 10, and 40 percent response levels (*i.e.*, RPFs ranged from 1.66–1.71). This indicates that the selected RPF of 1.66 derived from the 40 percent response level is expected to provide a reasonable estimate of potency at the 5 and 10 percent response levels, indicating parallel dose-response curves. This increases EPA's confidence in the selected RPF for DCHP.
- *Similarity of BMD Results Obtained via Different Approaches:* EPA also conducted BMD modeling of the individual DCHP fetal testicular testosterone data from each of the three studies included in the meta-analysis using EPA's BMDS Online software (Version 25.1) (U.S. EPA, 2025x). One benefit of this analysis is that BMDS includes a broader suite of models compared to those included in the meta-analysis approach (*i.e.*, Exponential, Hill, Polynomial, Power, Linear models vs. linear and linear-quadratic models in the meta-analysis). BMD modeling of individual fetal testicular testosterone data supported $BMD_5$ and $BMDL_5$ estimates nearly identical to those estimated via meta-analysis (see (U.S. EPA, 2025x) for further discussion). For example, $BMD_5$ and $BMDL_5$ estimates for reduced fetal testicular testosterone are 9.0 and 5.2 mg/kg-day for the best-fitting Exponential 3 model (Furr et al., 2014) and 13.7 and 10.0 mg/kg-day for the best-fitting Exponential 3 model (Gray et al., 2021), compared to 8.4 and 6.0 mg/kg-day for the best-fitting linear-quadratic model in the meta-analysis.

***Dose-Response Data Supporting the Individual Phthalate POD*.**

- *Quantity and Quality of Dose-Response Data Supporting the POD:* The DCHP POD is an HED of 2.4 mg/kg-day and is derived from a NOAEL of 10 mg/kg-day based on a spectrum of effects on the developing male reproductive system consistent with phthalate syndrome (U.S. EPA, 2025x). The DCHP POD is supported by six gestational exposure studies of rats, including two high-quality (Ahbab and Barlas, 2015; Furr et al., 2014) and four medium-quality studies (Ahbab et al., 2017; Li et al., 2016; Ahbab and Barlas, 2013; Hoshino et al., 2005).
- *Dose-Range Between the NOAEL and LOAEL:* The six studies supporting the selected POD for DCHP support a narrow range of NOAEL (10–17 mg/kg-day) and LOAEL (20–33 mg/kg-day) values for phthalate syndrome-related effects in gestationally exposed rats (see Section 4 of (U.S. EPA, 2025x) for further discussion). This increases EPA's confidence in the selected POD for DCHP.
- *Comparison of BMD Modeling and NOAEL/LOAEL Approaches:* EPA's meta-analysis and BMD-analysis of fetal testicular testosterone data (including the analysis of individual datasets) supports $BMDL_5$ estimates ranging from 5.2 to 10 mg/kg-day, which further supports the selected NOAEL of 10 mg/kg-day (U.S. EPA, 2025x). Although 2 out of 3 of the $BMDL_5$ estimates are below (*i.e.,* more sensitive than) the selected NOAEL of 10 mg/kg-day, EPA selected the NOAEL over a $BMDL_5$ estimate because all $BMDL_5$ estimates for reduced fetal testicular testosterone were below the lowest dose included in each respective study by factors of approximately 5 to 10×. Consistent with EPA's *Benchmark Dose Technical Guidance* (U.S. EPA, 2012a), the lack of data to inform the low-end of the dose-response curve reduces EPA's confidence in the $BMDL_5$ estimates for use in risk characterization in the individual DCHP risk evaluation.

Based on the weight of scientific evidence considerations outlined in the developed framework (Table 4-20), EPA weighed the strengths and uncertainties associated with the DCHP RPF (Approach 1) and the DCHP POD (Approach 2 and individual DCHP risk evaluation). EPA acknowledges there are strengths and uncertainties of both approaches and concludes that Approach 2 using the POD from the single chemical assessment is the most appropriate for deriving cumulative risks for DCHP. This conclusion is based on the following:

- The POD approach (Approach 2) is based on 6 studies, including the (Li et al., 2016) study with testosterone data measured postnatally, and considers the full spectrum of adverse outcomes relevant to phthalate syndrome across a broad range of dose levels, including multiple studies at or near 10 mg/kg-day. In contrast, the RPF approach (Approach 1) is based on three studies using a single adverse outcome (fetal testosterone) where only high-dose data are available, reducing confidence in the BMD estimates at the lower end of the dose-response curve. As a result, EPA believes that the POD approach is more appropriate for extrapolating cumulative risk than the RPF approach because the underlying data for the POD approach considers a broader range of adverse outcomes and dose levels.

### 4.4.4 Cumulative Risk Estimates for Workers

This section summarizes cumulative risk estimates for female workers of reproductive age from acute duration exposures to DCHP. EPA focused its occupational CRA on this population and exposure duration because as described in Section 4.4 and (U.S. EPA, 2025ai), this population and exposure duration are considered most directly applicable to the common hazard outcome that serves as the basis for the cumulative analysis (*i.e.,* phthalate syndrome).

To evaluate cumulative risk to female workers of reproductive age, EPA combined inhalation and dermal exposures to DCHP from each individual occupational COU/OES with non-attributable cumulative exposure to BBP, DBP, DEHP, DIBP, and DINP (estimated from NHANES urinary biomonitoring using reverse dosimetry). For Approach 2 (described further in Section 4.4.3), exposures from individual DCHP OESs were not scaled by RPFs, but instead remained in units of exposure of mg/kg-day DCHP. MOEs were then calculated using exposures from individual DCHP OES and the DCHP POD and combined with the non-attributable cumulative MOE (from NHANES, with all exposures expressed in index chemical [DBP] equivalents).

As discussed previously in Section 4.3.2.3, OSHA and NIOSH both recommend a hierarchy of controls to address hazardous exposures in the workplace. OSHA and NIOSH recommend the use of PPE (*e.g.*, respirators, gloves) as the last means of control, when the other control measures cannot reduce workplace exposure to an acceptable level. Cumulative MOEs for female workers of reproductive age are presented in Table 4-21 and the *Occupational and Consumer Cumulative Risk Calculator for DCHP* (U.S. EPA, 2025ab) assume no PPE use. For COUs with acute cumulative MOEs below the cumulative benchmark of 30, corresponding PPE required to raise the cumulative MOE above the benchmark are also presented. Since inhalation exposure from individual DCHP OES is the primary contributor to risk, Table 4-21 presents the minimum respirator APF value necessary to bring the cumulative MOE above the benchmark MOE of 30.

#### 4.4.4.1 Cumulative Risk Characterization – Approach 2

Because DCHP inhalation and dermal exposures are not scaled by RPFs for Approach 2, the only factor contributing to slightly lower cumulative MOEs using Approach 2 compared to the individual DCHP assessment is the addition of non-attributable cumulative exposure from NHANES. As part of its CRA, EPA calculated non-attributable cumulative exposure to BBP, DBP, DEHP, DIBP, and DINP using NHANES urinary biomonitoring data from the 2017 to 2018 survey (most recent dataset available) and reverse dosimetry (see Section 4.4.2 and (U.S. EPA, 2025ai) for further details), representing exposure to a national population. *DCHP was not included as part of the cumulative non-attributable national exposure estimate because DCHP has not been included in NHANES analyses since 2011 due to low frequencies of detection and low detection levels in urine* (Section 4.4.2). Non-attributable cumulative exposure estimates were scaled by relative potency and expressed in index chemical (DBP) equivalents. Non-attributable cumulative exposure was then combined with acute inhalation and dermal DCHP exposures for each individual COU/OES.

For female workers of reproductive age, EPA added a non-attributable cumulative exposure of 5.16 µg/kg index chemical (DBP) equivalents to calculate the cumulative MOE. This non-attributable cumulative exposure estimate is the 95th percentile estimate for black non-Hispanic females of reproductive age (16 to 49 years). *This non-attributable cumulative exposure contributes approximately 7.4 percent to the risk cup with a benchmark MOE of 30.* Overall, EPA has robust confidence in the non-attributable cumulative exposure estimate because it was calculated from CDC's NHANES biomonitoring dataset, which provides a statistically representative sampling of the U.S. civilian population. Furthermore, the Agency used a well-established reverse dosimetry approach to calculate phthalate daily intake values from urinary biomonitoring data.

Table 4-21 summarizes the acute duration central tendency and high-end MOEs for female workers of reproductive age used to characterize cumulative risk using Approach 2 from exposure to DCHP, DEHP, DBP, BBP, DIBP, and DINP, as well as DCHP MOEs without non-attributable cumulative exposure (*i.e.*, NHANES) included. As discussed in Section 4.3.2, high-end acute MOEs for female workers of reproductive age were below the benchmark of 30 for all DCHP COUs/OES evaluated as

part of the individual chemical assessment. Addition of non-attributable cumulative national exposure (from NHANES) would have no influence on high-end risk conclusions for any OES. Therefore, EPA focused its cumulative risk characterization on central tendency MOEs (none of which was <30 in the individual DCHP assessment in Section 4.3.2).

Acute central tendency cumulative MOEs using Approach 2 were above the benchmark of 30 (ranging from 32–301) for all 18 of the OES evaluated for DCHP (Table 4-21).

#### 4.4.4.2 Overall Confidence in Cumulative Worker Risk Estimates

As described in Section 4.1.1.5 and the *Environmental Release and Occupational Exposure Assessment for DCHP* (U.S. EPA, 2025s), EPA has moderate confidence in the inhalation and dermal exposures estimates for the assessed OESs. As discussed above in Section 4.4.3.1, EPA has weighed the strengths and uncertainties associated with the DCHP RPF (Approach 1) and the DCHP POD (Approach 2 and individual DCHP risk evaluation). From both an adverse outcome pathway perspective and a dose-response perspective EPA has concluded that the POD approach (*i.e.,* Approach 2) is more robust and more appropriate for extrapolating cumulative risk compared to Approach 1.

**Table 4-21. Acute Cumulative MOE Summary Table for Female Workers of Reproductive Age Using Approach 2**

| Life Cycle Stage – Category | Subcategory | OES | Exposure Level | Cumulative MOE (Dermal Exp. from COU + Inhal. Exp. from COU + Non-Attributable Cumulative Exp. from NHANES) [a] (Benchmark = 30) | Respirator APF to Get Cumulative MOE Above the Benchmark of 30 |
|---|---|---|---|---|---|
| Manufacturing – Domestic manufacturing | Domestic manufacturing | Manufacturing | CT | 32 | – |
| | | | HE | **3.4** | 10 |
| Manufacturing – Importing | Importing | Import and repackaging | CT | 93 | – |
| Processing – Repackaging | Repackaging (*e.g.*, laboratory chemicals) | | HE | **5.7** | 10 |
| Processing – Processing – incorporation into formulation, mixture, or reaction product | Plasticizer in:<br>– Adhesive manufacturing | Incorporation into adhesives and sealants | CT | 32 | – |
| | Adhesive and sealant chemicals in:<br>– Adhesive manufacturing | | | | |
| | Stabilizing Agent in:<br>– Adhesive manufacturing | | HE | **3.4** | 10 |
| Processing – Processing – incorporation into formulation, mixture, or reaction product | Plasticizer in:<br>– Paint and coating manufacturing<br>– Printing ink manufacturing | Incorporation into paints and coatings | CT | 32 | – |
| | Stabilizing agent in:<br>– Paint and coating manufacturing | | HE | **3.4** | 10 |
| Processing – Processing – incorporation into formulation, mixture, or reaction product | Stabilizing agent in:<br>Asphalt paving, roofing, and coating materials manufacturing | Incorporation into other formulations, mixtures, or reaction products | CT | 32 | – |
| | | | HE | **3.4** | 10 |
| Processing – Processing – incorporation into formulation, mixture, or reaction product | Plasticizer in:<br>– Plastic material and resin manufacturing<br>– Plastics product manufacturing | PVC plastics compounding | CT | 60 | – |
| | Stabilizing agent in:<br>–Plastics product manufacturing | | HE | **3.6** | 10 |

| Life Cycle Stage – Category | Subcategory | OES | Exposure Level | Cumulative MOE (Dermal Exp. from COU + Inhal. Exp. from COU + Non-Attributable Cumulative Exp. from NHANES) [a] (Benchmark = 30) | Respirator APF to Get Cumulative MOE Above the Benchmark of 30 |
|---|---|---|---|---|---|
| Processing – Processing – incorporation into article | Plasticizer in:<br>– Plastics product manufacturing | PVC plastics converting | CT | 108 | – |
| | | | HE | **7.9** | 5 |
| Processing – Processing – incorporation into formulation, mixture, or reaction product | Plasticizer in:<br>– Plastics product manufacturing<br>– Rubber product manufacturing<br>– Plastic material and resin manufacturing | Non-PVC material compounding | CT | 89 | – |
| | Stabilizing agent in:<br>–Plastics product manufacturing | | HE | **6.0** | 10 |
| Processing – Processing – incorporation into article | Plasticizer in:<br>– Plastics product manufacturing<br>– Rubber product manufacturing | Non-PVC material converting | CT | 168 | – |
| | | | HE | **17** | 5 |
| Industrial Use – Finishing agent | Cellulose film production | Application of paints and coatings – liquids | CT | 36 | – |
| Industrial Use – Inks, toner, and colorant products | Inks, toner, and colorant products (*e.g.*, screen printing ink) | | | | |
| Commercial Use – Inks, toner, and colorant products | Inks, toner, and colorant products (*e.g.*, screen printing ink) | | | | |
| Industrial Use – Paints and coatings | Paints and coatings | | | | |
| Commercial Use – Paints and coatings | Paints and coatings | | HE | **2.0** | 25 |

| Life Cycle Stage – Category | Subcategory | OES | Exposure Level | Cumulative MOE (Dermal Exp. from COU + Inhal. Exp. from COU + Non-Attributable Cumulative Exp. from NHANES) [a] (Benchmark = 30) | Respirator APF to Get Cumulative MOE Above the Benchmark of 30 |
|---|---|---|---|---|---|
| Industrial Use – Finishing agent | Cellulose film production | Application of paints and coatings – solids | CT | 51 | – |
| Industrial Use – Inks, toner, and colorant products | Inks, toner, and colorant products (*e.g.*, screen printing ink) | | | | |
| Commercial Use – Inks, toner, and colorant products | Inks, toner, and colorant products (*e.g.*, screen printing ink) | | | | |
| Industrial Use – Paints and coatings | Paints and coatings | | | | |
| Commercial Use – Paints and coatings | Paints and coatings | | | | |
| | | | HE | **3.5** | 10 |
| Industrial Uses – Adhesives and sealants | Adhesives and sealants (*e.g.*, computer and electronic product manufacturing; transportation equipment manufacturing) | Application of adhesives and sealants – liquids | CT | 301 | – |
| Commercial Uses – Adhesives and sealants | Adhesives and sealants | | | | |
| | | | HE | 239 | – |
| Industrial Uses – Adhesives and sealants | Adhesives and sealants in (*e.g.*, computer and electronic product manufacturing; transportation equipment manufacturing) | Application of adhesives and sealants – solids | CT | 84 | – |
| | | | HE | **6.3** | 10 |
| Commercial Use – Laboratory chemicals | Laboratory chemicals | Use of laboratory chemicals – liquid | CT | 301 | – |
| | | | HE | 239 | – |
| Commercial Use – Laboratory chemicals | Laboratory chemicals | Use of laboratory chemicals – solid | CT | 70 | – |
| | | | HE | **6.3** | 10 |

| Life Cycle Stage – Category | Subcategory | OES | Exposure Level | Cumulative MOE (Dermal Exp. from COU + Inhal. Exp. from COU + Non-Attributable Cumulative Exp. from NHANES) [a] (Benchmark = 30) | Respirator APF to Get Cumulative MOE Above the Benchmark of 30 |
|---|---|---|---|---|---|
| Industrial Use – Other articles with routine direct contact during normal use including rubber articles; plastic articles (hard) | Other articles with routine direct contact during normal use including rubber articles; plastic articles (hard) (*e.g.*, transportation equipment manufacturing) | Fabrication or use of final products or articles | CT | 118 | – |
| Commercial Use – Building/construction materials not covered elsewhere | Building/construction materials not covered elsewhere | | | | |
| Commercial Use – Other articles with routine direct contact during normal use including rubber articles; plastic articles (hard) | Other articles with routine direct contact during normal use including rubber articles; plastic articles (hard) | | HE | **20** | 5 |
| Processing – Recycling | Recycling | Recycling | CT | 105 | – |
| | | | HE | **11** | 5 |
| Disposal – Disposal | Disposal | Waste handling, treatment and disposal | CT | 105 | – |
| | | | HE | **11** | 5 |

[a] The acute cumulative MOE is derived by summing inhalation exposure from each individual DCHP COU with dermal exposure from the same DCHP COU and the cumulative non-attributable exposure to BBP, DBP, DEHP, DIBP, and DINP. Non-attributable cumulative exposure was estimated from NHANES urinary biomonitoring data using reverse dosimetry.
Benchmark MOE = 30. **Bold** text in a gray shaded cell indicates an MOE is below the benchmark value of 30.

### 4.4.5 Cumulative Risk Estimates for Consumers

This section summarizes cumulative risk estimates for consumers from acute duration exposures to DCHP. EPA focused its CRA on females of reproductive age and male infants and children. EPA focused its consumer CRA on these populations for the acute exposure duration because, as described in Section 4.2 and (U.S. EPA, 2025ai), these populations and exposure duration are considered most directly applicable to the common hazard outcome that serves as the basis for the cumulative assessment (*i.e.*, reduced fetal testicular testosterone). For consumers, EPA did not specifically evaluate females of reproductive age or male infants and children; however, consumer exposures of teenagers (16–20 years) and adults (21+ years) were considered a proxy for females of reproductive age, while infants (<1 year), toddlers (1–2 years), children (3–5 and 6–10 years), and young teens (11–15 years) were considered a proxy for male infants and children.

To evaluate cumulative risk to consumers, EPA combined inhalation, dermal, and ingestion exposures to DCHP from each individual consumer COU and product/article exposure scenario with non-attributable cumulative exposure to BBP, DBP, DEHP, DIBP, and DINP (estimated from NHANES urinary biomonitoring using reverse dosimetry). For Approach 2 (described further in Section 4.4.3), exposures from individual DCHP OES were not scaled by RPFs, but instead remained in units of exposure of mg/kg-day DCHP. MOEs were then calculated using exposures from individual DCHP OES and the DCHP POD and combined with the non-attributable cumulative MOE (from NHANES, with all exposures expressed in index chemical [DBP] equivalents).

Cumulative MOEs calculated using Approach 2 are shown in Table 4-22 and the *Occupational and Consumer Cumulative Risk Calculator for DCHP* (U.S. EPA, 2025ab).

#### 4.4.5.1 Cumulative Risk Characterization – Approach 2

As described in Section 4.3.3, EPA quantitatively evaluated five product or article example exposure scenarios associated with three consumer COUs. All five of the assessed consumer product or article example scenarios have high-intensity cumulative MOEs exceeding the cumulative benchmark of 30 (ranging from 154–467) using Approach 2 (Table 4-22).

#### 4.4.5.2 Overall Confidence in Cumulative Consumer Risks

As discussed in Section 4.3.3 and in more detail in the *Consumer and Indoor Exposure Assessment for DCHP* (U.S. EPA, 2025c), EPA has moderate to robust confidence in the inhalation, ingestions, and dermal exposure estimates for the evaluated consumer product exposure scenarios.

**Table 4-22. Consumer Acute Cumulative MOE Summary Table for CRA Approach 2**

| Life Cycle Stage: COU: Subcategory | Product or Article | Exposure Scenario (H, M, L) [a] | Life Stage (Years) Acute Cumulative MOE (Dermal exp. from COU + Inhalation Exp. from COU + Ingestion Exp. from COU + Non-Attributable Cumulative Exp. from NHANES) (Benchmark MOE = 30) | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | Infants (<1 Year) | Toddlers (1–2 Years) | Pre-schoolers (3–5 years) | Middle Childhood (6–10 years) | Young Teens (11–15 years) | Teenagers (16–20 years) | Adults (21+ years) |
| Consumer Uses: Adhesives and sealants: Adhesives and sealants | Adhesives for small repairs | H | – | – | – | – | 467 | 398 | 397 |
| Consumer Uses: Adhesives and sealants: Adhesives and sealants | Automotive adhesives | H | 193 | 193 | 193 | 284 | 457 | 391 | 390 |
| Consumer Uses: Other articles with routine direct contact during normal use including rubber articles; plastic articles (hard) | Small articles with potential for semi-routine contact: labels, nitrocellulose; ethylcellulose; chlorinated rubber; PVAc; PVC | H | 178 | 180 | 182 | 264 | 435 | 376 | 374 |
| Consumer Uses: Consumer articles that contain dicyclohexyl phthalate from: Inks, toner, and colorants; Paints and coatings; Adhesives and sealants (*e.g.*, paper products, textiles, products using cellulose film, etc.) | Outdoor seating | H | 154 | 159 | 163 | 232 | 369 | 329 | 325 |
| Consumer Uses: Consumer articles that contain dicyclohexyl phthalate from: Inks, toner, and colorants; Paints and coatings; Adhesives and sealants (*e.g.*, paper products, textiles, products using cellulose film, etc.) | Small articles with the potential for semi-routine contact: labels, and packaging adhesives, foil and cellophane lacquers, and printing inks | H | 178 | 180 | 182 | 264 | 435 | 376 | 374 |
| Consumer Uses: Consumer articles that contain dicyclohexyl phthalate from: Inks, toner, and colorants; Paints and coatings; Adhesives and sealants (*e.g.*, paper products, textiles, products using cellulose film, etc.) | Electronics containing dye adhesive | Exposures not expected. Identified in dye attach adhesive used in wirebond packaging for semiconductor devices or in automotive cameras. As the adhesive is used in small quantities and contained within the electronic articles, no exposures are expected during potential use of these items. | | | | | | | |

Exposure scenario intensities include high (H), medium (M), and low (L).
[b] Bystander scenarios
[c] Indoor scenario
Benchmark MOE = 30. **Bold text** in a gray shaded cell (there are none) would have indicated an MOE is below the benchmark value of 30.

### 4.4.6 Cumulative Risk Estimates for the General Population

For DCHP, EPA did not evaluate cumulative risk for the general population from environmental releases. As discussed in Section 4.1.3, the Agency employed a screening level approach to assess risk from exposure to DCHP for the general population from environmental releases. Using this conservative screening level approach, EPA did not identify any pathways of concern, indicating that refinement was not necessary. Further, as discussed in Section 4.4.2, EPA did evaluate cumulative exposure and risk from exposure to several toxicologically similar phthalates—BBP, DBP, DEHP, BBP, DIBP, and DINP—using NHANES urinary biomonitoring data. DCHP metabolites are no longer measured in CDC's NHANES urinary biomonitoring dataset due to low detection levels and a low frequency of detection. Therefore, DCHP was not included in the NHANES cumulative exposure estimate. CDC's NHANES biomonitoring dataset is a statistical representation of the general, non-institutionalized, civilian U.S. population and provides estimates of average aggregate exposure to individual phthalates. As can be seen from Table 4-18, and as discussed in more detail in the CRA TSD (U.S. EPA, 2025ai), 95th percentile cumulative MOEs ranged from 194 to 592 (cumulative benchmark = 30) for women of reproductive age and male children. These MOEs indicate that the risk cup is 6.2 to 15.5 percent full and indicate that cumulative exposure to BBP, DBP, DEHP, DIBP, and DINP, based on the most recent NHANES survey data (2017–2018), does not currently pose a risk to most male children or pregnant women within the U.S. civilian population.

## 4.5 Comparison of Single Chemical and Cumulative Risk Assessments

In support of the developed CRA, EPA has relied substantially on existing CRA-related work by the Agency's Risk Assessment Forum (RAF), EPA Office of Pesticide Programs (OPP), the OECD, the European Commission, and the World Health Organization (WHO) and International Programme on Chemical Safety (IPCS), including the following:

- *Guidelines for the Health Risk Assessment of Chemical Mixtures* (U.S. EPA, 1986);
- *Guidance for Identifying Pesticide Chemicals and Other Substances that Have a Common Mechanism of Toxicity* (U.S. EPA, 1999);
- *Supplementary Guidance for Conducting Health Risk Assessment of Chemical Mixtures* (U.S. EPA, 2000);
- *General Principles for Performing Aggregate Exposure and Risk Assessments* (U.S. EPA, 2001);
- *Guidance on Cumulative Risk Assessment of Pesticide Chemicals that Have a Common Mechanism of Toxicity* (U.S. EPA, 2002a);
- *Framework for Cumulative Risk Assessment* (U.S. EPA, 2003);
- *Concepts, Methods and Data Sources for Cumulative Health Risk Assessment of Multiple Chemicals, Exposures, and Effects: A Resource Document* (U.S. EPA, 2007a);
- *Pesticide Cumulative Risk Assessment: Framework for Screening Analysis Purpose* (U.S. EPA, 2016);
- *Advances in Dose Addition for Chemical Mixtures: A White Paper* (U.S. EPA, 2023a).
- *Phthalates and Cumulative Risk Assessment: The Tasks Ahead* (NRC, 2008);
- *State of the Art Report on Mixture Toxicity* (Kortenkamp et al., 2009);
- *Risk Assessment of Combined Exposure to Multiple Chemicals: A WHO/IPCS Framework* (Meek et al., 2011); and
- *Considerations for Assessing the Risks of Combined Exposure to Multiple Chemicals* (OECD, 2018).

Herein, EPA has evaluated risks for workers (Section 4.3.2), consumers (Section 4.3.3), and the general population (Section 4.3.4) from exposure to DCHP alone, as well as cumulative risks for workers

(Section 4.4.4) and consumers (Section 4.4.5) that take into account differences in relative potency and cumulative non-attributable exposure to BBP, DBP, DEHP, DIBP, and DINP from NHANES biomonitoring and reverse dosimetry.

There are several notable differences between the individual DCHP assessment (Section 4.3) and the CRA (Section 4.4). As part of the individual DCHP assessment (Section 4.3), EPA considered all human health hazards of DCHP and selected a POD based on a NOAEL for phthalate syndrome-related effects to characterize risk from exposure to DCHP. As part of its exposure assessment in the individual DCHP assessment, EPA considered acute, intermediate, and chronic exposures durations for a broad range of populations—including female workers of reproductive age, average adult workers, ONUs, the general population, and consumers of various life stages (*e.g.*, infants, toddlers, children, adults). Furthermore, in the individual DCHP assessment, EPA evaluated inhalation and dermal exposures to workers, as well as consumer exposure to DCHP via the inhalation, dermal, and ingestion exposure routes. In contrast, the CRA is more focused in scope (Section 4.4). For example, the CRA is focused on acute duration exposures and the most sensitive populations (*i.e.*, women of reproductive age, male infants, male children). As discussed in Section 4.4.3.1, EPA has concluded that Approach 2 is the most scientifically-supportable approach for characterizing cumulative risk for DCHP. For Approach 2, DCHP exposures were not scaled by relative potency but instead use the individual DCHP POD and are combined with non-attributable cumulative exposures for each phthalate estimated using NHANES (Section 4.4.3).

Both the individual DCHP assessment (Section 4.3.3) and the CRA using Approach 2 (Section 4.4.5) led to similar conclusions regarding risk estimates for consumers (Section 4.4.5) and workers (Section 4.4.4). As discussed in Section 4.3.3, high-intensity MOEs for consumer scenarios ranged from 740 to 950,000 in the individual DCHP assessment (benchmark = 30), whereas cumulative consumer MOEs ranged from 154 to 467 using Approach 2 (cumulative benchmark = 30) (Section 4.4.5). As discussed in Section 4.3.2, high-end MOEs for all worker scenarios in the individual DCHP assessment were below the benchmark or 30, while all central tendency cumulative MOEs were above the benchmark of 30, ranging from 32 to 301. Overall, there is one factor that influences the differences in risk estimates between the individual DCHP assessment and the CRA using Approach 2. That is the addition of non-attributable cumulative exposure to BBP, DBP, DEHP, DIBP, and DIBP using NHANES urinary biomonitoring, which adds 6.2 to 15.5 percent to the risk cup—depending on the population and age group.

Ultimately, there is little additional cumulative risk by adding the simultaneous exposure of other phthalates to the single chemical risk estimates for DCHP using Approach 2 (*i.e.*, non-attributable cumulative exposure from NHANES adds 6.2 to 15.5 percent to the risk cup).

# 5 ENVIRONMENTAL RISK ASSESSMENT

**DCHP - Environmental Risk Assessment (Section 5):**
**Key Points**

EPA evaluated the reasonably available information to support the environmental risk assessment of DCHP. The key points of the environmental risk assessment are summarized below:

- DCHP is expected to be released to the environment via air, water, biosolids, and disposal to landfills. Based on DCHP's fate parameters, concentrations of DCHP in soil and groundwater resulting from releases to the landfill or via biosolids were not quantified but are discussed qualitatively because DCHP is not expected to be persistent or be mobile in soils (Section 2).
- High-end concentrations of DCHP in surface water were estimated for the purpose of risk assessment for environmental exposure. Plastic compounding was the highest release with subsequent environmental concentrations in surface water (Section 3 and (U.S. EPA, 2025p)).
- The physical and chemical properties of DCHP indicate that it has low bioaccumulation potential and is unlikely to biomagnify. Therefore, EPA did not analyze the trophic transfer of DCHP through dietary exposures to aquatic organisms (U.S. EPA, 2025p).
- EPA derived a concentration of concern (COC) of 32 µg/L DCHP based on reproductive effects from chronic DCHP exposure to an aquatic invertebrate, *Daphnia magna* (U.S. EPA, 2025o). Empirical toxicity data for laboratory rats were used to estimate a terrestrial mammal hazard threshold of 179.3 mg/kg bw/d DCHP (U.S. EPA, 2025o).
- EPA found no reasonably available definitive environmental hazard data for DCHP exposures to birds, reptiles, sediment-dwelling animals, terrestrial invertebrates, or plants (U.S. EPA, 2025o). Therefore, DCHP hazards to these organisms were not assessed.
- Based on qualitative risk characterization, EPA does not expect risk for any assessed pathways for exposure of DCHP to terrestrial organisms. Risk is not expected because exposure to terrestrial organisms in water, soil, air, and diet is expected to be low (Section 2), and no evidence of DCHP hazard to wild terrestrial organisms was reasonably available (Section 5.2). EPA considered DCHP hazard to laboratory rodents in lieu of reasonably available wild mammal hazard resulting in conservative dietary mammal exposures being at least an order of magnitude lower than the hazard threshold (Section 5.3). The Agency has robust confidence in the determination of no risk to terrestrial organisms.
- Based on qualitative risk characterization, EPA does not expect risk for acute durations of DCHP exposure to aquatic organisms because reasonably available data found no acute hazard effects up to and above the estimated upper bound of the range of probable water solubility limits (1,480 µg/L) (Section 5.3).
- EPA does not expect risk of chronic DCHP exposure to aquatic animals. Considerable uncertainties exist about the limit of water solubility, water release estimates, and low flow surface water modeling estimates. No RQ values were greater than the benchmark of 1 under scenarios of lower limits of water solubility, typical release estimates, wastewater treatment removal, more rapid stream flow, and available measured DCHP water concentrations from the literature.

## 5.1 Summary of Environmental Exposures

EPA assessed environmental concentrations of DCHP in air, water, and land (soil, biosolids, and groundwater) for use in environmental exposure. The environmental exposures are described in the *Physical Chemistry and Fate and Transport Assessment for Dicyclohexyl Phthalate (DCHP)* (U.S. EPA, 2025ac) and the *Environmental Media, General Population, and Environmental Exposure Assessment for Dicyclohexyl Phthalate (DCHP)* (U.S. EPA, 2025p). DCHP will preferentially sorb into sediments,

soils, particulate matter in air, and in wastewater solids during wastewater treatment. High-quality studies of DCHP biodegradation rates and physical and chemical properties indicate that DCHP will have limited persistence and mobility in soils receiving biosolids (U.S. EPA, 2025ac). Surface water, pore water, and sediment concentrations of DCHP were modeled using VVWM-PSC. The PVC plastics compounding COU resulted in the highest estimated release to water. DCHP concentrations in receiving waters were estimated to be 218 µg/L DCHP in the water column in low flow (7Q10) conditions with the most conservative inputs and assumptions. For the land pathways, there are uncertainties in the relevance of limited monitoring data for biosolids and landfill leachate to the COUs considered. However, based on high-quality physical and chemical property data, EPA determined that DCHP will have low persistence potential and mobility in soils. Therefore, groundwater concentrations resulting from releases to the landfill or to agricultural lands via biosolids applications were not quantified but were discussed qualitatively.

Limited measured data were reasonably available from the scientific literature on DCHP concentrations in soils, biosolids, soils receiving biosolids, and landfills. No monitoring data of DCHP in these environments were reasonably available. Limited reasonably available information was available related to the uptake and bioavailability of DCHP soils. Based on the range of estimates of water solubility (30–1,480 µg/L) and hydrophobicity (log $K_{OW}$ = 4.82; log $K_{OC}$ = 4.47), DCHP is expected to have low bioavailability in soil. DCHP has not readily measured or monitored in aquatic or terrestrial organisms and has low bioaccumulation and biomagnification potential. Therefore, DCHP has low potential for trophic transfer through food webs. DCHP is expected to have minimal air to soil deposition.

## 5.2 Summary of Environmental Hazards

EPA evaluated the reasonably available information for environmental hazard endpoints associated with DCHP exposure to ecological receptors in aquatic and terrestrial ecosystems. The Agency reviewed two references from the peer-reviewed literature and four studies reported by the Japanese Ministry of the Environment that were subsequently summarized by the European Union (EU) ECHA. EPA determined all references had high or medium data quality. These hazards are described in the *Environmental Hazard Assessment for Dicyclohexyl Phthalate (DCHP)* (U.S. EPA, 2025o).

EPA found limited definitive environmental hazard data for DCHP. The reasonably available studies found all acute exposure hazards to fish, invertebrates, and algae to be higher than the upper bound of the range of probable water solubility limits of 1,480 µg/L DCHP. However, DCHP caused chronic reproductive effects to an aquatic invertebrate (*Daphnia magna*) and a fish species (*Danio rerio*) at concentrations below the water solubility limit. EPA derived a concentration of concern (COC) for reproductive effects of chronic DCHP water exposure of 32 µg/L DCHP.

In terrestrial habitats, the available data suggest that DCHP might cause hazard to terrestrial mammals through dietary exposures. A hazard effects threshold was estimated based on laboratory rodent experiments because wild organism hazard studies were not reasonable available. EPA determined a terrestrial mammal hazard threshold leading to reduced body weight over two generations of dietary exposure to 179.3 mg/kg bw/d DCHP.

No hazard data were reasonably available for birds, reptiles, terrestrial invertebrates, and plants. Therefore, these taxa were not assessed.

## 5.3 Environmental Risk Characterization

### 5.3.1 Risk Assessment Approach

The environmental risk characterization of DCHP was conducted to evaluate whether the potential releases and resultant exposures of DCHP in water, air, or soil will exceed the DCHP concentrations observed to result in hazardous effects to aquatic or terrestrial organisms. In evaluating the DCHP exposure concentrations, monitored and modeled DCHP concentrations in surface water were used quantitatively. Concentrations of DCHP in soil (biosolids, landfills, air deposition) and air is limited or is not expected to be bioavailable and were used qualitatively. In evaluating the environmental hazard of DCHP, a weight of evidence approach was used to select hazard threshold concentrations for the derivation of risk quotients (RQs) for aquatic organisms. A weight of evidence approach was also used to select hazard threshold concentrations for a description of risk for terrestrial organisms.

Environmental risk was characterized by calculating RQs (U.S. EPA, 1998; Barnthouse et al., 1982). The RQ is defined in Equation 5-1 below.

**Equation 5-1. Calculating the Risk Quotient**

$$RQ = \frac{Predicted\ Environmental\ Concentration}{Hazard\ Threshold}$$

For aquatic organisms, the "effect level" is a derived COC based on a hazard effects concentration. The COC used to calculate RQs for aquatic organisms was derived from hazard values resulting from chronic exposures to DCHP. The benchmark value for RQs in environmental risk characterization is 1. If the RQ was above 1, the exposure was greater than the effect concentration. If the RQ was below 1, the exposure was less than the effect concentration. An RQ equal to 1 indicated that the exposures were the same as the concentration that caused effects. In this assessment, an initial RQ value was determined only for surface water exposure to aquatic organisms where the most conservative scenario of release, flow, water solubility and chronic invertebrate hazard were considered. After further consideration of realistic conditions and hazards, risk was assessed qualitatively for surface water exposures and all other pathways.

In addition to modeling, environmental monitoring and biomonitoring data were reviewed and screened to assess wildlife exposure to DCHP (U.S. EPA, 2025p). EPA qualitatively assessed the trophic transfer of DCHP through food webs to wildlife using conservative and protective scenarios and physical and chemical properties. DCHP is not expected to be persistent in the environment as it is expected to degrade rapidly under most environmental conditions with delayed biodegradation in low-oxygen media and DCHP's bioavailability is expected to be limited (U.S. EPA, 2025ac). Estimates of the DCHP limit of water solubility range from 30 to 1,480 µg/l, leading to uncertainty about DCHP dissolved in surface water. DCHP is expected to have low bioaccumulation potential, biomagnification potential, and low potential for uptake based on a log BCF (bioconcentration factor) of 2.85 and a log BAF (bioaccumulation factor) of 1.83 (U.S. EPA, 2025p, 2025ac).

### 5.3.2 Risk Estimates for Aquatic and Terrestrial Species

For DCHP, surface water exposure was the only scenario where modeled concentrations could be compared with a hazard threshold or a COC. Thus, EPA calculated an initial RQ for surface water DCHP concentration but did not calculate RQs for other scenarios of exposure to organisms. Instead, because either exposure or hazard effects estimates were not reasonably available for other scenarios,

environmental risk of DCHP to other organisms was characterized by a qualitative description of risk (Table 5-1).

**Table 5-1. Relevant Exposure Pathway to Receptors and Corresponding Risk Assessment for the DCHP Environmental Risk Characterization**

| Exposure Pathway | Receptor | Risk Assessment |
|---|---|---|
| Surface water | Chronic exposure to aquatic species (reduced *Daphnia magna* reproduction >21 days) | Screening assessment; risk quotient (RQ) < 1 in all but the most conservative modeling scenario |
| | Acute exposure: no hazard up to and above 2,000 µg/L DCHP to fish (*Oryzias latipes*), *D. magna*, and algae (*Raphidocelis subcapitata*) | Qualitative; no RQs calculated |
| Trophic transfer | Terrestrial mammal | Qualitative; no RQs calculated |
| Biosolids | Terrestrial mammal | Qualitative; no RQs calculated |
| Landfills | Terrestrial mammal | Qualitative; no RQs calculated |

***Surface Water***

The COC was derived from a study of the hazard effects due to chronic (21-day) aqueous exposures to the freshwater invertebrate, *Daphnia magna* (NITE, 2000) and determined to be 32 µg/L DCHP. The reasonably available studies on Japanese medaka (*Oryzias latipes*), *D. magna*, and the freshwater algae (*Raphidocelis subcapitata*) found no aquatic acute exposure hazards up to and above the water solubility limit of 1,480 µg/L DCHP (U.S. EPA, 2025o).

EPA found no evidence from monitoring reports or the scientific literature that DCHP occurs in surface water at the COC of 32 µg/L (U.S. EPA, 2025p). EPA modeled surface water release under the most conservative and least likely scenario from the PVC plastics compounding OES, which had the highest estimated release to water (18 kg/site-day). Other OESs have potential releases to water, incineration, or landfill, with unknown proportions of the total release discharged to water, but the total releases did not exceed 18 kg/site-day (Table 3-5). This conservative model included the highest modeled release estimate, the lowest 7-day average flow over 10 years from a generic stream, the highest modeled estimate of the limit of DCHP water solubility (1,480 µg/L), and no wastewater treatment removal. These conditions are unlikely for at least three reasons. First, it combined the highest release from a facility into a low flow scenario indicative of a small stream. Without site-specific data, EPA does not have evidence that a high release, small stream combination exists in the Unites States. Second, the assumption of no wastewater treatment removal is unlikely given the solid state of DCHP and the DCHP life cycle (U.S. EPA, 2025s). Finally, experimental evidence suggests that the functional limit of DCHP water solubility may be near the lower EPA-estimated range of 30 µg/L rather than the upper bound of the estimated range of 1,480 µg/L. Specifically, two studies that attempted to find hazard thresholds of DCHP to aquatic organisms report their inability to keep DCHP in solution above 30 to 50 µg/L, even with the aid of cosolvents (KemI, 2023; Mathieu-Denoncourt et al., 2016). The VVWM-PSC-modeled concentrations were 218 µg/L DCHP in surface water and 126 µg/L in porewater over 21 days, which are below the upper-bound estimate of the limit of water solubility of 1,480 µg/L (U.S. EPA, 2024b), but over three times greater than the lower-bound estimate of the limit of water solubility (30 µg/L) and the water solubility limit (30 µg/L) proposed by the Swedish Chemicals Agency (KemI, 2023).

A first-tier screen computed RQs using the upper-bound estimate of water solubility (1,480 µg/L), the highest release, median low flow (7Q10), no wastewater treatment, and the COC (32 µg/L) resulting in a

surface water concentration of 218 µg/L and an RQ greater than the benchmark of 1 (RQ = 6.8). Applying 71.2 percent wastewater treatment removal (U.S. EPA, 2025p) under the more typical (*i.e.*, central tendency) daily release of 1.1 kg/site-day resulted in RQ of 0.41. However, RQs were less than the benchmark of 1 under all other scenarios that considered one or more of the following surface water scenarios, higher flow rates (*e.g.*, 75th percentile 7Q10), modeled central tendency release estimates (*e.g.*, 1.11 kg/day), or limits of water solubility at the lower-bound estimate (30 µg/L). Additional uncertainty about the first-tier screen RQ is due to the DCHP COC being derived from a *Daphnia* study that found a 12.9 percent reduction in offspring reproduction after two to three generations of exposure to 572 µg/L DCHP (NITE, 2000). The exposure concentrations in this experiment were enhanced by the use of dimethylformamide as a cosolvent, which resulted in DCHP concentrations well above the lower-bound estimate of water solubility (30 µg/L) (NITE, 2000). Therefore, EPA determined a low likelihood of DCHP persisting in surface waters for a long enough duration (21 days) to cause chronic hazard in aquatic invertebrates and thus a low likelihood of RQs exceeding the benchmark of 1 in the environment.

In one available study, DCHP concentrations measured in the water column did not exceed 0.014 µg/L (Keil et al., 2011). Monitoring by the Washington State Department of Ecology resulted in no DCHP detection above the detection limit (0.05 µg/L) (WA DOE, 2022). No information is available on the potential continuous or persistent nature of DCHP in the water column of natural systems or from specific release sites. Modeled concentrations from the Processing/ PVC plastics compounding COU/OES release scenarios coupled with low flow conditions predict unlikely conditions for exposure to exceed COCs. Risk of chronic DCHP exposure to aquatic invertebrates requires surface water concentrations to be three orders of magnitude greater than those reported in the literature as background concentration or at a point source (Keil et al., 2011). Modeled DCHP water concentrations from release scenarios of all other OES did not indicate risk even in similar low flow conditions.

***Sediment and Pore Water***

DCHP is expected to partition primarily to soil and sediment, regardless of the compartment of environmental release (U.S. EPA, 2025q). DCHP is not expected to undergo long-range transport and is expected to be found predominantly in sediments near point sources, with a decreasing trend in sediment concentrations downstream due to DCHP's strong affinity and sorption potential for organic carbon in sediment. EPA's maximum modeled concentrations under low flow conditions of 148 mg/kg/d (U.S. EPA, 2025p) reflect the physical and chemical properties of DCHP and its predicted affinity for sediment (U.S. EPA, 2025ac) but may be overestimated due to conservative parameters and the VVWM-PSC three compartment model. Also, DCHP is not expected to be persistent in the environment as it is expected to degrade rapidly under most environmental conditions with delayed biodegradation in low-oxygen media (U.S. EPA, 2025ac).

EPA found no evidence from monitoring reports or the scientific literature that DCHP occurs in pore water at the COC of 32 µg/L. Porewater DCHP concentrations from VVWM-PSC modeling resulted in a maximum of 126 µg/L, which exceeded the DCHP limit of solubility (30 µg/L). EPA found no reasonably available studies on the hazard effects of DCHP sediment exposures to aquatic organisms (U.S. EPA, 2025o). Despite this, the Agency considered the COC of DCHP to *Daphnia* (32 µg/L) to indicate chronic exposure hazard effects to sediment-dwelling animals. Because of the water solubility uncertainties described for surface risk to aquatic invertebrates, EPA determined a low likelihood of DCHP persisting in sediment and pore waters for a long enough duration (21 days) to cause chronic hazard in aquatic invertebrates, and thus low likelihood of RQs exceeding the benchmark of 1 in the environment.

***Air***

No studies on the hazardous effects of DCHP inhalation were reasonably available for EPA to review. Only a few studies that monitored ambient DCHP air concentrations were reasonably available for the Agency to review. DCHP in particulates averaged 0.01 ng/$m^3$ in one study (Lee et al., 2019). Low to negligible air concentrations are expected from TSCA COUs and air to soil modeling was not conducted. Thus, EPA qualitatively assessed risk using low exposures via air pathways and thus low likelihood of RQs exceeding the benchmark of 1 in the environment.

***Landfill***

EPA qualitatively assessed risk of landfill to groundwater and soil DCHP exposure to aquatic and terrestrial organisms. No hazard data were reasonably available for groundwater- or soil-dwelling animals or plants. EPA considered the COC of DCHP to *Daphnia* (32 µg/L) to indicate chronic exposure hazard effects to groundwater dwelling animals. Empirical toxicity data for rats and mice were used to estimate a hazard threshold value for terrestrial mammals that may ingest soils at 179.3 mg/kg-bw/day (U.S. EPA, 2025o).

DCHP may be deposited into landfills through various waste streams, including consumer waste, residential waste, and industrial waste, as well as through municipal waste like dewatered wastewater biosolids. No studies were identified that reported the concentration of DCHP in landfills or in the surrounding land. There is limited information regarding DCHP in dewatered biosolids, which may be sent to landfills for disposal. DCHP is not expected to be persistent in the environment as it is expected to degrade rapidly under most environmental conditions with delayed biodegradation in low-oxygen media. DCHP is slightly soluble in water (range from 0.03–1,480 µg/L) and has limited potential to leach from landfills into nearby groundwater or surface water systems. However, DCHP is expected to have a high affinity to particulate (log $K_{OC}$ = 4.47) and organic media (log $K_{OW}$ = 4.82), which would cause significant retardation in groundwater and limit leaching to groundwater. Because of its high hydrophobicity and high affinity for soil sorption, it is not expected to be bioavailable for uptake. As a result, the available evidence indicates that migration from landfills to surface water and sediment is limited, and EPA did not model DCHP leaching from landfills to groundwater or surface water systems. EPA determined a low likelihood of DCHP persisting in and being bioavailable in groundwater from landfills for a long enough duration to cause chronic hazard in animals, and thus low likelihood of RQs exceeding the benchmark of 1 in the environment.

There is limited reasonably available information related to the uptake and bioavailability of DCHP in soils. DCHPs solubility and sorption coefficients suggest that bioaccumulation and biomagnification will not be of significant concern for soil-dwelling organisms adjacent to landfills. The combination of factors such as biodegradation (U.S. EPA, 2025ac) and the weight of evidence supporting a lack of bioaccumulation and lack of biomagnification supports this qualitative assessment that potential DCHP concentrations in landfills do not present concentrations greater than the hazard thresholds to terrestrial organisms. EPA determined a low likelihood of DCHP persisting and being bioavailable to solid-dwelling animals, plants, or in the diets of mammals for a long enough duration to cause chronic hazard, and thus low likelihood of RQs exceeding the benchmark of 1 in the environment.

***Biosolids***

EPA qualitatively assessed risk of biosolids to soil DCHP exposure to terrestrial organisms. No hazard data were reasonably available for soil-dwelling animals or plants. Empirical toxicity data for rats and mice were used to estimate a hazard threshold value for terrestrial mammals at 179.3 mg/kg-bw/day (U.S. EPA, 2025o). DCHP may be introduced to biosolids by the absorption or adsorption of DCHP to particulate or organic material during wastewater treatment. Wastewater treatment is expected to remove

up to 98 percent of DCHP during wastewater treatment via sorption of DCHP to biosolids (Wu et al., 2019). Modeling of DCHP removal in wastewater treatment predicts sorption to account for a total of 71.2 percent removal of DCHP with 70.6 percent overall removal attributed to biosolid sorption and the remaining 0.6 percent removal attributed to biological treatment (U.S. EPA, 2017). There are currently no reasonably available U.S.-based studies reporting DCHP concentration in biosolids or in soil following land application.

High-end release scenarios were considered not to be applicable to the evaluation of land application of biosolids. More specifically, high-end releases of DCHP from industrial facilities are unlikely to be discharged directly to municipal wastewater treatment plants without pretreatment, and biosolids from industrial facilities are unlikely to be directly land applied following on-site treatment.

There is limited measured data on concentrations of DCHP in biosolids or soils receiving biosolids and there is uncertainty that concentrations used in this analysis are representative of all types of environmental releases. However, the high-quality biodegradation rates and physical and chemical properties show that DCHP will have limited persistence potential and mobility in soils receiving biosolids (U.S. EPA, 2025ac). The combination of factors such as biodegradation and the weight of evidence supporting a lack of bioaccumulation and lack of biomagnification supports this qualitative assessment that potential DCHP concentrations in biosolids do not present concentrations greater than hazard threshold values to terrestrial organisms. Therefore, EPA determined a low likelihood of DCHP persisting and being bioavailable to soil-dwelling animals, plants, or in the diets of mammals for a long enough duration to cause chronic hazard; thus, there is a low likelihood of RQs exceeding the benchmark of 1 in the environment.

***Trophic Transfer***

EPA did not conduct a quantitative modeling analysis of the trophic transfer of DCHP through food webs because of the chemical properties and fate of DCHP indicate low potential for bioaccumulation or biomagnification. Specifically, the Agency does not expect DCHP to persist in surface water, groundwater, or air. DCHP is not expected to be persistent in the environment as it is expected to degrade rapidly under most environmental conditions with delayed biodegradation in low-oxygen media, and DCHP's bioavailability is expected to be limited (U.S. EPA, 2025ac). Estimates of the DCHP limit of water solubility range from 30 to 1,480 µg/L, leading to uncertainty about DCHP dissolved in surface water. DCHP is expected to have low bioaccumulation potential, biomagnification potential, and low potential for uptake based on a log BCF of 2.85 and a log BAF of 1.83 (U.S. EPA, 2025p, 2025ac). For example, a conservative and protective screening scenario that uses the upper bound of water solubility as the water concentration (1,480 µg/L DCHP) and BAF of 67, results in 99 mg/kg-bw DCHP in fish. A similar calculation results in 17 mg/kg-bw DCHP in fish if the highest modeled concentration from EPA's VVWM-PSC (218 µg/L) is used. These values are less than the terrestrial mammal threshold value of 179.3 mg/kg-bw/day over 70 days. These values would only be lower in simulations that incorporate other release and exposure scenarios in a trophic transfer model. Finally, EPA also did not find reasonably available data sources that report the aquatic bioconcentration, aquatic bioaccumulation, aquatic food web magnification, terrestrial biota-sediment accumulation, or terrestrial bioconcentration of DCHP. Therefore, EPA determined a low likelihood of DCHP transferring through food webs to reach the terrestrial mammal threshold value of 179.3 mg/kg-bw/day and thus low likelihood of RQs exceeding the benchmark of 1 in the environment.

***Distribution in Commerce***

For purposes of assessment in this risk evaluation, distribution in commerce consists of the transportation associated with the moving of DCHP or DCHP-containing products and/or articles

between sites manufacturing, processing, and use COUs, or the transportation of DCHP containing wastes to recycling sites or for final disposal. EPA expects all the DCHP or DCHP-containing products and/or articles to be transported in closed system or otherwise to be transported in a form (*e.g.*, articles containing DCHP) such that there is negligible potential for releases except during an incident. However, most of the releases from this COU/OES are expected to be captured within the releases of other COUs/OESs because most of the activities (loading, unloading) generating releases from distribution of commerce are release points of other COU/OESs.

### 5.3.3 Overall Confidence and Remaining Uncertainties Confidence in Environmental Risk Characterization

The environmental risk characterization of DCHP evaluated confidence from environmental exposures and environmental hazards. Exposure confidence is detailed within U.S. EPA (2025p), the TSD *Environmental Media and General Population and Environmental Exposure Assessment for Dicyclohexyl Phthalate (DCHP)*, represented by modeled and monitored data. Hazard confidence was represented by evidence as reported previously in the *Environmental Hazard Assessment for Dicyclohexyl Phthalate (DCHP)* U.S. EPA (2025o).

The overall confidence in the risk characterization for the aquatic assessment is robust. EPA has indicated no risk to aquatic organisms under most realistic release, flow, wastewater treatment, and solubility scenarios—except in a scenario with the most conservative assumptions. The Agency has robust confidence that the scenario with the most conservative assumptions is unlikely for several reasons. First, EPA has determined DCHP water releases to be low due to its chemical properties and predicted fate (U.S. EPA, 2025ac), making modeled exposure predictions greater than COCs unlikely. Also, DCHP is a solid at room temperature with considerable variation in the estimates of water solubility that ranges from 30 µg/L to 1,480 µg/L. Under EPA's release of DCHP to water generic scenarios, the amount of DCHP that may be released to surface water as a solid and the amount that is dissolved in water critically depends on the functional or environmentally relevant solubility of DCHP in water bodies. Evidence from the only available U.S. monitoring study reported the maximum DCHP at 0.014 µg/L (Keil et al., 2011), plus two toxicity studies that reported DCHP leaving solution above 30 µg/L (KemI, 2023; Mathieu-Denoncourt et al., 2016) suggest that EPA's modeled, high-end release and low stream flow scenario resulting 218 µg/L DCHP is unlikely to occur in aquatic ecosystems. Thus, no reasonably available evidence reports dissolved water concentrations as high as 218 µg/L and the weight of evidence points to a low likelihood of DCHP concentrations reaching 218 µg/L.

The environmental hazard to aquatic organisms is also not clear because only two peer-reviewed studies and a handful of reports are reasonably available for EPA to review. These studies have high data quality evaluation ratings, but corroborating results from additional studies would improve the accuracy and precision of the Agency's COC for chronic exposure while increasing the confidence for indications of low likelihood of risk. All but two of these studies did not find acute exposure effects at concentrations up to 2,000 µg/L, indicating that short exposure durations pose little risk to aquatic organisms. Chronic exposure effects on reproductive endpoints were documented for an invertebrate and a fish at approximately 30 µg/L DCHP concentrations. All these studies used solvent carriers to keep DCHP in solution. Taken together, it remains unclear whether high concentrations of DCHP in the water column occur in ecosystems and whether these exposure concentrations can persist long enough to incur reproductive effects on aquatic organisms. Thus, the weight of evidence summarized in this risk evaluation leads to the characterization of no risk to aquatic receptors in the environment.

The overall confidence in the risk characterization for the terrestrial assessment is robust. EPA has robust confidence that DCHP is not likely to present environmental risk through most scenarios that may

expose DCHP to terrestrial organisms. This confidence is due to the relatively low volumes of release across COUs, the physical and chemical properties of DCHP, and the low number of studies that document DCHP in the environment. These result in low to negligible exposure concentrations in air, landfills, biosolids and soils. Trophic transfer of DCHP through food webs is also unlikely due to DCHP's chemical and fate properties that indicate that it has low potential to bioaccumulate or biomagnify in food webs. This weight of evidence of low potential for DCHP exposures in terrestrial ecosystems—coupled with no reasonably available studies of DCHP hazard effects to wildlife and a relatively high surrogate mammal hazard threshold from laboratory rodent data—indicate exposure above the hazard threshold is an unlikely risk to terrestrial organisms. Although the lack of reasonably available studies on the hazardous effects of DCHP on wildlife does not rule out hazard and subsequent risk, the weight of evidence summarized in this document leads to the indication that risk to terrestrial receptors is not expected.

# 6 UNREASONABLE RISK DETERMINATION

TSCA section 6(b)(4) requires EPA to conduct a risk evaluation 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 PESS identified by EPA as relevant to this risk evaluation, under the COUs.

EPA is determining that DCHP presents unreasonable risk of injury to human health driven by identified significant contributions to unreasonable risk from two COUs, due to acute inhalation exposure to workers. The acute inhalation exposure to workers is the primary route contributing to the aggregate and cumulative exposure for workers.[6] EPA did not identify significant contributions to unreasonable risk to human health due to DCHP exposures to ONUs, consumers, or the general population.

EPA determined that DCHP does not present an unreasonable risk to the environment due to exposures to terrestrial or aquatic organisms under the COUs. Accordingly, no conditions of use significantly contribute to any unreasonable risk to the environment. This unreasonable risk determination is based on the information in previous sections of this risk evaluation, the appendices, and assessment/TSDs and supplemental files of this risk evaluation (see Appendix C) in accordance with TSCA section 6(b). This unreasonable risk determination and the underlying evaluation are consistent with the best available science (TSCA section 26(h)) and based on the weight of scientific evidence (TSCA section 26(i)).

EPA will initiate risk management for DCHP by applying one or more of the requirements under TSCA section 6(a) to the extent necessary so that DCHP no longer presents an unreasonable risk. The Agency expects risk management requirements to focus on those COUs that significantly contribute to the determination of unreasonable risk of DCHP. As the acute inhalation risk presented in the single chemical analysis is the driver of unreasonable risk, EPA's risk management will focus on the significant contributions to risk presented in the single chemical analysis of DCHP. The Agency may select from among a suite of risk management options related to manufacture (including import), processing, distribution in commerce, commercial use, and disposal of DCHP to address the unreasonable risk. The Agency could also consider whether such risk may be prevented or reduced to a sufficient extent by action taken under another federal law, such that referral to another agency under TSCA section 9(a) or use of another EPA-administered authority to protect against such risk pursuant to TSCA section 9(b) may be appropriate.

Table 4-14 and Table 6-1 show that when personal protective equipment (PPE) is used, the high-end and central tendency MOEs for all occupational COUs no longer indicate risk (see Section 4.3.2.2 for additional information). Because EPA does not currently have reasonably available information regarding use of PPE under the COUs, this unreasonable risk determination does not reflect use of PPE.

As noted in the Executive Summary, DCHP is used primarily as a plasticizer in manufacturing adhesives, paints and coatings, printing inks, plastic products, rubber products, and plastic resins. It is also used as a stabilizing agent, specifically as a "phlegmatizer" for dibenzoyl peroxide (BPO) and peroxide-based formulations. Other applications include industrial use of adhesives and sealants in transportation equipment and computer and electronic product manufacturing; and in commercial and consumer products, including adhesives and sealants, paints and coatings, and plastic and rubber

[6] The Agency conducted analyses on aggregate exposures and cumulative risks. Aggregate exposure analyses consider effects on populations that are exposed to DCHP via multiple routes (*e.g.*, dermal contact, ingestion, inhalation). Cumulative risk refers to human health risks related to exposures to multiple chemicals with similar effects (*i.e.*, aggregate + NHANES = cumulative). See Section 4.4 for more information.

products. Workers may be exposed to DCHP when making these products or otherwise using DCHP in the workplace. When it is manufactured or used to make products, DCHP can be released into the water, where because of its properties, most of it will end up in the sediment at the bottom of lakes and rivers. If it is released into the air, DCHP will attach to dust particles and then be deposited onto land or into water. Indoors, DCHP has the potential over time to come out of products and adhere to dust particles. If it does, people could inhale or ingest dust that contains DCHP.

EPA notes that uses that are not subject to TSCA (*e.g.*, cosmetics, use of shells and cartridges as identified in 26 U.S.C. § 4181 and food additives like food contact materials) were not evaluated as COUs by the Agency because these uses are explicitly excluded from TSCA's definition of chemical substance. It is not appropriate to extrapolate from this risk determination to form conclusions about uses of DCHP that are not subject to TSCA and that EPA did not evaluate as COUs.

Where relevant, the Agency conducted analyses on aggregate exposures and cumulative risks. Aggregate exposure analyses consider effects on populations that are exposed to DCHP via multiple routes (*e.g.*, dermal contact, ingestion, and inhalation). Cumulative risk refers to human health risks related to exposures to multiple chemicals. Workers and consumers can be exposed to other phthalates that have the same toxicological endpoint (*i.e.*, decreased fetal testicular testosterone) as well as the exposure to DCHP, with greater risk in total. EPA has developed a CRA technical support document (TSD) of DCHP and five other toxicologically similar phthalates (*i.e.*, BBP, DBP, DEHP, DIBP, BBP, and DINP) that are also being evaluated under TSCA (U.S. EPA, 2025ai). This analysis allowed EPA to assess the combined risk to health from multiple chemicals with similar effects simultaneously, recognizing that human exposure to phthalates is widespread and that multiple phthalates can disrupt development of the male reproductive system. For DCHP, the acute inhalation exposure to workers is the primary route contributing to the aggregate and cumulative exposure for workers.

The full list of COUs evaluated for DCHP are listed in Table 1-1. EPA determined that the following two COUs significantly contribute to unreasonable risk of injury to human health due to non-cancer risks from acute inhalation exposure to workers (from Approach 2):

- Industrial use – paints and coatings; and
- Commercial use – paints and coatings.

EPA did not identify significant contributions to unreasonable risk to human health or the environment from the following 22 COUs:

- Manufacturing – domestic manufacturing;
- Manufacturing – importing;
- Processing – incorporation into formulation, mixture, or reaction product – adhesive and sealant chemicals in adhesive manufacturing;
- Processing – incorporation into formulation, mixture, or reaction product – plasticizer in adhesive manufacturing, paint and coating manufacturing, and printing ink manufacturing;
- Processing – incorporation into formulation, mixture, or reaction product –stabilizing agent in adhesive manufacturing; asphalt paving, roofing, and coating materials manufacturing; and paints and coating manufacturing;
- Processing – incorporation into article – plasticizer in plastics product manufacturing and rubber product manufacturing;
- Processing – repackaging (*e.g.*, laboratory chemicals);
- Processing – recycling;
- Distribution in commerce;

- Industrial use – adhesives and sealants;
- Industrial use – finishing agent – cellulose film production;
- Industrial use – inks, toner, and colorant products (*e.g.,* screen printing ink);
- Industrial use – other articles with routine direct contact during normal use including rubber articles; plastic articles (hard);
- Commercial use – adhesives and sealants;
- Commercial use – building/construction materials not covered elsewhere;
- Commercial use – inks, toner, and colorant products (*e.g.,* screen printing ink);
- Commercial use – laboratory chemicals;
- Commercial use – other articles with routine direct contact during normal use including rubber articles; plastic articles (hard);
- Consumer use – adhesives and sealants;
- Consumer use – other articles with routine direct contact during normal use including rubber articles; plastic articles (hard);
- Consumer use – other consumer articles that contain dicyclohexyl phthalate from: inks, toner, and colorants; paints and coatings; adhesives and sealants (*e.g.,* paper products, textiles, products using cellulose film, etc.); and
- Disposal.

There were no COUs that significantly contribute to unreasonable risk for ONUs, consumers, the general population, or the environment.

For some COUs, such as Distribution in commerce, the Agency has limited reasonably available information to derive risk estimates, such as margin of exposures (MOEs) or risk quotients (RQs), to support a determination of whether the COU contributes to the unreasonable risk of injury to human health or the environment. In such cases, EPA integrates reasonably available information, such as physical and chemical properties and available monitoring data, in a risk characterization using a weight of evidence approach and professional judgment to support conclusions. The risk characterizations of COUs without risk estimates qualitatively presents what EPA expects given the weight of scientific evidence without overstating the science.

The unreasonable risk determination must be informed by science, and in making a finding of "presents unreasonable risk," EPA considered risk-related factors beyond exceedance of benchmarks. Risk-related factors include the type and severity of health effects under consideration, the reversibility of the health effects being evaluated, exposure-related considerations (*e.g.,* duration, magnitude, frequency of exposure), or population exposed—particularly populations with greater exposure or greater susceptibility (PESS) and the confidence in the information used to inform the hazard and exposure values. EPA also considered, where relevant, the Agency's analyses on aggregate exposures and cumulative risk. For COUs evaluated quantitatively, as described in the risk characterization, EPA based the risk determination on the risk estimate that best represents the COU. The Agency describes the strength of the scientific evidence supporting the human health and environmental assessments as robust, moderate, slight, or indeterminate.

Robust confidence suggests thorough understanding of the scientific evidence and uncertainties, and the supporting weight of scientific evidence outweighs the uncertainties to the point where it is unlikely that the uncertainties could have a significant effect on the risk estimates. Moderate confidence suggests some understanding of the scientific evidence and uncertainties, and the supporting scientific evidence weighed against the uncertainties is reasonably adequate to characterize risk. Slight confidence is assigned when the weight of scientific evidence may not be adequate to characterize the risk, and when

the Agency is making the best scientific assessment possible in the absence of complete information. In cases where EPA lacked reasonably available data, the Agency's confidence in risk is indeterminate. In general, EPA makes a determination of unreasonable risk based on risk estimates that have an overall confidence rating of moderate or robust because those confidence ratings indicate the scientific evidence is adequate to characterize risk estimates despite uncertainties or is such that it is unlikely the uncertainties could have a significant effect on the risk estimates.

This risk evaluation discusses important assumptions and key sources of uncertainty in the risk characterization; these are described in more detail in the respective weight of scientific evidence conclusions sections for fate and transport (Section 2.2), environmental release (Section 3.3.1), environmental exposures (Section 5.1), environmental hazards (Section 5.3.3), human health hazards (Section 4.2), human health risk characterization (Section 4.3), and Appendix F. It also includes overall confidence and remaining uncertainties sections for human health and environmental risk characterizations. Again, in general, EPA makes an unreasonable risk determination based on risk estimates that have an overall confidence rating of moderate or robust.

## 6.1 Unreasonable Risk to Human Health

Calculated risk estimates (MOEs[7]) provide a risk profile of DCHP by presenting a range of estimates for different health effects for different COUs. When characterizing the risk to human health from occupational exposures during risk evaluation under TSCA, EPA conducts baseline assessments of risk and makes its determination of unreasonable risk in a manner that takes into consideration reasonably available information (*e.g.*, information submitted by manufacturers and processors of DCHP; multiple, representative site visits if relevant) regarding whether use of respiratory protection or other PPE[8] is standard practice at all sites. This allows EPA to make unreasonable risk determinations based on the information regarding workers wearing PPE where the Agency has confidence that the information is representative. In addition, the risk estimates are based on exposure scenarios with monitoring data that reflect existing requirements, such as those established by OSHA or industry sector best practices. In this risk evaluation, the risk estimates calculated reflect both use with and without PPE—including information on PPE that could be used to reduce the exposures. Although EPA has contacted manufacturers and processors of DCHP, the Agency has limited information regarding ongoing appropriate and consistent use of PPE that would already address the unreasonable risk under the COUs. No information was received in public comment further describing current PPE practices. Therefore, the risk determination is based on risk estimates that do not reflect use of PPE.

### 6.1.1 Populations and Exposures EPA Assessed to Determine Unreasonable Risk to Human Health

EPA has evaluated risk to adolescent and adult workers (including ONUs and female workers of reproductive age) aged 16 years and older; consumer users and bystanders, including infants and children; and the general population, including infants and children and people who consume fish. The Agency evaluated these risks using reasonably available monitoring and modeling data for inhalation and dermal exposures, as applicable. EPA has evaluated risk from inhalation, dermal, and aggregate (combination of inhalation and dermal) exposure of DCHP to workers, including ONUs, as appropriate for each exposure scenario—but the primary route of exposure was inhalation. The Agency evaluated risk from inhalation, dermal, and oral exposure to consumer users and inhalation exposures to

[7] EPA derives non-cancer MOEs by dividing the non-cancer POD (HEC [mg/m$^3$] or HED [mg/kg-day]) by the exposure estimate (mg/m$^3$ or mg/kg-day). Section 4.2 has additional information on the risk assessment approach for human health.
[8] In some cases, baseline conditions may reflect certain mitigation measures, such as engineering controls, in instances where exposure estimates are based on monitoring data at facilities that have engineering controls in place.

bystanders. Finally, EPA also evaluated risk from exposures from surface water, drinking water, fish ingestion, ambient air, and land pathways (*i.e.,* landfills and application of biosolids) to the general population.

In developing the exposure and hazard assessments for DCHP, EPA also analyzed reasonably available information to ascertain whether some human populations may have greater exposure and/or susceptibility than the general population to the hazard posed by DCHP. For this DCHP risk evaluation, EPA has accounted for PESS groups in two main categories: people who are expected to have greater exposure to DCHP, and population group life stages that may have greater susceptibility to the health effects of DCHP. The former includes people exposed to DCHP at work; people in close proximity to releasing facilities (including fenceline communities); infants and children who frequently have contact with consumer products and/or articles containing high concentrations of DCHP; those who may have greater intake of DCHP per body weight (*e.g.,* infants, children, adolescents); those exposed to DCHP through certain age-specific behaviors (*e.g.,* mouthing by infants and children); and Tribes and subsistence fishers whose diets include large amounts of fish. The latter PESS group includes women of reproductive age, pregnant women, infants, children, and adolescents. A full PESS analysis is provided in Section 4.3.5 of this risk evaluation.

### 6.1.2 Summary of Human Health Effects

EPA is determining that the unreasonable risk presented by DCHP is due to non-cancer effects in workers from inhalation exposure. The acute inhalation exposure to workers is the primary route contributing to the aggregate and cumulative exposure for workers.

For the acute duration for DCHP, EPA derived non-cancer risk estimates for occupational and consumer exposures using two approaches of the cumulative analysis, detailed in Section 4.4.3. Based on the weight of scientific evidence considerations, the Agency weighed the strengths and uncertainties associated with the DCHP RPF (Approach 1) and the DCHP POD (Approach 2 and single chemical DCHP risk evaluation). EPA acknowledges there are strengths and uncertainties of both approaches and concludes that Approach 2 using the POD from the single chemical assessment is the most appropriate for deriving cumulative risks for DCHP. This conclusion is based on the following: The POD approach (*i.e.,* Approach 2) is based on 6 studies, including the Li et al. (Li et al., 2016) study with testosterone data measured post-natally, and considers the full spectrum of adverse outcomes relevant to phthalate syndrome across a broad degree of dose levels, including multiple studies at or near 10 mg/kg-day. In contrast, the RPF approach (*i.e.,* Approach 1) is based on three studies using a single adverse outcome (fetal testosterone) where only high-dose data are available, reducing confidence in the BMD estimates at the lower end of the dose-response curve. As a result, both from an adverse outcome pathway perspective and a dose-response perspective, the underlying data for the POD approach are more robust and more appropriate for extrapolating cumulative risk.

EPA's cumulative approach adds non-attributable exposures from other phthalates (*i.e.,* BBP, DDP, DEHP, DIBP, and DINP) as estimated from NHANES, to acute aggregate DCHP exposures for females of reproductive age for each DCHP OES/COU. For DCHP, this non-attributable phthalate exposure contributes approximately 7.4 percent to the risk cup for female workers of reproductive age, assuming a benchmark MOE of 30. Note that while the non-attributable exposure is being added to aggregate exposures only (*i.e.,* not dermal or inhalation exposures separately), the primary contributor to cumulative risk for DCHP is inhalation exposure from the DCHP COUs, which accounts for approximately 88 to 99 percent of exposure.

EPA's exposure and overall risk characterization point of departures (PODs) and MOEs are summarized in Section 4.3, with specific health risk estimates for workers (including ONUs), consumers, bystanders, and the general population presented in Section 4.3.2 (workers), Section 4.3.3 (consumers and bystanders), Section 4.3.4 (general population), and Section 4.3.5 (PESS). These MOEs and benchmarks are not "bright-lines," and EPA has discretion to consider other risk-related factors when concluding whether a COU significantly contributes to the unreasonable risk.

### 6.1.3 Basis for Unreasonable Risk to Workers

Based on the occupational risk estimates and related risk factors, EPA is determining that two COUs significantly contribute to the unreasonable risk from DCHP; this is driven by significant contributions to non-cancer risks from acute inhalation exposure to workers.

For ONUs, EPA did not have specific data on inhalation exposure; therefore, EPA used worker central tendency exposure as representative of ONU exposure. Furthermore, dermal exposure to ONUs was modeled as incidental skin contact equal to the surface area of one palm. EPA has determined that there are no exposures to DCHP that significantly contribute to unreasonable risk to ONUs, because inhalation and dermal risk was not indicated.

Risk from dermal exposures at any duration is not indicated (*i.e.,* MOEs were not below the benchmark of 30) to any workers, including ONUs, at the central tendency or high-end for dermal exposures. Dermal exposures are not driving DCHP's acute non-cancer risks to workers in occupational settings; rather the primary contributor to risk is inhalation exposure to DCHP.

In determining whether a COU significantly contributes to the unreasonable risk to DCHP, EPA relied on the central tendency for most of the occupational estimates because central tendency estimates are often expected to be the most reflective of actual worker exposures. For example, in the absence of inhalation monitoring data, EPA used the PNOR Model for inhalation exposures, which uses the assumption that the concentration of DCHP in workplace dust is the same as the maximum concentration of DCHP manufactured or in the product as an input. This assumption is conservative because it is likely that workplace dusts contain a variety of constituents besides the final product, because (1) the concentration of DCHP in workplace dust is likely less than the concentration of DCHP in the final product, and (2) exposure to dusts with such high-end DCHP concentrations are unlikely in actual workplaces. However, for both COUs that were assessed with the scenario of Application of paints and coatings liquids, EPA's risk determination is based on the estimates associated with the high-end scenario due to a number of variables discussed in more detail below.

Two occupational COUs that EPA determined significantly contribute to unreasonable risk are represented by two different OESs—Application of paints and coatings both as a liquid and as a solid:

- Industrial use – paints and coatings; and
- Commercial use – paints and coatings.

As explained above, the central tendency is expected to be the most reflective of worker exposures within the DCHP COUs that utilize the PNOR Model, such as for activities associated with the Applications of paints and coatings *solids*, which do not significantly contribute to unreasonable risk (*i.e.,* no risk estimates are below the benchmark of 30). Central tendency is the most reflective because the high-end assumption about the concentration of DCHP in workplace dust is conservative and highly unlikely in actual workplaces. In comparison, for Application of paints and coatings *liquids*, while central tendency generally represents the typical exposure of most workers to DCHP through spray application, a confluence of a subset of variables (*e.g.,* low ventilation, high-pressure spray, etc.)

resulting in risk below the benchmark is possible; and EPA evaluated such a situation based on an existing DCHP product. While most workers are not expected to experience elevated exposures (*i.e.*, greater than 90th percentile of mist concentration data for an 8-hour period) on a daily basis, it is considered reasonable for such exposures to occur in an acute, 1-day scenario. EPA verified the paint and coating product line that is used to inform the exposure scenario for this OES in 2019 (U.S. EPA, 2019d). The company confirmed that their paint and coating could be sprayed (both air and airless techniques), rolled, or brushed on and was used in industrial and high heat settings to coat various elements of factories, tanks, stacks, and so on. (U.S. EPA, 2019d), providing further support that the exposure scenario is accurate and potentially represents real worker exposures to paints and coatings. For more information on this COU please see Appendix E.

Therefore, for the two COUs of industrial and commercial paints and coatings, assessed with the scenario of Application of paints and coatings *liquids*, EPA has determined that these COUs significantly contribute to the unreasonable risk of DCHP based on the estimates associated with the acute high-end inhalation exposure for average adult workers (MOE of 2.2). This use of high-end MOEs is consistent with EPA's approach to liquid spray applications in other phthalate risk evaluations, such as with DINP and DIDP. Note that given this elevated exposure for spray applications is not expected on a daily basis, central tendency was considered for both intermediate and chronic inhalation exposures, which had MOEs of 62 and 66 when considering an average adult worker.

Three other occupational COUs were assessed using the same two OESs (application of paints and coatings both as a liquid and as a solid), but EPA concluded that the following three COUs do not significantly contribute to the unreasonable risk of DCHP:

- Industrial use – finishing agent – cellulose film production;
- Industrial use – inks, toner, and colorant products (*e.g.*, screen printing ink); and
- Commercial use – inks, toner, and colorant products (*e.g.*, screen printing ink);

EPA's understanding is that these liquid products are applied via non-spray methods. For any DCHP liquid products assessed under the Paints and coatings *liquids* OES (*e.g.*, inks, toner, and colorant products and a finishing agent in cellulose film production) that are applied using non-spray methods, inhalation exposures are expected to be *de minimis* because mists or dusts are not generated during application and the vapor pressure of DCHP is extremely low at room temperature. However, workers may be exposed through the dermal route under non-spray application scenarios. Therefore, exposures associated with the non-spray application of liquid paint and coating products containing DCHP are characterized by the range of dermal risk values only. As previously mentioned, dermal exposures do not indicate risk from DCHP (*i.e.*, MOEs were not below the benchmark of 30) at any duration for workers, at the central tendency or high-end.[9] For example, acute, high-end, dermal exposure for the average adult worker has an MOE of 532. As a result, EPA is concluding that these three COUs do not significantly contribute to unreasonable risk of DCHP.

Four different occupational COUs (represented by 1–5 different OESs depending on the COU) potentially indicated unreasonable risk, but EPA ultimately concluded that these four COUs do not significantly contribute to the unreasonable risk of DCHP for the reasons discussed below.

- Manufacturing – domestic manufacturing;

[9] Note that dermal MOEs in the draft DCHP risk evaluation (see Table 4-15) were also not below the benchmark of 30 for the OES of "Application of paints and coatings – liquids" (U.S. EPA, 2024c); due to further reconsideration of these three COUs (industrial and commercial use of inks, toner, and colorant products [*e.g.*, screen printing ink] and cellulose film), EPA believes they are best characterized by the liquid non-spray application scenario.

- Processing – incorporation into formulation, mixture, or reaction product – adhesive and sealant chemicals in adhesive manufacturing;
- Processing – incorporation into formulation, mixture, or reaction product – plasticizer in adhesive manufacturing, paint and coating manufacturing, plastic material and resin manufacturing, plastics product manufacturing, printing ink manufacturing, and rubber product manufacturing; and
- Processing – incorporation into formulation, mixture, or reaction product – stabilizing agent in adhesive manufacturing, asphalt paving, roofing, and coating materials manufacturing, paints and coating manufacturing, and plastics product manufacturing.

Considering central tendency (which is highlighted as the most reflective of worker exposures for these COUs due to the aforementioned uncertainties around DCHP concentrations in workplace dust) for average adult workers, the MOE for inhalation exposure is 40 or 36 for females of reproductive age under every scenario but two: PVC plastic compounding and Non-PVC material compounding (which had even higher MOEs). Based on central tendency and the risk estimates, EPA is determining that these four COUs do not significantly contribute to the unreasonable risk of DCHP.

As described in Section 4.1.1.5 and the *Environmental Release and Occupational Exposure Assessment for DCHP* (U.S. EPA, 2025s), EPA has moderate confidence in the inhalation and dermal exposure estimates for the assessed OESs and robust confidence in the non-cancer POD selected to characterize risk from acute, intermediate, and chronic duration exposures to DCHP (Section 4.2). Overall, the Agency has moderate confidence in the risk estimates calculated for worker inhalation and dermal exposure scenarios. Sources of uncertainty associated with the occupational COUs are discussed above in Section 4.3.2.

### 6.1.4 Basis for No Unreasonable Risk to Consumers

Based on the consumer risk estimates and related risk factors, EPA is determining that consumer uses do not significantly contribute to the unreasonable risk of DCHP. The consumer and bystander exposure scenarios described in the risk evaluation (Sections 4.4.5 and 6.1.4) represent a wide selection of consumer use patterns. EPA did not find MOEs that were below the benchmark for any consumer COU.

For DCHP COUs, EPA quantitatively assessed consumer risk from inhalation, and dermal exposures, as well as aggregated exposure from these two routes. Consumer and bystander populations assessed were infants (<1 year), toddlers (1–2 years), preschoolers (3–5 years), middle childhood (6–10 years), young teens (11–15 years), teenagers (16–20), and adults (21+ years). A screening level assessment for consumers was conducted considering high-intensity exposure scenario risk estimates, which rely on conservative assumptions to assess exposures that would be expected to be on the high-end of the exposure distribution. Risk estimates for the high-intensity exposures were above the benchmark MOE of 30 (ranging from 193–950,000) for all consumer COUs for all populations and all durations.

EPA has moderate to robust confidence in the assessed inhalation, ingestion, and dermal consumer exposure scenarios, and robust confidence in the acute, intermediate, and chronic non-cancer PODs selected to characterize risk from acute, intermediate, and chronic duration exposures to DCHP. The exposure doses used to estimate risk relied on conservative, health-protective inputs and parameters that are considered representative of a wide selection of use patterns. More information on the Agency's confidence in these risk estimates and the uncertainties associated with them can be found in this risk evaluation and the *Consumer and Indoor Dust Exposure Assessment Dicyclohexyl Phthalate (DCHP)* (U.S. EPA, 2025c).

### 6.1.5 Basis for No Unreasonable Risk to the General Population

EPA employed a screening level approach for general population exposures for DCHP because of limited environmental monitoring data for DCHP and lack of location data for DCHP releases. If risks were not indicated for an individual (adult, infant, etc.) identified as having the potential for the highest exposure associated with a COU for a given pathway of exposure (*i.e.,* at high-end or the 95th percentile), then that pathway was determined not to significantly contribute to the risk and was not further analyzed. Also, as a part of EPA's screening level approach, the Agency considered the environmental concentration of DCHP in a given environmental medium resulting from the OES (*e.g.,* PVC plastics compounding) that had the highest release compared with any other OES for the same releasing media. Release estimates from OESs resulting in lower environmental media concentrations were not considered for this screening level assessment. EPA did not evaluate cumulative risk for the general population from environmental releases because after using the previously described conservative screening level approach, the Agency did not identify any pathways of concern, indicating that refinement and further evaluation were not necessary. EPA evaluated surface water, sediment, drinking water, fish ingestion, and ambient air pathways quantitatively, and land pathways (*i.e.,* landfills and application of biosolids) qualitatively (see Section 4.1.3).

EPA is determining that the COUs do not significantly contribute to the unreasonable risk of DCHP to the general population from the ambient air—including people living or working near facilities (fenceline populations)—based on analysis of non-cancer risk. This is due in part to the physical and chemical properties of DCHP; for example, it has low bioaccumulation potential, low water solubility (1.48 mg/L), low affinity for sorption to soil, and is unlikely to migrate.

## 6.2 Unreasonable Risk to the Environment

Based on the risk evaluation for DCHP—including the risk estimates, the environmental effects of DCHP, the exposures, physical and chemical properties of DCHP, and consideration of uncertainties—EPA did not identify unreasonable risk of injury to the environment for DCHP.

EPA assessed environmental concentrations of DCHP in air, water, and land (soil, biosolids, and groundwater) for use in the environmental exposure assessment. DCHP will preferentially sorb into sediments, soils, particulate matter in air, and wastewater solids during wastewater treatment. High-quality studies of DCHP biodegradation rates and physical and chemical properties indicate that DCHP will have limited persistence and mobility in soils receiving biosolids (U.S. EPA, 2025ac) and low bioavailability in soil. DCHP is not readily found in aquatic or terrestrial organisms and has low bioaccumulation and biomagnification potential. Therefore, DCHP has low potential for trophic transfer through food webs. DCHP is expected to have minimal air to soil deposition.

### 6.2.1 Basis for No Unreasonable Risk to the Environment

Risks to aquatic organisms from chronic exposure to DCHP were characterized quantitatively using RQs. Calculated RQs can provide a risk profile by presenting a range of estimates for different environmental hazard effects for different COUs. An RQ equal to 1 indicates that the exposures are the same as the concentration that causes effects. An RQ less than 1, when the exposure is less than the effect concentration, generally indicates that there is no risk of injury to the environment that would support a determination of unreasonable risk for the chemical substance. An RQ greater than 1, when the exposure is greater than the effect concentration, generally indicates that there is risk of injury to the environment that would support a determination of unreasonable risk for the chemical substance. Additionally, if an RQ is 1 or greater, EPA considers the days of exceedance before making a determination of unreasonable risk.

As explained in Section 5.3.1, EPA used a screening level approach in this risk evaluation using conservative environmental release estimates for occupational COUs with the highest releases to determine whether there is risk to the environment. The Agency first characterized risk based on the COU with the highest estimated concentrations for a given pathway, based on the OES and the associated environmental media assessed in the risk evaluation. If this exposure concentration did not exceed the hazard thresholds harmful to organisms, EPA based the risk determination on this maximum exposure scenario to be most inclusive and protective by encompassing the exposures from other COUs within the OES.

Surface water was determined to be the driver of exposure to DCHP and was the only pathway where modeled concentrations could be compared with a concentration of concern (COC). The reasonably available studies found all acute exposure hazards to fish, invertebrates, and algae to be higher than the water solubility limit of DCHP, so no unreasonable risk for acute exposures to DCHP in surface water was indicated. For chronic exposures, EPA derived a COC for reproductive effects of chronic DCHP water exposure to a single aquatic invertebrate (*Daphnia magna*) (NITE, 2000) and fish species (*Danio rerio*). The Agency found no evidence that DCHP occurs in surface water at or above the COC of 32 µg/L. In fact, as described in Section 3.3.1.1, the highest reported monitored surface water concentration was several orders of magnitude lower at 0.014 µg/L. EPA modeled surface water concentrations and, under the most conservative and least likely scenario, estimated a high-end concentration of 165 µg/L DCHP and an RQ greater than 1. However, all other scenarios with more realistic release values, stream flow rates, or DCHP water solubility had RQs less than 1. Therefore, EPA determined a low likelihood of DCHP persisting in surface waters for a long enough duration (21 days) to cause chronic hazard in aquatic invertebrates; therefore, EPA has determined that chronic exposure to aquatic animals does not significantly contribute to the unreasonable risk of DCHP.

Other releases and pathways of exposure were assessed qualitatively. The physical characteristics and environmental fate of DCHP make exposures through the air, soil, and trophic transfer unlikely. This includes any exposures from down-the-drain disposal. Therefore, EPA has determined that exposures to terrestrial organisms and sediment-dwelling organisms, as well as exposures to aquatic organisms via deposition from air or transport from biosolids or landfills, do not significantly contribute to the unreasonable risk of DCHP. Releases from Distribution in Commerce are expected to be similar to or less than those from the highest-releasing OESs, so EPA did not identify any significant contribution to unreasonable risk to the environment for this COU.

The overall confidence in the risk characterization for both the aquatic and terrestrial assessments is robust. EPA has found no indication of risk to aquatic organisms under most realistic release, flow, wastewater treatment, and solubility scenarios, except in a scenario with the most conservative assumptions. The Agency has robust confidence that the scenario with the most conservative assumptions is unlikely. Although the lack of reasonably available studies on the hazardous effects of DCHP on wildlife does not rule out hazard and subsequent risk, the weight of evidence summarized in this risk evaluation leads to the indication that risk to terrestrial receptors is not expected. See Section 5.3.3 for a more detailed explanation of the confidence in the hazards and exposures.

## 6.3 Supporting Basis for the Unreasonable Risk Determination

Table 6-1 summarizes the basis for this unreasonable risk determination of injury to human health. In this table, **bold/shaded text** indicates that a risk estimate significantly contributes to unreasonable risk. Table 6-1 also identifies the duration of exposure (*i.e.*, acute, intermediate, chronic duration) and the exposure route to the population. As explained in Sections 6.1 and 6.2 for this unreasonable risk determination, EPA has considered the effects of DCHP on human health and the environment,

including PESS, using a range of risk estimates as appropriate. The Agency also considered risk-related factors and the confidence in the analysis. See Sections 4.3 and 4.4 for a summary of risk estimates.

**Table 6-1. Supporting Basis for the Unreasonable Risk Determination for Human Health (Occupational COUs )**

| Life Cycle Stage – Category | Subcategory | OES | Worker Pop. | Exp. Level | Inhalation Risk Estimates (Benchmark MOE = 30) | | | | Dermal Risk Estimates (Benchmark MOE = 30) | | | | Aggregate Risk Estimates (Benchmark MOE = 30) | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Acute | Intermed. | Chronic | APF [a] | Acute | Intermed. | Chronic | PF [a] | Acute | Intermed. | Chronic | APF/PF [a] |
| Manufacturing – Domestic Manufacturing | Domestic manufacturing | Manufacturing | Average Adult Worker | CT | 40 | 55 | 58 | N/A | 1,064 | 1,451 | 1,553 | N/A | 39 | 53 | 56 | N/A |
| | | | | HE | **3.8** | **5.2** | **5.6** | APF 10 | 532 | 725 | 776 | N/A | 3.8 | **5.2** | **5.6** | APF 10 |
| | | | Females of Repro. Age | CT | 36 | 49 | 53 | N/A | 1,157 | 1,578 | 1,689 | N/A | 35 | 48 | 51 | N/A |
| | | | | HE | **3.5** | **4.7** | **5.1** | APF 10 | 579 | 789 | 845 | N/A | **3.5** | **4.7** | **5.0** | APF 10 |
| | | | ONU [b] | CT | 40 | 55 | 58 | N/A | 2,126 | 2,899 | 3,104 | N/A | 39 | 54 | 57 | N/A |
| Manufacturing – Importing | Importing | Import and repackaging | Average Adult Worker | CT | 148 | 201 | 259 | N/A | 1,064 | 1,451 | 1,867 | N/A | 130 | 177 | 228 | N/A |
| | | | | HE | **6.4** | **8.7** | **9.3** | APF 5 | 532 | 725 | 776 | N/A | **6.3** | **8.6** | **9.2** | APF 5 |
| | | | Females of Repro. Age | CT | 134 | 182 | 235 | N/A | 1,157 | 1,578 | 2,031 | N/A | 120 | 163 | 210 | N/A |
| Processing – Repackaging | Repackaging (*e.g.*, laboratory chemicals) | | | HE | **5.8** | **7.9** | **8.5** | APF 10 | 579 | 789 | 845 | N/A | **5.7** | **7.8** | **8.4** | APF 10 |
| | | | ONU [b] | CT | 148 | 201 | 259 | N/A | 2,126 | 2,899 | 3,731 | N/A | 138 | 188 | 242 | N/A |
| Processing – Processing – incorporation into formulation, mixture, or reaction product | Plasticizer in: – adhesive manufacturing | Incorporation into adhesives and sealants | Average Adult Worker | CT | 40 | 55 | 58 | N/A | 1,064 | 1,451 | 1,553 | N/A | 39 | 53 | 56 | N/A |
| | Adhesive and sealant chemicals in: – adhesive manufacturing | | | HE | **3.8** | **5.2** | **5.6** | APF 10 | 532 | 725 | 776 | N/A | **3.8** | **5.2** | **5.6** | APF 10 |
| | Stabilizing agent in: – adhesive manufacturing | | Females of Repro. Age | CT | 36 | 49 | 53 | N/A | 1,157 | 1,578 | 1,689 | N/A | 35 | 48 | 51 | N/A |
| | | | | HE | **3.5** | **4.7** | **5.1** | APF 10 | 579 | 789 | 845 | N/A | **3.5** | **4.7** | **5.0** | APF 10 |
| | | | ONU [b] | CT | 40 | 55 | 58 | N/A | 2,126 | 2,899 | 3,104 | N/A | 39 | 54 | 57 | N/A |

| Life Cycle Stage – Category | Subcategory | OES | Worker Pop. | Exp. Level | Inhalation Risk Estimates (Benchmark MOE = 30) | | | | Dermal Risk Estimates (Benchmark MOE = 30) | | | | Aggregate Risk Estimates (Benchmark MOE = 30) | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Acute | Intermed. | Chronic | APF [a] | Acute | Intermed. | Chronic | PF [a] | Acute | Intermed. | Chronic | APF/PF [a] |
| Processing – Processing – incorporation into formulation, mixture, or reaction product | Plasticizer in: – paint and coating manufacturing – printing ink manufacturing | Incorporation into paints and coatings | Average Adult Worker | CT | 40 | 55 | 58 | N/A | 1,064 | 1,451 | 1,553 | N/A | 39 | 53 | 56 | N/A |
| | Stabilizing agent in: – Paint and coating manufacturing | | | HE | **3.8** | **5.2** | **5.6** | APF 10 | 532 | 725 | 776 | N/A | **3.8** | **5.2** | **5.6** | APF 10 |
| | | | Females of Repro. Age | CT | 36 | 49 | 53 | N/A | 1,157 | 1,578 | 1,689 | N/A | 35 | 48 | 51 | N/A |
| | | | | HE | **3.5** | **4.7** | **5.1** | APF 10 | 579 | 789 | 845 | N/A | **3.5** | **4.7** | **5.0** | APF 10 |
| | | | ONU [b] | CT | 40 | 55 | 58 | N/A | 2,126 | 2,899 | 3,104 | N/A | 39 | 54 | 57 | N/A |
| Processing – Processing – incorporation into formulation, mixture, or reaction product | Stabilizing agent in: – asphalt paving, roofing, and coating materials manufacturing | Incorporation into other formulations, mixtures, or reaction products | Average Adult Worker | CT | 40 | 55 | 58 | N/A | 1,064 | 1,451 | 1,553 | N/A | 39 | 53 | 56 | N/A |
| | | | | HE | **3.8** | **5.2** | **5.6** | APF 10 | 532 | 725 | 776 | N/A | **3.8** | **5.2** | **5.6** | APF 10 |
| | | | Females of Repro. Age | CT | 36 | 49 | 53 | N/A | 1,157 | 1,578 | 1,689 | N/A | 35 | 48 | 51 | N/A |
| | | | | HE | **3.5** | **4.7** | **5.1** | APF 10 | 579 | 789 | 845 | N/A | **3.5** | **4.7** | **5.0** | APF 10 |
| | | | ONU [b] | CT | 40 | 55 | 58 | N/A | 2,126 | 2,899 | 3,104 | N/A | 39 | 54 | 57 | N/A |
| Processing – Processing – incorporation into formulation, mixture, or reaction product | Plasticizer in: – plastic material and resin manufacturing – plastics product manufacturing | PVC plastics compounding | Average Adult Worker | CT | 83 | 114 | 137 | N/A | 1,064 | 1,451 | 1,741 | N/A | 77 | 106 | 127 | N/A |
| | | | | HE | **4.1** | **5.6** | **6.0** | APF 10 | 532 | 725 | 776 | N/A | **4.1** | **5.5** | **5.9** | APF 10 |
| | Stabilizing agent in: – plastics product manufacturing | | Females of Repro. Age | CT | 76 | 103 | 124 | N/A | 1,157 | 1,578 | 1,894 | N/A | 71 | 97 | 116 | N/A |
| | | | | HE | **3.7** | **5.0** | **5.4** | APF 10 | 579 | 789 | 845 | N/A | **3.7** | **5.0** | **5.4** | APF 10 |
| | | | ONU [b] | CT | 83 | 114 | 137 | N/A | 2,126 | 2,899 | 3,480 | N/A | 80 | 110 | 131 | N/A |

| Life Cycle Stage – Category | Subcategory | OES | Worker Pop. | Exp. Level | Inhalation Risk Estimates (Benchmark MOE = 30) | | | | Dermal Risk Estimates (Benchmark MOE = 30) | | | | Aggregate Risk Estimates (Benchmark MOE = 30) | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Acute | Intermed. | Chronic | APF [a] | Acute | Intermed. | Chronic | PF [a] | Acute | Intermed. | Chronic | APF/PF [a] |
| Processing – Processing – incorporation into article | Plasticizer in: – Plastics product manufacturing | PVC plastics converting | Average Adult Worker | CT | 186 | 253 | 309 | N/A | 1,064 | 1,451 | 1,773 | N/A | 158 | 215 | 263 | N/A |
| | | | | HE | **9.1** | **12** | **13** | APF 5 | 532 | 725 | 776 | N/A | **8.9** | **12** | **13** | APF 5 |
| | | | Females of Repro. Age | CT | 168 | 229 | 280 | N/A | 1,157 | 1,578 | 1,929 | N/A | 147 | 200 | 244 | N/A |
| | | | | HE | **8.2** | **11** | **12** | APF 5 | 579 | 789 | 845 | N/A | **8.1** | **11** | **12** | APF 5 |
| | | | ONU [b] | CT | 186 | 253 | 309 | N/A | 2,126 | 2,899 | 3,543 | N/A | 171 | 233 | 284 | N/A |
| Processing – Processing – incorporation into formulation, mixture, or reaction product | Plasticizer in: – plastics product manufacturing – rubber product manufacturing – plastic material and resin manufacturing | Non-PVC material compounding | Average Adult Worker | CT | 139 | 190 | 217 | N/A | 1,064 | 1,451 | 1,659 | N/A | 123 | 168 | 192 | N/A |
| | | | | HE | **6.8** | **9.3** | **9.9** | APF 5 | 532 | 725 | 776 | N/A | **6.7** | **9.2** | **9.8** | APF 5 |
| | | | Females of Repro. Age | CT | 126 | 172 | 196 | N/A | 1,157 | 1,578 | 1,805 | N/A | 114 | 155 | 177 | N/A |
| | Stabilizing agent in: – Plastics product manufacturing | | | HE | **6.2** | **8.4** | **9.0** | APF 5 | 579 | 789 | 845 | N/A | **6.1** | **8.3** | **8.9** | APF 10 |
| | | | ONU [b] | CT | 139 | 190 | 217 | N/A | 2,126 | 2,899 | 3,316 | N/A | 131 | 178 | 204 | N/A |
| Processing – Processing – incorporation into article | Plasticizer in: – plastics product manufacturing – rubber product manufacturing | Non-PVC material converting | Average Adult Worker | CT | 417 | 569 | 696 | N/A | 1,064 | 1,451 | 1,773 | N/A | 300 | 409 | 500 | N/A |
| | | | | HE | **20** | **28** | 30 | APF 5 | 532 | 725 | 776 | N/A | **20** | **27** | **29** | APF 5 |
| | | | Females of Repro. Age | CT | 378 | 515 | 630 | N/A | 1,157 | 1,578 | 1,929 | N/A | 285 | 388 | 475 | N/A |
| | | | | HE | **18** | **25** | **27** | APF 5 | 579 | 789 | 845 | N/A | **18** | **24** | **26** | APF 5 |
| | | | ONU [b] | CT | 417 | 569 | 696 | N/A | 2,126 | 2,899 | 3,543 | N/A | 349 | 476 | 581 | N/A |

| Life Cycle Stage – Category | Subcategory | OES | Worker Pop. | Exp. Level | Inhalation Risk Estimates (Benchmark MOE = 30) | | | | Dermal Risk Estimates (Benchmark MOE = 30) | | | | Aggregate Risk Estimates (Benchmark MOE = 30) | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | **Acute** | **Intermed.** | **Chronic** | **APF [a]** | **Acute** | **Intermed.** | **Chronic** | **PF [a]** | **Acute** | **Intermed.** | **Chronic** | **APF/PF [a]** |
| Industrial Use – Finishing agent | Cellulose film production | Application of paints and coatings – liquids | Average Adult Worker | CT | 45 | 62 | 66 | N/A | 1,064 | 1,451 | 1,553 | N/A | 44 | 59 | 64 | N/A |
| Industrial Use – Inks, toner, and colorant products | Inks, toner, and colorant products (*e.g.*, screen printing ink) | | | HE | **2.2** | **3.0** | **3.2** | APF 25 | 532 | 725 | 776 | N/A | **2.2** | **2.9** | **3.2** | APF 25 |
| | | | Females of Repro. Age | CT | 41 | 56 | 60 | N/A | 1,157 | 1,578 | 1,689 | N/A | 40 | 54 | 58 | N/A |
| Commercial Use – Inks, toner, and colorant products | Inks, toner, and colorant products (*e.g.*, screen printing ink) | | | HE | **2.0** | **2.7** | **2.9** | APF 25 | 579 | 789 | 845 | N/A | 2.0 | 2.7 | 2.9 | APF 25 |
| Industrial Use – Paints and coatings | Paints and coatings | | ONU [b] | CT | 45 | 62 | 66 | N/A | 2,126 | 2,899 | 3,104 | N/A | 45 | 61 | 65 | N/A |
| Commercial Use – Paints and coatings | Paints and coatings | | | | | | | | | | | | | | | |
| Industrial Use – Finishing agent | Cellulose film production | Application of paints and coatings – solids | Average Adult Worker | CT | 69 | 94 | 100 | N/A | 1,064 | 1,451 | 1,553 | N/A | 64 | 88 | 94 | N/A |
| Industrial Use – Inks, toner, and colorant products | Inks, toner, and colorant products (*e.g.*, screen printing ink) | | | HE | **3.9** | **5.3** | **5.7** | APF 10 | 532 | 725 | 776 | N/A | **3.9** | **5.3** | **5.7** | APF 10 |
| Commercial Use – Inks, toner, and colorant products | Inks, toner, and colorant products (*e.g.*, screen printing ink) | | Females of Repro. Age | CT | 62 | 85 | 91 | N/A | 1,157 | 1,578 | 1,689 | N/A | 59 | 80 | 86 | N/A |
| Industrial Use – Paints and coatings | Paints and coatings | | | HE | **3.5** | **4.8** | **5.2** | APF 10 | 579 | 789 | 845 | N/A | **3.5** | **4.8** | **5.1** | APF 10 |
| | | | ONU [b] | CT | 69 | 94 | 100 | N/A | 2,126 | 2,899 | 3,104 | N/A | 66 | 91 | 97 | N/A |
| Commercial Use – Paints and coatings | Paints and coatings | | | | | | | | | | | | | | | |

| Life Cycle Stage – Category | Subcategory | OES | Worker Pop. | Exp. Level | Inhalation Risk Estimates (Benchmark MOE = 30) | | | | Dermal Risk Estimates (Benchmark MOE = 30) | | | | Aggregate Risk Estimates (Benchmark MOE = 30) | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | **Acute** | **Intermed.** | **Chronic** | **APF [a]** | **Acute** | **Intermed.** | **Chronic** | **PF [a]** | **Acute** | **Intermed.** | **Chronic** | **APF/PF [a]** |
| Industrial Uses – Adhesives and sealants | Adhesives and sealants (*e.g.*, computer and electronic product manufact.; transportation equipment manufact.) | Application of adhesives and sealants – liquids | Average Adult Worker | CT | N/A | N/A | N/A | N/A | 1,064 | 1,451 | 1,674 | N/A | 1,064 | 1,451 | 1,674 | N/A |
| | | | | HE | N/A | N/A | N/A | N/A | 532 | 725 | 776 | N/A | 532 | 725 | 776 | N/A |
| | | | Females of Repro. Age | CT | N/A | N/A | N/A | N/A | 1,157 | 1,578 | 1,821 | N/A | 1,157 | 1,578 | 1,821 | N/A |
| Commercial uses – Adhesives and sealants | Adhesives and sealants | | | HE | N/A | N/A | N/A | N/A | 579 | 789 | 845 | N/A | 579 | 789 | 845 | N/A |
| | | | ONU | CT | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| Industrial Uses – Adhesives and sealants | Adhesives and sealants in – computer and electronic product manufact.; transportation equipment manufact. | Application of adhesives and sealants – solids | Average Adult Worker | CT | 128 | 175 | 201 | N/A | 1,064 | 1,451 | 1,674 | N/A | 114 | 156 | 180 | N/A |
| | | | | HE | **7.1** | **9.7** | **10** | APF 5 | 532 | 725 | 776 | N/A | **7.0** | **9.6** | **10** | APF 5 |
| | | | Females of Repro. Age | CT | 116 | 158 | 182 | N/A | 1,157 | 1,578 | 1,821 | N/A | 105 | 144 | 166 | N/A |
| Commercial Uses – Adhesives and sealants | Adhesives and sealants | | | HE | **6.4** | **8.8** | **9.4** | APF 5 | 579 | 789 | 845 | N/A | **6.4** | **8.7** | **9.3** | APF 5 |
| | | | ONU [b] | CT | 128 | 175 | 201 | N/A | 2,126 | 2,899 | 3,345 | N/A | 121 | 165 | 190 | N/A |
| Commercial Use – Laboratory chemicals | Laboratory chemicals | Use of laboratory chemicals – liquid | Average Adult Worker | CT | N/A | N/A | N/A | N/A | 1,064 | 1,451 | 1,652 | N/A | 1,064 | 1,451 | 1,652 | N/A |
| | | | | HE | N/A | N/A | N/A | N/A | 532 | 725 | 776 | N/A | 532 | 725 | 776 | N/A |
| | | | Females of Repro. Age | CT | N/A | N/A | N/A | N/A | 1,157 | 1,578 | 1,797 | N/A | 1,157 | 1,578 | 1,797 | N/A |
| | | | | HE | N/A | N/A | N/A | N/A | 579 | 789 | 845 | N/A | 579 | 789 | 845 | N/A |
| | | | ONU | CT | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |

| Life Cycle Stage – Category | Subcategory | OES | Worker Pop. | Exp. Level | Inhalation Risk Estimates (Benchmark MOE = 30) | | | | Dermal Risk Estimates (Benchmark MOE = 30) | | | | Aggregate Risk Estimates (Benchmark MOE = 30) | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | **Acute** | **Intermed.** | **Chronic** | **APF [a]** | **Acute** | **Intermed.** | **Chronic** | **PF [a]** | **Acute** | **Intermed.** | **Chronic** | **APF/PF [a]** |
| Commercial Use – Laboratory chemicals | Laboratory chemicals | Use of laboratory chemicals – solid | Average Adult Worker | CT | 101 | 138 | 157 | N/A | 1,064 | 1,451 | 1,652 | N/A | 92 | 126 | 143 | N/A |
| | | | | HE | **7.1** | **9.7** | **10** | APF 5 | 532 | 725 | 776 | N/A | **7.0** | **9.6** | **10** | APF 5 |
| | | | Females of Repro. Age | CT | 91 | 125 | 142 | N/A | 1,157 | 1,578 | 1,797 | N/A | 85 | 116 | 132 | N/A |
| | | | | HE | **6.4** | **8.8** | **9.4** | APF 5 | 579 | 789 | 845 | N/A | **6.4** | **8.7** | **9.3** | APF 5 |
| | | | ONU [b] | CT | 101 | 138 | 157 | N/A | 2,126 | 2,899 | 3,302 | N/A | 96 | 132 | 150 | N/A |
| Industrial Use – Other articles with routine direct contact during normal use including rubber articles; plastic articles (hard) | Other articles with routine direct contact during normal use including rubber articles; plastic articles (hard) (*e.g.*, transportation equipment manufact.) | Fabrication or use of final products or articles | Average Adult Worker | CT | 213 | 291 | 311 | N/A | 1,064 | 1,451 | 1,553 | N/A | 178 | 242 | 259 | N/A |
| | | | | HE | **24** | 32 | 35 | APF 5 | 532 | 725 | 776 | N/A | **23** | 31 | 33 | APF 5 |
| | | | Females of Repro. Age | CT | 193 | 263 | 282 | N/A | 1,157 | 1,578 | 1,689 | N/A | 166 | 226 | 242 | N/A |
| Commercial Use – Building/ construction materials not covered elsewhere | Building/ construction materials not covered elsewhere | | | HE | **21** | **29** | 31 | APF 5 | 579 | 789 | 845 | N/A | **21** | **28** | 30 | APF 5 |
| Commercial Use – Other articles with routine direct contact during normal use including rubber articles; plastic articles (hard) | Other articles with routine direct contact during normal use including rubber articles; plastic articles (hard) | | ONU [b] | CT | 213 | 291 | 311 | N/A | 2,126 | 2,899 | 3,104 | N/A | 194 | 264 | 283 | N/A |

| Life Cycle Stage – Category | Subcategory | OES | Worker Pop. | Exp. Level | Inhalation Risk Estimates (Benchmark MOE = 30) | | | | Dermal Risk Estimates (Benchmark MOE = 30) | | | | Aggregate Risk Estimates (Benchmark MOE = 30) | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Acute | Intermed. | Chronic | APF [a] | Acute | Intermed. | Chronic | PF [a] | Acute | Intermed. | Chronic | APF/PF [a] |
| Processing – Recycling | Recycling | Recycling | Average Adult Worker | CT | 178 | 242 | 291 | N/A | 1,064 | 1,451 | 1,741 | N/A | 152 | 208 | 249 | N/A |
| | | | | HE | **12** | **17** | **18** | APF 5 | 532 | 725 | 776 | N/A | **12** | **16** | **17** | APF 5 |
| | | | Females of Repro. Age | CT | 161 | 219 | 263 | N/A | 1,157 | 1,578 | 1,894 | N/A | 141 | 193 | 231 | N/A |
| | | | | HE | **11** | **15** | **16** | APF 5 | 579 | 789 | 845 | N/A | **11** | **15** | **16** | APF 5 |
| | | | ONU [b] | CT | 178 | 242 | 291 | N/A | 2,126 | 2,899 | 3,480 | N/A | 164 | 224 | 269 | N/A |
| Disposal – Disposal | Disposal | Waste handling, treatment and disposal | Average Adult Worker | CT | 178 | 242 | 291 | N/A | 1,064 | 1,451 | 1,741 | N/A | 152 | 208 | 249 | N/A |
| | | | | HE | **12** | **17** | **18** | APF 5 | 532 | 725 | 776 | N/A | **12** | **16** | **17** | APF 5 |
| | | | Females of Repro. Age | CT | 161 | 219 | 263 | N/A | 1,157 | 1,578 | 1,894 | N/A | 141 | 193 | 231 | N/A |
| | | | | HE | **11** | **15** | **16** | APF 5 | 579 | 789 | 845 | N/A | **11** | **15** | **16** | APF 5 |
| | | | ONU [b] | CT | 178 | 242 | 291 | N/A | 2,126 | 2,899 | 3,480 | N/A | 164 | 224 | 269 | N/A |

[a] This value is the protection factor of personal protective equipment required to raise the acute MOE above the benchmark of 30.
[b] ONU = occupational non-users, CT = central tendency; HE = high-end; MOE = margin of exposure, PF = protection factor, APF = assigned protection factor, Pop = Population, Expos = Exposure, Repro = Reproductive, Inter = Intermediate
[c] Benchmark MOE = 30. **Bold/shaded** text indicates an MOE that is below the benchmark value of 30 and is significantly contributing to unreasonable risk.

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# APPENDICES

## Appendix A KEY ABBREVIATIONS AND ACRONYMS

| | |
|---|---|
| AD | Acute dose |
| ADD | Average daily dose |
| ADR | Acute dose rate |
| AERMOD | American Meteorological Society/Environmental Protection Agency Regulatory Model |
| APF | Assigned protection factor |
| BBP | Butyl benzyl phthalate |
| BLS | Bureau of Labor Statistics (U.S.) |
| BMD | Benchmark dose |
| BMDL | Benchmark dose limit |
| BPO | Dibenzoyl peroxide |
| CASRN | Chemical Abstracts Service Registry Number |
| CBI | Confidential business information |
| CDC | Centers for Disease Control and Prevention (U.S.) |
| CDR | Chemical Data Reporting |
| CEHD | Chemical Exposure Health Data (OSHA) |
| CEM | Consumer Exposure Model |
| CFR | Code of Federal Regulations |
| COC | Concentration of concern |
| COU | Condition of Use |
| CPSC | Consumer Product Safety Commission |
| CRA | Cumulative risk assessment |
| DBP | Dibutyl phthalate |
| DCHP | Dicyclohexyl phthalate |
| DEHP | Diethylhexyl phthalate |
| DIBP | Diisobutyl phthalate |
| DIDP | Diisodecyl phthalate |
| DINP | Diisononyl phthalate |
| DIY | Do-it-yourself |
| DMR | Discharge Monitoring Report |
| ECHA | European Chemicals Agency |
| EPA | Environmental Protection Agency (U.S.) |
| ESD | Emission scenario document |
| EU | European Union |
| FDA | Food and Drug Administration (U.S.) |
| GS | Generic scenario |
| KOC | Soil organic carbon:water partitioning coefficient |
| KOW | Octanol:water partition coefficient |
| HEC | Human equivalent concentration |
| HED | Human equivalent dose |
| IADD | Intermediate average daily dose |
| IIOAC | Integrated Indoor-Outdoor Air Calculator |
| IR | Inhalation rate |
| LCD | Life cycle diagram |
| LOAEL | Lowest-observed-adverse-effect level |
| Log KOC | Logarithmic organic carbon:water partition coefficient |

| | |
|---|---|
| Log KOW | Logarithmic octanol:water partition coefficient |
| MMA | Methyl methacrylate |
| MOA | Mode of action |
| MOE | Margin of exposure |
| NAICS | North American Industry Classification System |
| NEI | National Emissions Inventory |
| NHANES | National Health and Nutrition Examination Survey |
| NICNAS | National Industrial Chemicals Notification and Assessment Scheme |
| NOAEL | No-observed-adverse-effect level |
| NPDES | National Pollutant Discharge Elimination System |
| OCSPP | Office of Chemical Safety and Pollution Prevention (EPA) |
| OECD | Organisation for Economic Co-operation and Development |
| OES | Occupational exposure scenario |
| ONU | Occupational non-user |
| OPPT | Office of Pollution Prevention and Toxics (EPA) |
| OSHA | Occupational Safety and Health Administration |
| PESS | Potentially exposed or susceptible subpopulations |
| PF | Protection factor |
| PNOR | Particulates not otherwise regulated |
| POD | Point of departure |
| PVC | Polyvinyl chloride |
| RPF | Relative potency factor |
| RQ | Risk quotient |
| SACC | Science Advisory Committee on Chemicals |
| SDS | Safety data sheet |
| SOC | Standard occupational classification |
| SpERC | Specific environmental release category |
| TRI | Toxics Release Inventory |
| TSCA | Toxic Substances Control Act |
| TSD | Technical support document |
| TWA | Time-weighted average |
| UF | Uncertainty factor |
| U.S. | United States |
| VVWM-PSC | Variable Volume Water Model-Point Source Calculator |
| 7Q10 | The lowest 7-day average flow that occurs (on average) once every 10 years |
| 30Q5 | The lowest 30-day average flow that occurs (on average) once every 5 years |

# Appendix B REGULATORY AND ASSESSMENT HISTORY

## B.1 Federal Laws and Regulations

**Table_Apx B-1. Federal Laws and Regulations**

| Statutes/Regulations | Description of Authority/Regulation | Description of Regulation |
|---|---|---|
| EPA statutes/regulations | | |
| Toxic Substances Control Act (TSCA) – section 6(b) | EPA is directed to identify high-priority chemical substances for risk evaluation; and conduct risk evaluations on at least 20 high priority substances no later than 3.5 years after the date of enactment of the Frank R. Lautenberg Chemical Safety for the 21st Century Act. | DCHP is one of the 20 chemicals EPA designated as a high-priority substance for risk evaluation under TSCA (84 FR 71924, December 30, 2019). Designation of DCHP as high-priority substance constitutes the initiation of the risk evaluation on the chemical. |
| Toxic Substances Control Act (TSCA) – section 8(a) | The TSCA section 8(a) Chemical Data Reporting (CDR) Rule requires manufacturers (including importers) to give EPA basic exposure-related information on the types, quantities, and uses of chemical substances produced domestically and imported into the United States. | DCHP manufacturing (including importing), processing and use information is reported under the CDR rule (85 FR 20122, April 9, 2020). |
| Toxic Substances Control Act (TSCA) – section 8(b) | EPA must compile, keep current and publish a list (the TSCA Inventory) of each chemical substance manufactured (including imported) or processed in the United States. | DCHP was on the initial TSCA Inventory and therefore was not subject to EPA's new chemicals review process under TSCA section 5 (60 FR 16309, March 29, 1995). |
| Clean Water Act (CWA) – sections 301, 304, 306, 307, and 402 | Clean Water Act section 307(a) established a list of toxic pollutants or combination of pollutants under the CWA. The statute specifies a list of families of toxic pollutants also listed in the Code of Federal Regulations at 40 CFR part 401.15. The "priority pollutants" specified by those families are listed in 40 CFR part 423 Appendix A. These are pollutants for which best available technology effluent limitations must be established on either a national basis through rules (sections 301(b), 304(b), 307(b), 306) or on a case-by-case best professional judgment basis in National Pollutant Discharge Elimination System (NPDES) permits, see section 402(a)(1)(B). EPA identifies the best available technology that is economically achievable for that industry after considering statutorily prescribed factors | As a phthalate ester, DCHP is designated as a toxic pollutant under section 307(a)(1) of the CWA, and as such is subject to effluent limitations (40 CFR 401.15). |

| Statutes/Regulations | Description of Authority/Regulation | Description of Regulation |
|---|---|---|
| | and sets regulatory requirements based on the performance of that technology. | |
| Other federal statutes/regulations | | |
| Federal Food, Drug, and Cosmetic Act (FFDCA) | Provides the Food and Drug Administration (FDA) with authority to oversee the safety of food, drugs, and cosmetics, except residues of pesticides in food are regulated by EPA under FFDCA section 408 (discussed above where applicable). | DCHP is listed as an optional substance to be used in: adhesives to be used as components of articles intended for use, in accordance with prescribed conditions, in packaging, transporting, or holding food (21 CFR section 175.105); the base sheet and coating of cellophane (21 CFR section 177.1200); plasticizers in polymeric substances (21 CFR section 178.3740). |
| Consumer Product Safety Improvement Action of 2008 (CPSIA) | Under section 108 of the Consumer Product Safety Improvement Act of 2008 (CPSIA), Consumer Product Safety Commission (CPSC) prohibits the manufacture for sale, offer for sale, Distribution in Commerce or Importation of eight phthalates in toys and childcare articles at concentrations >0.1%: DEHP, DBP, BBP, DINP, DIBP, DPENP, DHEXP and DCHP. | The use of DCHP at concentrations >0.1% is banned in toys and childcare articles (16 CFR part 1307). |
| All hyperlinks in this table were last accessed on December 19, 2025. | | |

## B.2 State Laws and Regulations

**Table_Apx B-2. State Laws and Regulations**

| State Actions | Description of Action |
|---|---|
| Chemicals of High Concern to Children | Several states have adopted reporting laws for chemicals in children's products containing DCHP, including Maine (38 MRSA Chapter 16-D) and Washington State (Wash. Admin. Code 173-334-130). |
| Other | DCHP is listed as a Candidate Chemical under California's Safer Consumer Products Program established under Health and Safety Code section 25252 and 25253 (California, Candidate Chemical List). California lists DCHP as a designated priority chemical for biomonitoring under criteria established by California SB 1379 (Biomonitoring California, Priority Chemicals, February 2019). Oregon lists DCHP as a toxic air contaminant (OAR 340-245-8020 Table 2). |
| All hyperlinks in this table were last accessed on December 19, 2025. | |

## B.3 International Laws and Regulations

**Table_Apx B-3. International Laws and Regulations**

| Country/ Organization | Requirements and Restrictions |
|---|---|
| European Union (EU) | On June 27, 2018, DCHP was listed on the Candidate List as a Substance of Very High Concern (SVHC) under regulation (EC) No 1907/2006 - REACH (Registration, Evaluation, Authorization and Restriction of Chemicals because it is toxic for reproduction (Article 57(c) and has endocrine disrupting properties (Article 57(f) - |

| Country/ Organization | Requirements and Restrictions |
|---|---|
| | human health). DCHP was evaluated under the 2017 Community rolling action plan (CoRAP) under regulation (European Commission [EC]) No1907/2006 - REACH (Registration, Evaluation, Authorization and Restriction of Chemicals) (European Chemicals Agency (ECHA) database). |
| Australia | DCHP was assessed under Human Health Tier II of the Inventory Multi-Tiered Assessment and Prioritization (IMAP) as part of the C4-6 side chain transitional phthalates. Uses reported include in adhesives and printing inks (NICNAS, 2016, Human Health Tier II assessment for C4-6 side chain transitional phthalates). In addition, DCHP was assessed under Environment Tier II of IMAP as part of the phthalate esters. In 2015, DCHP was also assessed as a Priority Existing Chemical (Assessment Report No. 40) (National Industrial Chemicals Notification and Assessment Scheme (NICNAS). Chemical inventory. Database accessed April 3, 2019). |
| Japan | DCHP is regulated in Japan under the following legislation:<br>• Act on the Evaluation of Chemical Substances and Regulation of Their Manufacture, etc. (Chemical Substances Control Law; CSCL)<br>• Act on Confirmation, etc. of Release Amounts of Specific Chemical Substances in the Environment and Promotion of Improvements to the Management Thereof.<br>(National Institute of Technology and Evaluation [NITE] Chemical Risk Information Platform [CHRIP]). |
| Austria, Denmark, Ireland, New Zealand, United Kingdom | Occupational exposure limits for DCHP (GESTIS International limit values for chemical agents (Occupational exposure limits, OELs) database). Austria, Ireland, New Zealand and the United Kingdom have an eight-hours limit of 5 mg/m$^3$. Denmark has an eight-hours limit of 3 mg/m$^3$ and a short-term limit of 6 mg/m$^3$. |
| All hyperlinks in this table were last accessed on December 19, 2025. | |

## B.4 Assessment History

**Table_Apx B-4. Assessment History of DCHP**

| Authoring Organization | Publication |
|---|---|
| U.S. EPA publications | |
| – | – |
| Other U.S.-based organizations | |
| U.S. CPSC | Chronic Hazard Panel on Phthalates and Phthalate Alternatives Final Report (with Appendices) (CPSC, 2014)<br><br>Toxicity Review of DCHP (CPSC, 2011) |
| International | |
| EU, European Chemicals Agency (ECHA) | Committee for Risk Assessment RAC Opinion proposing harmonized classification and labelling at EU level of DCHP, EC number: 201-545-9, CAS number: 84-61-7 (ECHA, 2014) |
| Government of Canada, Environment Canada, Health Canada | Screening Assessment: Phthalate Substance Grouping (Health Canada, 2020)<br><br>State of the science report: Phthalate substance grouping: Medium-chain phthalate esters: Chemical Abstracts Service Registry Numbers: |

| Authoring Organization | Publication |
|---|---|
| | 84-61-7; 84-64-0; 84-69-5; 523-31-9; 5334-09-8;16883-83-3; 27215-22-1; 27987-25-3; 68515-40-2; 71888-89-6 (EC/HC, 2015) |
| NICNAS, Australian Government | C4-6 side chain transitional phthalates: Human health tier II assessment (NICNAS, 2016)<br><br>Phthalates hazard compendium: A summary of physicochemical and human health hazard data for 24 ortho-phthalate chemicals (NICNAS, 2008) |

# Appendix C LIST OF TECHNICAL SUPPORT DOCUMENTS AND SUPPLMENTAL FILES

The below list indicates all technical support documents and supplemental files associated with this risk evaluation. These include discipline-specific assessments, systematic review results, risk calculations, modeling outputs, and public communication documents. Files are numbered corresponding with the filenames uploaded to the dockets ("1" is for this risk evaluation): https://www.regulations.gov/docket/EPA-HQ-OPPT-2018-0504.

Associated **Systematic Review Protocol and Data Quality Evaluation and Data Extraction** Documents – Provide additional detail and information on systematic review methodologies used as well as the data quality evaluations and extractions criteria and results.

2. *Systematic Review Protocol for Dicyclohexyl Phthalate (DCHP)* (U.S. EPA, 2025ah) – In lieu of an update to the *Draft Systematic Review Protocol Supporting TSCA Risk Evaluations for Chemical Substances*, also referred to as the "2021 Draft Systematic Review Protocol" (U.S. EPA, 2021a), this systematic review protocol for the Risk Evaluation for DCHP describes some clarifications and different approaches that were implemented than those described in the 2021 Draft Systematic Review Protocol in response to (1) SACC comments, (2) public comments, or (3) to reflect chemical-specific risk evaluation needs. This supplemental file may also be referred to as the "DCHP Systematic Review Protocol."

3. *Data Quality Evaluation and Data Extraction Information for Physical and Chemical Properties for Dicyclohexyl Phthalate (DCHP)* (U.S. EPA, 2025j) – Provides a compilation of tables for the data extraction and data quality evaluation information for DCHP. Each table shows the data point, set, or information element that was extracted and evaluated from a data source that has information relevant for the evaluation of physical and chemical properties. This supplemental file may also be referred to as the "DCHP Data Quality Evaluation and Data Extraction Information for Physical and Chemical Properties."

4. *Data Quality Evaluation and Data Extraction Information for Environmental Fate and Transport for Dicyclohexyl Phthalate (DCHP)* (U.S. EPA, 2025h) – Provides a compilation of tables for the data extraction and data quality evaluation information for DCHP. Each table shows the data point, set, or information element that was extracted and evaluated from a data source that has information relevant for the evaluation for Environmental Fate and Transport. This supplemental file may also be referred to as the "DCHP Data Quality Evaluation and Data Extraction Information for Environmental Fate and Transport."

5. *Data Quality Evaluation and Data Extraction Information for Environmental Release and Occupational Exposure for Dicyclohexyl Phthalate (DCHP)* (U.S. EPA, 2025i) – Provides a compilation of tables for the data extraction and data quality evaluation information for DCHP. Each table shows the data point, set, or information element that was extracted and evaluated from a data source that has information relevant for the evaluation of environmental release and occupational exposure. This supplemental file may also be referred to as the "DCHP Data Quality Evaluation and Data Extraction Information for Environmental Release and Occupational Exposure."

6. *Data Quality Evaluation Information for General Population, Consumer, and Environmental Exposure for Dicyclohexyl Phthalate (DCHP)* (U.S. EPA, 2025l) – Provides a compilation of tables for the data quality evaluation information for DCHP. Each table shows the data point, set, or

information element that was evaluated from a data source that has information relevant for the evaluation of general population, consumer, and environmental exposure. This supplemental file may also be referred to as the "DCHP Data Quality Evaluation Information for General Population, Consumer, and Environmental Exposure."

7. *Data Extraction Information for General Population, Consumer, and Environmental Exposure for Dicyclohexyl Phthalate (DCHP)* (U.S. EPA, 2025g) – Provides a compilation of tables for the data extraction for DCHP. Each table shows the data point, set, or information element that was extracted from a data source that has information relevant for the evaluation of general population, consumer, and environmental exposure. This supplemental file may also be referred to as the "DCHP Data Extraction Information for General Population, Consumer, and Environmental Exposure."

8. *Data Quality Evaluation Information for Human Health Hazard Epidemiology for Dicyclohexyl Phthalate (DCHP)* (U.S. EPA, 2025n) – Provides a compilation of tables for the data quality evaluation information for DCHP. Each table shows the data point, set, or information element that was evaluated from a data source that has information relevant for the evaluation of epidemiological information. This supplemental file may also be referred to as the "DCHP Data Quality Evaluation Information for Human Health Hazard Epidemiology."

9. *Data Quality Evaluation Information for Human Health Hazard Animal Toxicology for Dicyclohexyl Phthalate (DCHP)* (U.S. EPA, 2025m) – Provides a compilation of tables for the data quality evaluation information for DCHP. Each table shows the data point, set, or information element that was evaluated from a data source that has information relevant for the evaluation of human health hazard animal toxicity information. This supplemental file may also be referred to as the "DCHP Data Quality Evaluation Information for Human Health Hazard Animal Toxicology."

10. *Data Quality Evaluation Information for Environmental Hazard for Dicyclohexyl Phthalate (DCHP)* (U.S. EPA, 2025k) – Provides a compilation of tables for the data quality evaluation information for DCHP. Each table shows the data point, set, or information element that was evaluated from a data source that has information relevant for the evaluation of environmental hazard toxicity information. This supplemental file may also be referred to as the "DCHP Data Quality Evaluation Information for Environmental Hazard."

11. *Data Extraction Information for Environmental Hazard and Human Health Hazard Animal Toxicology and Epidemiology for Dicyclohexyl Phthalate (DCHP)* (U.S. EPA, 2025f) – Provides a compilation of tables for the data extraction for DCHP. Each table shows the data point, set, or information element that was extracted from a data source that has information relevant for the evaluation of environmental hazard and human health hazard animal toxicology and epidemiology information. This supplemental file may also be referred to as the "DCHP Data Extraction Information for Environmental Hazard and Human Health Hazard Animal Toxicology and Epidemiology."

Associated **Technical Support Documents and Supplemental Files** – Provide additional details and information on physical chemistry, fate, exposure, hazard, and risk assessments.

12. *Physical Chemistry and Fate and Transport Assessment for Dicyclohexyl Phthalate (DCHP) (DCHP)* (U.S. EPA, 2025ac).

13. *Environmental Release and Occupational Exposure Assessment for Dicyclohexyl Phthalate (DCHP)* (U.S. EPA, 2025s).

14. *Consumer and Indoor Dust Exposure Assessment for Dicyclohexyl Phthalate (DCHP)* (U.S. EPA, 2025c).

15. *Environmental Media and General Population and Environmental Exposure Assessment for Dicyclohexyl Phthalate (DCHP)* (U.S. EPA, 2025p).

16. *Environmental Hazard Assessment for Dicyclohexyl Phthalate (DCHP)* (U.S. EPA, 2025o).

17. *Non-Cancer Human Health Hazard Assessment for Dicyclohexyl Phthalate (DCHP)* (U.S. EPA, 2025x).

18. *Cancer Human Health Hazard Assessment for Di(2-ethylhexyl) Phthalate (DEHP), Dibutyl Phthalate (DBP), Butyl Benzyl Phthalate (BBP), Diisobutyl Phthalate (DIBP), and Dicyclohexyl Phthalate (DCHP)* (U.S. EPA, 2025b).

19. *Consumer Risk Calculator for Dicyclohexyl Phthalate (DCHP)* (U.S. EPA, 2025e).

20. *Consumer Exposure Analysis for Dicyclohexyl Phthalate (DCHP)* (U.S. EPA, 2025d).

21. *Risk Calculator for Occupational Exposures for Dicyclohexyl Phthalate (DCHP)* (U.S. EPA, 2025ad).

22. *Fish Ingestion Risk Calculator for Dicyclohexyl Phthalate (DCHP)* (U.S. EPA, 2025t).

23. *Surface Water Human Exposure Risk Calculator for Dicyclohexyl Phthalate (DCHP)* (U.S. EPA, 2025ag).

24. *Ambient Air Exposure Assessment for Dicyclohexyl Phthalate (DCHP)* (U.S. EPA, 2025a).

25. *Occupational and Consumer Cumulative Risk Calculator for Dicyclohexyl Phthalate (DCHP)* (U.S. EPA, 2025ab).

26. *Meta-Analysis and Benchmark Dose Modeling of Fetal Testicular Testosterone for Di(2-ethylhexyl) Phthalate (DEHP), Dibutyl Phthalate (DBP), Butyl Benzyl Phthalate (BBP), Diisobutyl Phthalate (DIBP), and Dicyclohexyl Phthalate (DCHP)* (U.S. EPA, 2025u).

27. *Technical Support Document for the Cumulative Risk Analysis of Di(2-ethylhexyl) Phthalate (DEHP), Dibutyl Phthalate (DBP), Butyl Benzyl Phthalate (BBP), Diisobutyl Phthalate (DIBP), Dicyclohexyl Phthalate (DCHP), and Diisononyl Phthalate (DINP) Under the Toxic Substances Control Act (TSCA*) (U.S. EPA, 2025ai).

28. *Summary of Facility Release Data for Di(2-ethylhexyl) Phthalate (DEHP), Dibutyl Phthalate (DBP), and Butyl Benzyl Phthalate (BBP)* (U.S. EPA, 2025af).

# Appendix D UPDATES TO THE DCHP CONDITIONS OF USE TABLE

After the final scope document (U.S. EPA, 2020b), EPA received updated submissions under the 2020 CDR reported data. In addition to new submissions received under the 2020 CDR, the reporting name codes changed for the 2020 CDR reporting cycle (U.S. EPA, 2020a). Therefore, the Agency amended the description of certain DCHP COUs based on those submissions and new reporting name codes. Also, EPA received information from stakeholders on specific uses of DCHP. Table_Apx D-1 summarizes the changes to the COUs based on the new reporting codes in the 2020 CDR and any other additional information reasonably available to EPA between the publication of the final scope and the draft risk evaluation (U.S. EPA, 2024c). Note that no additional changes to the COUs have been incorporated between the draft and DCHP final risk evaluation.

**Table_Apx D-1. Additions and Name Changes to Categories and Subcategories of Conditions of Use Based on CDR Reporting and Stakeholder Engagement**

| Life Cycle Stage and Category | Original Subcategory in the Final Scope Document | Occurred Change | Revised Subcategory in the 2024 Draft and 2025 Final Risk Evaluation |
|---|---|---|---|
| Processing, Processing as a reactant | Processing aids not otherwise listed in:<br>– Miscellaneous manufacturing | Consolidated into a category and associated subcategory under "processing, incorporation into formulation, mixture, or reaction product, stabilizing agent" based on further consultations with the submitters of the CDR data, review of their 2020 CDR cycle submissions, and given EPA's refined understanding of how DCHP is used (U.S. EPA, 2024d, 2020a). | Processing – incorporation in formulation, mixture, or reaction product – stabilizing agent (plastics product manufacturing) |
| Processing, Processing as a reactant | Process regulator in:<br>– Paint and coating manufacturing<br>– Plastic material and resin manufacturing<br>– Plastics product manufacturing<br>– Rubber product manufacturing | Consolidated category and associated subcategories under "processing, incorporation into formulation, mixture, or reaction products" based on further consultations with the submitters of the CDR data, review of their 2020 CDR cycle submissions, and given EPA's refined understanding of how DCHP is used (U.S. EPA, 2024d, 2020a). | Processing – incorporation in formulation, mixture, or reaction product – plasticizer (plastic material and resin manufacturing; rubber product manufacturing)<br><br>And<br><br>Processing – incorporation in formulation, mixture, or reaction product – stabilizing agent (paint and coating manufacturing; plastics product manufacturing) |
| Processing, Incorporation into formulation, mixture, or reaction product | Filler in:<br>– Rubber product manufacturing | Removed COU based on further consultations with the submitters of the CDR data and review of their 2020 CDR cycle submissions (U.S. EPA, 2024d, 2020a). DCHP is not used as a hardener, or the previously reported CDR code of "filler" (Nouryon, 2024). | N/A |

| Life Cycle Stage and Category | Original Subcategory in the Final Scope Document | Occurred Change | Revised Subcategory in the 2024 Draft and 2025 Final Risk Evaluation |
|---|---|---|---|
| Processing, Incorporation into formulation, | Laboratory chemical | Consolidated category and associated subcategory under "repackaging" as an example based on further review of the COUs. | Processing – repackaging – repackaging (*e.g.*, laboratory chemical) |
| mixture, or reaction product | | DCHP is not being reformulated or used in laboratory manufacturing, rather it is being used as a technical standard or reference reagent (U.S. EPA, 2020d). | |
| Processing, Incorporation into formulation, mixture, or reaction product | Paint additives and coating additives not described by other codes:<br>– Printing ink manufacturing | Consolidated category and associated subcategory under a COU that was reported in a more recent CDR cycle. | Processing – incorporation in formulation, mixture, or reaction product – plasticizer (printing ink manufacturing) |
| Processing, Incorporation into formulation, mixture, or reaction product | N/A | Updated the subcategory to reflect the 2020 CDR cycle. | Processing – incorporation in formulation, mixture, or reaction product – plasticizer (plastic material and resin manufacturing) |
| Processing, Incorporation into formulation, mixture, or reaction product | Processing aids not otherwise listed:<br>– Services<br>– Paint and coating manufacturing<br>– Asphalt paving, roofing, and coating materials manufacturing<br>– Adhesive manufacturing | Consolidated category and associated subcategories as a "stabilizing agent" based on further consultations with the submitters of the CDR data and review of their 2020 CDR cycle submissions (U.S. EPA, 2024d; Nouryon Chemicals LLC, 2020; U.S. EPA, 2020a, 2019c). | Processing – incorporation in formulation, mixture, or reaction product – stabilizing agent (adhesive manufacturing; asphalt paving, roofing, and coating materials manufacturing; paint and coating manufacturing) |
| Processing, Incorporation into formulation, mixture, or reaction product | Process regulator in:<br>– Adhesive manufacturing | Consolidated category and associated subcategory under a COU that was both reported in a more recent CDR cycle and more appropriate given EPA's understanding of how DCHP is used. | Processing – incorporation in formulation, mixture, or reaction product – stabilizing agent (adhesive manufacturing) |
| Processing; Incorporation into formulation, mixture, or reaction product | N/A | Updated the subcategory to reflect the 2020 CDR cycle. | Processing – incorporation in formulation, mixture, or reaction product – stabilizing agent (paints and coating manufacturing) |
| Processing, Incorporation into formulation, mixture, or reaction product | N/A | Updated the subcategory to reflect the 2020 CDR cycle. | Processing – incorporation in formulation, mixture, or reaction product – stabilizing agent (plastics product manufacturing) |
| Industrial Use, Adhesives and sealants | Adhesives and sealants in:<br>– Transportation equipment manufacturing<br>– Computer and electronic product manufacturing | Updated the category and subcategory to add "computer and electronic product manufacturing" and "transportation equipment manufacturing" as examples to not preclude other industrial sectors. | Industrial use – adhesives and sealants (*e.g.*, computer and electronic product manufacturing; transportation equipment manufacturing) |

| Life Cycle Stage and Category | Original Subcategory in the Final Scope Document | Occurred Change | Revised Subcategory in the 2024 Draft and 2025 Final Risk Evaluation |
|---|---|---|---|
| Industrial Use | N/A | Added the COU "paints and coatings" to the new life cycle stage of "industrial use" based on a new understanding of information from a safety data sheet (SDS) that explained the use could take place on an industrial scale (Carboline, 2019b). | Industrial use – paints and coatings |
| Industrial Use, Plastic and rubber products not covered elsewhere | Plastic and rubber products not covered elsewhere in: – Transportation equipment manufacturing | Updated the category and subcategory to better reflect 2020 CDR reporting codes and to add "transportation equipment manufacturing" as an example to not preclude other industrial sectors. | Industrial use – other articles with routine direct contact during normal use including rubber articles; plastic articles (hard) (*e.g.*, transportation equipment manufacturing) |
| Commercial Use, Plastic and rubber products not covered elsewhere | Plastic and rubber products not covered elsewhere | Updated the category and subcategory to reflect the 2020 CDR cycle. | Commercial use – other articles with routine direct contact during normal use including rubber articles; plastic articles (hard) |
| Consumer Use, Arts, crafts, and hobby materials | Arts, crafts, and hobby materials (*e.g.*, modeling clay) | Removed this COU upon further review, concluding it was no longer reasonably foreseen. | N/A |
| Consumer Use, Plastic and rubber products not covered elsewhere | Plastic and rubber products not covered elsewhere | Updated the category and subcategory to reflect the 2020 CDR cycle. | Consumer use – other articles with routine direct contact during normal use including rubber articles; plastic articles (hard) |

As indicated in Table_Apx D-1, the changes were based on close examination of the CDR reports, including the 2020 CDR reports that were received after the scope was completed, additional research on the COUs, additional comments from stakeholders, and overall systematic review of the use information.

When developing the draft risk evaluation, EPA concluded that some subcategories of the COUs listed in the final scope (U.S. EPA, 2020b) were redundant and consolidation was needed to avoid evaluation of the same COU multiple times. The Agency further concluded that there were some instances where subcategory information on the processing and uses of DCHP was misreported by CDR reporters based on outreach with stakeholders. For these instances, EPA recategorized the activity described in the COU listed in the scope to fit the description of the COU included in both the draft and final risk evaluations.

In addition, EPA further analyzed the following COUs, which resulted in the changes presented in the table that warrant further explanation because these COUs changed significantly between the final scope and the draft and final risk evaluations:

- Processing, Processing as a reactant, "processing aids not otherwise listed in miscellaneous manufacturing; process regulator in paint and coating manufacturing, plastic material and resin manufacturing, plastics product manufacturing, and rubber product manufacturing" were all removed from the COUs as it was determined (due in part to a refined understanding of how DCHP is used and stakeholder outreach) that DCHP is not used as a reactant and it is more appropriately characterized as "Processing – incorporated into a formula, mixture or reaction product." These uses are better captured under other processing COUs that more accurately reflect EPA's understanding of how DCHP is used.

EPA has also included further information about any other COUs (reported in the 2020 CDR cycle (U.S. EPA, 2020a) or otherwise) that are not included in the DCHP risk evaluation:

- Processing, Processing as a reactant, "plasticizer in plastics product manufacturing; intermediate in all other basic organic chemical manufacturing; stabilizing agent in paint and coating manufacturing and plastics product manufacturing; and processing aids not otherwise specified in plastics product manufacturing" were reported in the 2020 CDR cycle and were not included in either the draft or final risk determination analysis as it was determined that DCHP is not used as a reactant and it is more appropriately characterized as "Processing – incorporated into a formula, mixture or reaction product." These uses are better captured under other processing COUs that more accurately reflect EPA's understanding of how DCHP is used.

- Processing, Processing as a reactant, "hardener in paint and coating manufacturing; and plastics product manufacturing" were reported in the 2020 CDR cycle and were not included in either the draft or final risk determination analysis as it was determined that DCHP is not used as a reactant and is more appropriately characterized as "Processing – incorporated into a formula, mixture or reaction product." Additionally, based on Agency research and communication with stakeholders it is EPA's understanding that the use of "hardener" is better captured as a "stabilizing agent" for the DCHP risk evaluation (U.S. EPA, 2024d). Ultimately, these uses are better captured under other processing COUs that more accurately reflect EPA's understanding of how DCHP is used.

- Processing, Processing incorporation into formulation, mixture, or reaction product, "processing aids not otherwise specified in plastics product manufacturing" was reported in the 2020 CDR cycle and was not included in either the draft or final risk determination analysis after additional research and communication with stakeholders (U.S. EPA, 2024d). It is EPA's understanding that this COU is more appropriately consolidated into Processing, Processing incorporation into formulation, mixture, or reaction product, "stabilizing agent."

- Note that in the final scope document for DCHP (U.S. EPA, 2020b), EPA removed the consumer use of dicyclohexyl phthalate in toys, playground, and sporting equipment as a COU for numerous reasons, which include: a public comment received on the draft DCHP scoping document (Aceto US LLC, 2020); the CPSC's Chronic Hazard Advisory Panel (CHAP) report from 2014 (CPSC, 2014) that states, "DCHP is currently not found in children's toys or child care articles, and it is not widely found in the environment" (page 117); the preamble of the 2017 CPSC final rule titled "Prohibition of Children's Toys and Child Care Articles Containing Specified Phthalates," which explains that ". . . the CPSC staff has not detected DCHP in toys and child care articles during routine compliance testing thus far. . ." (CPSC, 2017); and CPSC's final rule, which prohibits manufacture for sale, offer for sale, Distribution in Commerce, and Importation into the United States of any children's toy or child care article that contains more than 0.1 percent of dicyclohexyl phthalate as it "would prevent [DCHP's] use as a substitute for other banned phthalates" (82 FR 49982 (2017); 16 CFR 1307.3). As a result, EPA has no reasonably available information demonstrating that the consumer use of dicyclohexyl phthalate in toys, playground, and sporting equipment is intended, known, or reasonably foreseen, and therefore removed this COU from the final scope and has not included it in the analysis for the risk evaluation of DCHP.

# Appendix E CONDITIONS OF USE DESCRIPTIONS

The following descriptions are intended to include examples of uses, so as not to exclude other activities that may also be included in the COUs of the chemical substance. To better describe the COU, EPA considered CDR submissions from previous CDR cycles for DCHP (CASRN 84-61-7), and the COU descriptions reflect what the Agency identified as the best fit for those submissions. Examples of articles, products, or activities are included in the following descriptions to help describe the COU but are not exhaustive. EPA uses the terms "articles" and "products" or product mixtures in the following descriptions and is generally referring to articles and products as defined by 40 CFR part 751. There may be instances where the terms are used interchangeably by a company or commenters, or by EPA in reference to a code from CDR reports that are referenced (*e.g.*, "plastics products manufacturing," or "fabric, textile, and leather products"), EPA will clarify as needed when these references are included throughout the COU descriptions below.

## E.1 Manufacturing – Domestic Manufacturing

Domestic manufacture means to manufacture or produce DCHP within the United States. For purposes of the DCHP risk evaluation, this includes the extraction of DCHP from a previously existing chemical substance or complex combination of chemical substances and loading and repackaging (but not transport) associated with the manufacturing or production of DCHP.

DCHP is typically manufactured in a closed system through catalytic esterification of phthalic anhydride and cyclohexanol in solvent at elevated temperatures (130 °C) (CPSC, 2011). After the reaction, excess alcohol is recovered and DCHP is purified through vacuum distillation or activated charcoal (U.S. EPA, 2020b). Based on manufacturing operations for similar phthalates, activities may also include filtrations and quality control sampling of the DCHP product. Additionally, manufacturing operations include equipment cleaning/reconditioning and product transport to other areas of the manufacturing facility or offsite shipment for downstream processing or use. Current manufacturing processes can achieve a DCHP purity of 99 percent or greater, with some impurities of water and phthalic acid (CPSC, 2011). This COU includes the typical manufacturing process and any other similar production of DCHP.

***Examples of CDR Submissions.***
In the 2016 CDR cycle, one company reported domestic manufacturing of DCHP as large crystal pellets.

In the 2020 CDR cycle, two companies reported domestic manufacturing of DCHP. One CDR company reported domestic manufacturing of DCHP as pellets or large crystals, while the second company reported domestic manufacturing of DCHP as a dry powder.

## E.2 Manufacturing – Importing

Import refers to the import of DCHP into the customs territory of the United States. In general, chemicals may be imported into the United States in bulk via water, air, land, and intermodal shipments, and loading and repackaging (but not transport) associated with the import of DCHP (Tomer and Kane, 2015). These shipments take the form of oceangoing chemical tankers, railcars, tank trucks, and intermodal tank containers (U.S. EPA, 2020b).

Imported DCHP is shipped in either dry powder, liquid, water or solvent wet solid form (U.S. EPA, 2020a). Import sites unload the import containers and transfer DCHP into smaller containers (bags or supersacks) for downstream processing, use within the facility, or offsite use. Operations may include quality control sampling of DCHP product and equipment cleaning. No changes to chemical composition occur during importation of this COU (U.S. EPA, 2022a).

***Examples of CDR Submissions.***
In the 2016 CDR cycle, one company reported importation of DCHP in a solid form.

In the 2020 CDR cycle, two companies reported importation of DCHP.
One CDR company reported importation of DCHP as dry powder, liquid, while the second company reported importation of DCHP as water or a solvent wet solid.

## E.3 Processing – Incorporation into Formulation, Mixture, or Reaction Product – Adhesive and Sealant Chemicals in Adhesive Manufacturing

This COU refers to the preparation of a product; that is, the incorporation of DCHP into formulation, mixture, or a reaction product that occurs when a chemical substance is added to a product (or product mixture), after its manufacture, for Distribution in Commerce. In this case, processing of DCHP into an adhesive and sealant in adhesive manufacturing.

Based on the 2009 Emission Scenario Document (ESD) on the Manufacture of Adhesives, a typical adhesive incorporation site receives and unloads DCHP into adhesive and sealant formulations in industrial mixing vessels as a batch blending or mixing process, with no reactions or chemical changes occurring to the plasticizer (*i.e.*, DCHP) during the mixing process (OECD, 2009a). Process operations may also include quality control sampling. EPA expects that sites will load DCHP-containing adhesive and sealant products into bottles, small containers, or drums depending on the product type. (OECD, 2009a).

***Examples of CDR Submissions.***
In the 2016 cycle, one company reported the use of DCHP as adhesive and sealant chemicals in adhesive manufacturing.

## E.4 Processing – Incorporation into Formulation, Mixture, or Reaction Product – Plasticizer (Adhesive Manufacturing; Paint and Coating Manufacturing; Plastic Material and Resin Manufacturing; Plastics Product Manufacturing; Printing Ink Manufacturing; and Rubber Product Manufacturing)

This COU refers to the preparation of a product; that is, the incorporation of DCHP into formulation, mixture, or a reaction product that occurs when a chemical substance is added to a product (or product mixture) after its manufacture, for Distribution in Commerce—in this case as a plasticizer in various industrial sectors and uses, specifically as an adhesive, paint and coating, plastic material and resin, plastic product, printing or polyvinyl chloride (PVC) plastisol ink and as a rubber product.

The American Coatings Association explained that DCHP is a plasticizer, additive and impurity in adhesives in amounts less than 1 percent (ACA, 2019) and according to information provided to EPA, DCHP is also used within products or formulations for the manufacture, operation and maintenance of aerospace products (AIA, 2019). More specifically, the Aerospace Industries Association explained that DCHP can be used as a plasticizer for nitrocellulose, chlorinated rubber PVC and other polymers and adhesives.

In manufacturing of plastic material and resin through non-PVC and PVC compounding, DCHP is blended into polymers. Compounding involves the mixing of the polymer with the plasticizer and other

chemical such as fillers and heat stabilizers. The plasticizer needs to be absorbed into the particle to impart flexibility to the polymer. For PVC compounding, compounding occurs through mixing of ingredients to produce a powder (dry blending) or a liquid (plastisol blending). The most common process for dry blending involves heating the ingredients in a high-intensity mixer and transfer to a cold mixer. The plastisol blending is done at ambient temperature using specific mixers that allow for the breakdown of the PVC agglomerates and the absorption of the plasticizer into the resin particle. EPA is also aware that DCHP may be incorporated into PVC plastisol inks and inks for screen printing (Hallstar, 2022; LANXESS, 2021; Gans Ink and Supply, 2018; CPSC, 2015).

This COU also includes activities identified by the U.S. Department of Defense.

***Examples of CDR Submissions***
In the 2016 CDR cycle, one company reported the use of DCHP as a plasticizer in plastics product manufacturing and one CDR company reported the use of DCHP as a plasticizer in printing ink manufacturing.

In the 2020 CDR cycle, one company reported the use of DCHP as a plasticizer in plastics material and resin manufacturing and one CDR company reported the use of DCHP as a plasticizer in adhesive manufacturing.

## E.5 Processing – Incorporation into Formulation, Mixture, or Reaction Product – Stabilizing Agent (Adhesive Manufacturing; Asphalt Paving, Roofing, and Coating Materials Manufacturing; Paints and Coating Manufacturing; and Plastics Product Manufacturing)

This COU refers to the preparation of a product; that is, the incorporation of DCHP into formulation, mixture, or a reaction product that occurs when a chemical substance is added to a product (or product mixture), after its manufacture, for Distribution in Commerce. In this case DCHP is used as a stabilizing agent, specifically as a phlegmatizer (a compound that minimizes the explosive tendency of another compound or material) for dibenzoyl peroxide (BPO) and peroxide-based formulations to improve the safety and handling properties and to prevent explosions (U.S. EPA, 2024d; AIA, 2019). These BPO mixtures (in which DCHP is present) are then used as a curing agent for unsaturated polyesters or methyl methacrylate (MMA) systems, which is used in various industrial sectors and uses including asphalt, roofing, and flooring systems, coatings, adhesives, and within the aerospace industry (U.S. EPA, 2024d; Nouryon Chemicals LLC, 2020; AIA, 2019; U.S. EPA, 2019c). EPA has confirmed that this COU has recently been discontinued with the CDR submitter. However, the use of DCHP as a stabilizing agent was only recently ceased (*i.e.*, in 2021) and the available information regarding DCHP suggests that this COU could occur. Therefore, it is included in EPA's evaluation.

***Examples of CDR Submissions***
In the 2016 CDR cycle, one company reported the use of DCHP as a process regulator in paints and coating manufacturing, which has been recategorized in the COU table to "stabilizing agent" after discussions with the company that purchased the previous 2016 reporting company (U.S. EPA, 2024d, 2019c). See Appendix D for more information on the changes from the COU from the *Final Scope of the Risk Evaluation for Dicyclohexyl Phthalate (DCHP); CASRN 84-61-7* (U.S. EPA, 2020b).

In the 2020 CDR cycle, one company reported the use of DCHP as a stabilizing agent in paints and coating manufacturing.

## E.6 Processing – Incorporation into Articles – Plasticizer (Plastics Product Manufacturing and Rubber Product Manufacturing)

This COU refers to the preparation of an article; that is, the incorporation of DCHP into articles, meaning DCHP becomes an integral component of the article, after its manufacture, for Distribution in Commerce. In this case, DCHP is present in a raw material such as rubber or plastic that contains a mixture of plasticizers and other additives, and this COU refers to the manufacturing of PVC and non-PVC articles including rubber, plastic, and miscellaneous articles using those raw materials. According to information provided to EPA, DCHP is used as a plasticizer in plastic and rubber articles used in the aerospace industry (AIA, 2019), and a variety of articles in transportation equipment such as automotive vehicles (MEMA, 2019). Simple and complex plastic and rubber articles containing DCHP are also assumed to be used in electronics (CPSC, 2015), as well as a variety of other industrial and commercial end uses. DCHP is also assumed to be used as a plasticizer in a variety of other simple and complex articles such those found in building and construction materials (LANXESS, 2021).

This COU also includes activities identified by the U.S. Department of Defense.

***Examples of CDR Submissions***

In the 2016 CDR cycle, one company reported the use of DCHP as a plasticizer in plastics products manufacturing, one company reported the commercial and consumer use of DCHP in plastic and rubber products not covered elsewhere.

In the 2020 CDR cycle, one company reported the commercial and consumer use of DCHP as a plasticizer in other articles with routine direct contact during normal use including rubber articles; plastic articles (hard), which is a further refined description compared with the 2016 CDR cycle code of "plastic and rubber products not covered elsewhere."

## E.7 Processing – Repackaging (*e.g.*, Laboratory Chemical)

Repackaging refers to the preparation of DCHP for Distribution in Commerce in a different form, state, or quantity than originally received or stored by various industrial sectors, including chemical product and preparation manufacturing, wholesale and retail trade, and laboratory chemicals manufacturing. This COU includes the transferring of DCHP from a bulk container into smaller containers. One company explained that DCHP and phthalates more generally are domestically repackaged for laboratory use (U.S. EPA, 2020d). This COU would not apply to the relabeling or redistribution of a chemical substance without removing the chemical substance from the original container it was supplied in. No changes to chemical composition occur during repackaging of this COU (U.S. EPA, 2022a).

This COU was not reported in the 2016 or 2020 CDR cycles.

## E.8 Processing – Recycling

This COU refers to the process of treating generated waste streams (*i.e.*, which would otherwise be disposed of as waste) containing DCHP that are collected, either on-site or at a third-party site, for commercial purpose. DCHP is primarily recycled industrially in the form of DCHP-containing PVC/plastic waste streams. New PVC can be manufactured from recycled and virgin materials at the same facility. Some (ENF, 2024) estimate a total of 228 plastics recyclers operating in the United States, of which 58 accept PVC wastes for recycling. It is unclear if the total number of sites includes some or all circular recycling sites—facilities where new PVC can be manufactured from recycled and virgin materials on the same site. Articles containing DCHP from inks, coatings, etc., may also be recycled

(U.S. EPA, 2020b). EPA notes that although DCHP was not reported for recycling in the 2016 or 2020 CDR reporting periods, EPA is assuming that recycling waste streams could contain DCHP.

## E.9 Distribution in Commerce

For purposes of assessment in this risk evaluation, Distribution in Commerce consists of the transportation associated with the moving of DCHP or DCHP-containing products between sites manufacturing, processing or recycling DCHP or DCHP-containing products, or to final use sites, or for final disposal of DCHP or DCHP-containing products. More broadly under TSCA, "Distribution in Commerce" and "distribute in commerce" are defined under TSCA section 3(5). No changes to chemical composition occur during transportation of DCHP (U.S. EPA, 2022a).

## E.10 Industrial Use – Adhesive and Sealants (*e.g.*, Computer and Electronic Product Manufacturing; Transportation Equipment Manufacturing)

This COU refers to DCHP as it is used in various industrial sectors as a component of adhesive or sealant mixtures. Meaning the use of DCHP after it has already been incorporated into an adhesive and/or sealant product or mixture, as opposed to when it is used upstream (*e.g.*, when DCHP is processed into the adhesive and sealant formulation). The American Coatings Association explained that DCHP is a plasticizer, additive, and impurity in adhesives in amounts less than 1 percent (ACA, 2019).

According to information provided to EPA, DCHP is used as an adhesive within the aerospace industry (AIA, 2019) and as an adhesive sealant for body panel assemblies and parts by automobile manufacturers applications (MEMA, 2019). EPA has also identified several examples of specific products for this COU, such as a nonconductive die attach adhesive containing DCHP at concentrations of 0.1 to 1 percent. This adhesive has been formulated for use in high throughput die attach applications within the semi-conductor industry within various types of electronics (*e.g.*, automotive cameras) (Henkel, 2024, 2019, 2017).

***Examples of CDR Submissions***

In the 2016 CDR cycle, one company reported the use of DCHP as adhesive and sealant chemicals in adhesive manufacturing.

In the 2020 CDR cycle, one company reported the use of DCHP as a plasticizer in adhesive manufacturing.

## E.11 Industrial Use – Finishing Agent – Cellulose Film Production

This COU refers to the use of DCHP as a component of the finishing agent used in cellulose film production. Meaning the use of DCHP after it has already been incorporated into the finishing agent itself, as opposed to when it is used upstream (*e.g.*, when DCHP is processed into the finishing agent or paint and coating formulation).

CDR described a "finishing agent" as a chemical substance used to impart such functions as softening, static-proofing, wrinkle resistance, and water repellence. Substances may be applied to textiles, paper, and leather. In this case DCHP is used during the cellulose film production to bathe or coat the film, giving it barrier properties as well as promoting heat seal. This cellulose film is then used in a variety of labeling, and packaging end uses (U.S. EPA, 2020c; Earthjustice, 2019).

This COU was not reported in the 2016 or 2020 CDR reporting cycles.

## E.12 Industrial Use – Inks, Toner, and Colorant Products

This COU refers to the use of DCHP in various industrial sectors as a component in ink, toner, and colorant products. Meaning the use of DCHP after it has already been incorporated into ink, toner, and/or colorant products, or while it is being applied to various articles, as opposed to when it is used upstream (*e.g.,* when DCHP is processed into the ink, toner, and colorant product formulation).

According to information provided to EPA in 2021, DCHP (referred to in this case as Uniplex 250) has been used as an element of PVC inks/PVC plastisol formulations (Hallstar, 2022; LANXESS, 2021; U.S. EPA, 2021c, 2019e). Uniplex 250 is also marketed as being used as a polymer additive in labels and printing ink formulations (Hallstar, 2022) and DCHP has been used as part of the screen-printing process for textiles (Gans Ink and Supply, 2018). Printing inks are composed 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). 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).

***Examples of CDR Submissions***

In the 2016 CDR cycle, one company reported the use of DCHP as a plasticizer in printing ink manufacturing.

## E.13 Industrial Use – Paints and Coatings

This COU refers to the use of DCHP in various industrial sectors as a component in paints and coating mixtures. This is a use of DCHP after it has already been incorporated into paint and coating or BPO mixtures, or while it is being applied to various articles, as opposed to when it is used upstream (*e.g.,* when DCHP is processed into adhesive, sealant or BPO formulation).

EPA has identified an example of an industrial paint and coating product for this COU; a single-component silicone acrylic finish that air dries and is suitable for high temperature exposures up to 500 °F with DCHP concentrations of 2.5 to less than 10 percent. This paint and coating can be applied via brush, roller, pressurized or conventional spray (*i.e.*, air or airless) and can be used to protect various elements such as equipment, tanks, stacks, etc., in an industrial or manufacturing setting (Carboline, 2019a, b; U.S. EPA, 2019d). The paint or coating is particularly useful in high heat environments, and EPA confirmed the use in 2019 (U.S. EPA, 2019d). EPA expects that products under this COU would be applied in the industrial sector; however, note that it is possible for these products to be purchased by commercial users and applied in the commercial sector as well.

***Examples of CDR Submissions***

In the 2016 CDR cycle, one company reported the use of DCHP as a process regulator in paints and coating manufacturing, which has been recategorized in the COU table to "stabilizing agent" after discussions with the company that purchased the previous 2016 reporting company (U.S. EPA, 2024d). See Appendix D for more information on the changes from the COUs from the *Final Scope of the Risk Evaluation for Dicyclohexyl Phthalate (DCHP) CASRN 84-61-7* (U.S. EPA, 2020b).

In the 2020 CDR cycle, one company reported the use of DCHP as a stabilizing agent in paints and coating manufacturing.

## E.14 Industrial Use – Other Articles with Routine Direct Contact During Normal Use Including Rubber Articles; Plastic Articles (Hard) (*e.g.*, Transportation Equipment Manufacturing)

This COU refers to the use of DCHP in rubber and plastic products in various industrial sectors, such as transportation equipment manufacturing. Meaning the use of DCHP after it has already been incorporated into a plastic or rubber product, as opposed to when it is used upstream (*e.g.*, when DCHP is processed into the plastic/rubber product).

According to information provided to EPA, DCHP is used as a plasticizer in plastic and rubber products used in the aerospace industry (AIA, 2019) and a variety of transportation equipment such as both vehicles production parts and replacement parts (MEMA, 2019). The Alliance of Automobile Manufacturers and the Motor & Equipment Manufacturers Association did explain that "[t]he average scope of the relative mass of DCHP in the parts from the Alliance's data collection is 0.24 gram. Excluding body/exterior parts, that average drops below 0.01 gram" (MEMA, 2019).

As such, workers would be expected to handle or touch products covered by this COU with their hands and be exposed to DCHP through dermal contact.

This COU also includes activities identified by the U.S. Department of Defense.

***Examples of CDR Submissions***

In the 2016 CDR cycle, one company reported the commercial use of DCHP in plastic and rubber products not covered elsewhere.

In the 2020 CDR cycle, the same company reported the commercial use of DCHP as a plasticizer in other articles with routine direct contact during normal use including rubber articles; plastic articles (hard), which is a further refined description compared to the 2016 CDR cycle code of "plastic and rubber products not covered elsewhere".

## E.15 Commercial Use – Adhesives and Sealants

This COU is referring to the commercial use of DCHP in adhesives and sealants. Meaning the use of DCHP-containing adhesives and sealants in a commercial setting, such as a business or at a job site, as opposed to upstream use of DCHP (*e.g.*, when DCHP is processed into the adhesive and sealant formulation) or use in an industrial setting.

Workers in a commercial setting generally apply adhesives and sealants that already have DCHP incorporated as a plasticizer or combine two-part adhesives where DCHP acts as a phlegmatizer with BPO in unsaturated polyesters or MMA systems (U.S. EPA, 2024d). The American Coatings Association explained that DCHP is a plasticizer, additive and impurity in adhesives in amounts less than 1 percent (ACA, 2019). According to information provided to EPA, DCHP is used as an adhesive within the aerospace industry (AIA, 2019), and an adhesive sealant for body panel assemblies and parts by automobile manufacturers applications (MEMA, 2019).

Commercial adhesives and sealants that are used to fasten other materials together or to prevent the passage of liquid or gas are captured under this COU. For example, products under this COU can be two-part adhesives, glues or caulks, which are stored in separate parts, generally a base and an activator or a resin and a hardener that may undergo a reaction or cure once combined. EPA expects that some commercial applications of adhesives and sealants containing DCHP may occur using non-pressurized

methods, but that most commonly, the products containing DCHP are more likely applied via a syringe or caulk gun. More specifically, EPA has identified several examples of products for this COU, such as a metal bonding adhesive used in variety of automotive care applications (*e.g.*, panel bonding, weld and rivet bonding of quarter panels, rear body panels, roof panels, door skins, van side panels and outer truck bed panels) that contain DCHP concentrations of 1 to 5 percent (Lord Corporation, 2021, 2020, 2017) as well as a similar metal bonding product with DCHP concentrations from 3 to less than 5 percent (Ford Motor Company, 2015). EPA also identified various two-part adhesive anchoring systems, such as a two-part hammer-capsule system designed for use in the installation of a threaded rod into solid concrete and masonry materials that contained DCHP concentrations of 1 to 2.5 percent (DeWALT, 2024b, 2022, 2020), as well as another two-part polyester liquid system to be used once again in construction and building environments (MKT, 2023a, b, 2018).

EPA expects that the use of these types of products would occur in commercial applications; however, EPA notes that these products are likely to be sourced by do-it-yourself (DIY) consumers through various online vendors as well (DeWALT, 2024a; Lord Corporation, 2024; MKT, 2024). Similarly, EPA has also identified DCHP in a multi-purpose nitrocellulose adhesive/cement at 1 to 5 percent with suggested applications of china, vases, plastic, wood, metal, and crafts (Midwest Technology Products, 2024; Permatex, 2024, 2021) but could also be used in various commercial settings and applications.

This COU also includes activities identified by the U.S. Department of Defense.

***Examples of CDR Submissions***
In the 2016 CDR cycle, one company reported the use of DCHP as adhesive and sealant chemicals in adhesive manufacturing.

In the 2020 CDR cycle, one company reported the use of DCHP as a plasticizer in adhesive manufacturing.

## E.16 Commercial Use – Building/Construction Materials Not Covered Elsewhere

This COU is referring to the commercial use of DCHP in building/construction materials not covered elsewhere. Meaning the use of DCHP-containing building/construction materials in a commercial setting, such as at a business or at a job site, as opposed to upstream use of DCHP (*e.g.*, when DCHP is processed into articles).

According to information provided to EPA in 2021, DCHP (referred to in this case as Uniplex 250) has been used as an article in a "range of construction products-boards" (LANXESS, 2021). These boards are presumed to be used in a variety of commercial applications and settings.

***Examples of CDR Submissions***
In the 2012 CDR cycle, one company reported the commercial use of DCHP as building/construction materials not covered elsewhere.

## E.17 Commercial Use – Ink, Toner, and Colorant Products

This COU refers to the commercial use of DCHP in ink, toner, and colorant products. Meaning the use of DCHP-containing ink, toner, and/or colorant products in a commercial setting, such as a business or at a job site, as opposed to upstream use of DCHP (*e.g.*, when DCHP is processed into the ink, toner, and colorant product formulation) or use in an industrial setting.

According to information provided to EPA in 2021, DCHP (referred to in this case as Uniplex 250) has been used as an element of PVC inks/PVC plastisol formulations (LANXESS, 2021; U.S. EPA, 2021c, 2019e). Uniplex 250 is also marketed as being used as a polymer additive in labels and printing ink formulations (Hallstar, 2022) and has been used as part of the screen-printing process for textiles (Gans Ink and Supply, 2018). The expected users of these products would be specific to the printing community and these inks would likely be applied through mechanical methods or as part of the screen-printing process.

***Examples of CDR Submissions***
In the 2016 CDR cycle, one company reported the use of DCHP as a plasticizer in printing ink manufacturing.

## E.18 Commercial Use – Laboratory Chemicals

This COU is referring to the commercial use of DCHP in laboratory chemicals. DCHP can be used as a laboratory chemical, such as a chemical standard or reference material during analyses. Some laboratory chemical manufacturers identify use of DCHP as a certified reference material and research chemical (Restek Corp, 2024; Sigma-Aldrich, 2024a, b; U.S. EPA, 2020d; SPEX CertiPrep, 2019). Users of the products under this category would be expected to apply these products through general laboratory use applications. According to information provided to EPA by NASA, the Agency indicated that DCHP is used as a laboratory chemical in applications such as analytical standards, research, equipment calibration and sample preparation (NASA, 2020).

DCHP has also been used as the powder in a two-part laboratory acrylic mounting system for laboratory specimens that are sensitive to high pressures and temperatures, as well as an embedding polymer resin kit intended for preparation for samples for high resolution light microscopy (Ted Pella, 2024, 2017). DCHP in this case is used as part of a BPO catalyst.

This use was not reported to EPA in the 2016 or 2020 CDR cycles.

## E.19 Commercial Use – Paints and Coatings

This COU is referring to the commercial use of DCHP as a plasticizer and stabilizer (*i.e.*, phlegmatizer) in paints and coating systems. Meaning the use of DCHP-containing paints and coatings in a commercial setting, such as at a business or at a job site, as opposed to upstream use of DCHP (*e.g.*, when DCHP is processed into the paint, coating, or BPO formulation) or use in an industrial setting.

Workers in a commercial setting generally apply paints and coatings that already have DCHP incorporated as a plasticizer or combine two (or even sometimes 3) part paints and coatings where DCHP acts as a phlegmatizer with BPO in unsaturated polyesters or MMA systems (U.S. EPA, 2024d). The solid DCHP/BPO product often acts as a catalyst or curing agent when mixed with a second, often liquid, component by workers at the end use site before application. This mixing begins the polymerization reaction or process. Workers are expected to be potentially exposed when mixing components to form a liquid paint/coating, when transferring the liquid mixture to the application equipment if necessary, and/or when applying the coating or system itself to the substrate (U.S. EPA, 2014b; OECD, 2009b; U.S. EPA, 2004d). End use sites may also receive liquid paint and coating formulations already containing DCHP as a single component, making the need to mix two components obsolete. Application methods for DCHP-containing paints and coatings may include spray, brush, and/or trowel coating.

Various paints and coatings that utilize DCHP are applied in commercial settings such as in roofing, construction, and in cement/protection for high traffic areas, etc. often to provide waterproofing, UV protection and/or chemical resistance. More specifically, EPA has identified several examples of products for this COU, such as a single-component silicone acrylic finish that air dries and is suitable for high temperature exposures up to 500 °F with DCHP concentrations of 2.5 to less than 10 percent. This paint and coating is applied via pressurized spray and can be used to protect various elements, equipment, and so on, in an industrial or manufacturing setting (Carboline, 2019a, b; U.S. EPA, 2019d). EPA also identified various two or even multi-part paints and coatings systems including: a vinyl ester silicone filled mortar; a three component, MMA-based grout; a poly methyl-methacrylate (PMMA) resin used in roofing and waterproofing applications; a polyurethane modified methyl methacrylate (PUMMA) vehicular and pedestrian traffic coating system; and a MMA resin used as a penetrating crack healer/sealer or to fortify extremely porous concrete substrates.

The vinyl ester silicone filled mortar contained concentrations of DCHP at less than 0.005 percent and when used with chemical-resistant masonry units and the proper membrane, it will protect concrete and steel substrates from chemical attack and physical abuse. The mortar is a two-part system including a liquid and the powder (which contains DCHP), which must be mixed together (3.25 parts powder to 1 part liquid) prior to trowel based application of an average one-eighth inch thick bed directly on top of membrane or preceding course of brickwork. According to the company, this product is used in the construction of floors, sumps, trenches, tanks, vessels and bleach towers in chemical processing; food and beverage plants; dairies; laboratories; and textile, steel and pulp and paper mills (Sauereisen, 2024, 2022, 2015).

The three-component MMA based grout is flowable, non-shrink, durable polymer grout that according to the company's website, can be used as the grouting of bearing plates on bridges and trestles, rehabilitation of bridge decks, airport runways, expansion joints and column grouting. DCHP can be found in the catalyst or Part B in concentrations of 50 to 51 percent. Seven to 14 fluid ounces (oz) (depending on the ambient air temperature) of the catalyst/Part B, is mixed with 1 gallon of Part A resin, and 70 lb of Part C grout aggregate. Once mixed, the company directs workers to distribute the blended resin over the surface and brush in or prepare a form and pour the material into place (ChemMasters, 2024, 2018, 2017a, b).

The PMMA resin is used in roofing and waterproofing applications through a two-part plus fleece/membrane self-flashing and self-adhering system, which according to the company is used in structural below-grade concrete surfaces, and protected roof and split-slab decks (CETCO, 2024, 2018a, b, c). DCHP has been identified in the catalyst powder at 50 percent, which is then mixed with the resin at various ratios ranging from 2 to 6 percent depending on the weight of the resin used and temperature.

The polyurethane modified methyl methacrylate (PUMMA) vehicular and pedestrian traffic coating system, is specifically designed for use in parking structures, balconies, stadium seating, walkways, plaza decks, etc. (HYDRO-GARD, 2012a, b). This is a multi-component system, which uses a catalyst that contains DCHP in concentrations of 40 to 55 percent combined with a resin and a flashing or polyester fleece to create a liquid applied waterproofing membrane/coating (HYDRO-GARD, 2024, 2017a, b).

Finally, the last product example for commercial paints and coatings is an MMA resin that is used as a penetrating crack healer/sealer or to fortify extremely porous concrete substrates, such as parking and bridge decks, loading docks and warehouses. DCHP can be found in the initiator component in concentrations of 50 to less than 100 percent. To begin the hardening process the workers must add

roughly 0.5 oz to a gallon of resin at around 32 to 39 °F, increasing up to 2 oz at 90 to 105 °F. The product is then recommended to be spread evenly on the surface as a flood coat with a squeegee or rollers and allowed to absorb completely into the concrete substrate (Euclid Chemical Company, 2019a, b, 2018).

Note these listed examples are not all inclusive of every product under this COU, and that EPA expects that these types of products would be purchased by commercial operations and applied by professional contractors in various commercial settings. The Agency also expects that some of these products are likely to be used for industrial applications; however, they would be available and used in smaller scale commercial settings for similar purposes (*e.g.*, protection on structural components, construction).

***Examples of CDR Submissions***

In the 2016 CDR cycle, one company reported the use of DCHP as a process regulator in paints and coating manufacturing, which has been recategorized in the COU table to "stabilizing agent" after discussions with the company that purchased the previous 2016 reporting company (U.S. EPA, 2024d). See Appendix D for more information on the changes from the COUs from the *Final Scope of the Risk Evaluation for Dicyclohexyl Phthalate (DCHP); CASRN 84-61-7* (U.S. EPA, 2020b).

In the 2020 CDR cycle, one company reported the use of DCHP as a stabilizing agent in paints and coating manufacturing.

## E.20 Commercial Use – Other Articles with Routine Direct Contact During Normal Use Including Rubber Articles; Plastic Articles (Hard)

This COU is referring to the commercial use of DCHP in various rubber and plastic articles that are intended for routine direct contact. The 2020 CDR reporting category "other articles with routine direct contact during normal use including rubber articles; plastic articles (hard)" is intended to capture items such as gloves, boots, clothing, rubber handles, gear levers, steering wheels, handles, pencils, and handheld device casing. Given the use of DCHP as a general-purpose plasticizer for PVC and non-PVC applications, EPA expects that this use of DCHP has been identified in previous CDR reports as "plastic and rubber products not covered elsewhere."

According to information provided to EPA, DCHP is used as a plasticizer in plastic and rubber products used in the aerospace industry (AIA, 2019) and a variety of transportation equipment such as both vehicles production parts and replacement parts (*e.g.*, brake calipers, fender shim, disc brake assembly) (MEMA, 2019). The Alliance of Automobile Manufacturers and the Motor & Equipment Manufacturers Association did explain that "[t]he average scope of the relative mass of DCHP in the parts from the Alliance's data collection is 0.24 gram. Excluding body/exterior parts, that average drops below 0.01 gram" (MEMA, 2019).

As such, workers would be expected to handle or touch products covered by this COU with their hands and be exposed to DCHP through dermal contact.

This COU also includes activities identified by the U.S. Department of Defense.

***Examples of CDR Submissions***

In 2016 one CDR company reported the commercial use of DCHP in plastic and rubber products not covered elsewhere.

In 2020 the same CDR company reported the commercial use of DCHP as a plasticizer in other articles with routine direct contact during normal use including rubber articles; plastic articles (hard), which is a further refined description compared to the 2016 CDR cycle code of "plastic and rubber products not covered elsewhere."

## E.21 Consumer Use – Adhesives and Sealants

This COU is referring to the consumer use of DCHP in adhesives and sealants. According to information provided to EPA, the American Coatings Association explained that DCHP is a plasticizer, additive, and impurity in adhesives in amounts less than 1 percent (ACA, 2019). EPA has identified DCHP in a multi-purpose nitrocellulose adhesive/cement at one to five percent with suggested applications of china, vases, plastic, wood, metal, and crafts (Midwest Technology Products, 2024; Permatex, 2024, 2021) as well as adhesives and sealants meant for the industrial and commercial automotive industry that are also available to consumer customers (Lord Corporation, 2021, 2020, 2017). For example, the two-part metal bonding adhesive is meant for use in various elements of an automotive (*e.g.,* panel bonding, weld and rivet bonding of quarter panels, rear body panels, roof panels, door skins, van side panels and outer truck bed panels) and has a DCHP concentration of one to five percent (Lord Corporation, 2017). EPA has also identified various two-part adhesive anchoring systems, such as a two-part hammer-capsule system designed for use in the installation of a threaded rod into solid concrete and masonry materials that contained DCHP concentrations of 1 to 2.5 percent (DeWALT, 2024b, 2022, 2020), as well as another two-part polyester liquid system to be used once again in construction and building environments (MKT, 2023a, b, 2018).

Aside from the household glue, EPA expects that the primary use of several of these products is meant to occur in industrial/commercial applications only; however, the Agency notes that several of these products can be sourced by DIY consumers through various online vendors (DeWALT, 2024a; Lord Corporation, 2024; MKT, 2024).

This COU was not reported in the 2016 or 2020 CDR cycles.

## E.22 Consumer Use – Other Articles with Routine Direct Contact During Normal Use Including Rubber Articles; Plastic Articles (Hard)

This COU is referring to the consumer use of DCHP in various rubber and plastic articles that are intended for consumer use through routine direct contact. The 2020 CDR reporting category "other articles with routine direct contact during normal use including rubber articles; plastic articles (hard)" is intended to capture items such as gloves, boots, clothing, rubber handles, gear levers, steering wheels, handles, pencils, and handheld device casing. Given the use of DCHP as a general-purpose plasticizer for PVC and non-PVC applications, EPA expects that this use of DCHP has been identified in previous CDR reports as "plastic and rubber products not covered elsewhere."

According to information provided to EPA, DCHP is used as a plasticizer in plastic and rubber products used in the aerospace industry (AIA, 2019) as well as a variety of transportation equipment such as both vehicles production parts and replacement parts (MEMA, 2019). The Alliance of Automobile Manufacturers and the Motor & Equipment Manufacturers Association did explain that "[t]he average scope of the relative mass of DCHP in the parts from the Alliance's data collection is 0.24 gram. Excluding body/exterior parts, that average drops below 0.01 gram" (MEMA, 2019).

According to additional information provided to EPA in 2021, DCHP (referred to in this case as Uniplex 250) has been used as an article in a "range of construction products-boards" (LANXESS, 2021). These

boards are presumed to be used in a variety of commercial applications and settings; however, could still be a source of exposure for consumers.

As such, consumers would be expected to handle or touch products covered by this COU with their hands and be exposed to DCHP through dermal contact.

***Examples of CDR Submissions***
In the 2016 CDR cycle, one company reported the consumer use of DCHP in plastic and rubber products not covered elsewhere.

In the 2020 CDR cycle, the same company reported the consumer use of DCHP as a plasticizer in other articles with routine direct contact during normal use including rubber articles; plastic articles (hard), which is a further refined description compared to the 2016 CDR cycle code of "plastic and rubber products not covered elsewhere."

## E.23 Consumer Use – Other Consumer Articles that Contain DCHP from: Inks, Toner, and Colorants; Paints and Coatings; and Adhesives and Sealants

This COU is referring to the consumer use of articles that contain DCHP from inks, toner, and colorants, paints and coatings and adhesives and sealants.

According to information provided to EPA in 2021, DCHP (referred to in this case as Uniplex 250) has been used as an element of PVC inks/PVC plastisol formulations (LANXESS, 2021; U.S. EPA, 2019e). Uniplex 250 is also marketed as being used as a polymer additive in labels and printing ink formulations (Hallstar Website) and has been used as part of the screen-printing process for textiles (Gans Ink and Supply, 2018). EPA expects consumers to exposed to DCHP through various products, such as textiles, labels, packaging, etc.

The Agency has also identified several examples of commercial paints and coatings that already have DCHP incorporated as a plasticizer or combine two (or even multiple) components where DCHP acts as a phlegmatizer with BPO in unsaturated polyesters or MMA systems (U.S. EPA, 2024d). These paints and coatings that utilize DCHP, are often applied in commercial settings such as in roofing, construction, and in cement/protection for high traffic areas (etc.)—often to provide waterproofing, UV protection and/or chemical resistance. In particular, EPA identified a product that is used as a vehicular and pedestrian traffic coating system, specifically designed for use in parking structures, balconies, stadium seating, walkways, plaza decks, etc. (HYDRO-GARD, 2024, 2017a, b, 2012a, b). EPA expects consumers to be exposed to DCHP through this coating in areas where consumer access is presumed, such as balconies and stadium seating.

DCHP is also used during cellulose film production to bathe or coat the film, giving it barrier properties as well as promoting heat seal. This cellulose film is then used in a variety of labeling, and packaging end uses (U.S. EPA, 2020c; Earthjustice, 2019). Any packaging or cellulose film end uses that are not subject to the U.S. FDA regulations, would be captured under this COU. EPA would expect dermal exposure to DCHP through handling cellulose film.

Finally, EPA has identified commercial or industrial adhesives and sealants that already have DCHP incorporated as a plasticizer or combine a two-part adhesive where DCHP acts as a phlegmatizer in unsaturated polyesters or MMA systems (U.S. EPA, 2024d). The American Coatings Association

explained that DCHP is a plasticizer, additive, and impurity in adhesives in amounts less than one percent (ACA, 2019). According to information provided to EPA, DCHP is used as an adhesive within the aerospace industry (AIA, 2019), and an adhesive sealant for body panel assemblies and parts by automobile manufacturers applications (MEMA, 2019). EPA has also identified various industrial and commercial applications of adhesives and sealants in the construction industry, electronics etc. As a result, the Agency expects consumer to be exposed to DCHP through various complex articles that used an adhesive and sealant that contained DCHP, such as electronics, cars, airplanes, and building/construction materials.

***Examples of CDR Submissions***

In the 2016 CDR cycle, one company reported the use of DCHP as a plasticizer in printing ink manufacturing. One company reported the use of DCHP as a process regulator in paints and coating manufacturing, which has been recategorized in the COU table to "stabilizing agent" after discussions with the company that purchased the previous 2016 reporting company (U.S. EPA, 2024d). Another company reported the use of DCHP as an adhesive and sealant chemical in adhesive manufacturing.

In the 2020 CDR cycle, one company reported the use of DCHP as a stabilizing agent in paints and coating manufacturing and one company reported the use of DCHP as a plasticizer in adhesive manufacturing.

## E.24 Disposal

Each of the COUs of DCHP may generate waste streams of the chemical. For purposes of the DCHP risk evaluation, this COU refers to the DCHP in a waste stream that is collected from facilities and households and are unloaded at and treated or disposed at third-party sites. This COU also encompasses DCHP contained in wastewater discharged by consumers or occupational users to a POTW or other, non-POTW for treatment, as well as other wastes.

DCHP is expected to be released to other environmental media, such as introductions of biosolids to soil or migration to water sources, through waste disposal (*e.g.*, disposal of formulations containing DCHP, plastic and rubber products, and transport containers). Disposal may also include destruction and removal by incineration. Recycling of DCHP and DCHP containing products is considered a different COU. Environmental releases from industrial sites are assessed in each COU.

# Appendix F OCCUPATIONAL EXPOSURE VALUE DERIVATION

EPA calculated an 8-hour existing chemical occupational exposure value to summarize the occupational exposure scenario and sensitive health endpoints into a single value. This calculated value may be used to support risk management efforts for DCHP under TSCA section 6(a), 15 U.S.C. section 2605. EPA calculated the value rounded to 0.63 mg/m$^3$ for inhalation exposures to DCHP as an 8-hour time-weighted average (TWA) and for consideration in workplace settings (see Appendix F.1) based on the acute, non-cancer human equivalent concentration (HEC) for developmental toxicity (*i.e.*, phthalate syndrome-related effects on the developing male reproductive system).

TSCA requires risk evaluations to be conducted without consideration of costs and other nonrisk factors; therefore, this occupational exposure value represents a risk-only number. If risk management for DCHP follows the finalized risk evaluation, EPA may consider costs and other nonrisk factors, such as technological feasibility, the availability of alternatives, and the potential for critical or essential uses. Any existing chemical exposure limit used for occupational safety risk management purposes could differ from the occupational exposure value presented in this appendix based on additional consideration of exposures and nonrisk factors consistent with TSCA section 6(c).

This calculated value for DCHP represents the exposure concentration below which exposed workers and occupational non-users (ONUs) are not expected to exhibit any appreciable risk of adverse toxicological outcomes, accounting for PESS. It is derived based on the most sensitive human health effect (*i.e.*, effects on the developing male reproductive system) and exposure duration (*i.e.*, acute) relative to benchmarks and a standard occupational scenario assumption of an 8-hour work day.

EPA expects that at the occupational exposure value of 0.047 ppm (0.63 mg/m$^3$) a worker or ONU also would be protected against developmental toxicity from intermediate and chronic duration occupational exposures if ambient exposures are kept below this occupational exposure value. The Agency has not separately calculated a short-term (*i.e.*, 15-minute) occupational exposure value because EPA did not identify hazards for DCHP associated with this very short duration.

EPA did not identify a government-validated method for analyzing DCHP in air.

The Occupational Safety and Health Administration (OSHA) has not set a permissible exposure limit (PEL) as an 8-hour TWA for DCHP (accessed December 20, 2025). EPA located several occupational exposure limits for DCHP (CASRN 84-61-7) in other countries such as Germany (accessed December 20, 2025). Identified 8-hour TWA values range from 3 mg/m$^3$ in Denmark to 5 mg/m$^3$ in Austria, Ireland, New Zealand, South Africa, and the United Kingdom. Additionally, EPA found that New Zealand and the United Kingdom (both accessed December 20, 2025) have an established occupational exposure limit of 5 mg/m$^3$ (8-hour TWA) in each country's code of regulation that is enforced by each country's worker safety and health agency.

## F.1 Occupational Exposure Value Calculations

This appendix presents the calculations used to estimate occupational exposure values using inputs derived in this risk evaluation. Multiple values are presented below for hazard endpoints based on different exposure durations. For DCHP, the most sensitive occupational exposure value is based on non-cancer developmental effects and the resulting 8-hour TWA is rounded to 0.63 mg/m$^3$.

***Acute, Non-Cancer Occupational Exposure Value***

The acute occupational exposure value ($EV_{acute}$) was calculated as the concentration at which the acute margin of exposure (MOE) would equal the benchmark MOE for acute occupational exposures using Equation_Apx F-1:

**Equation_Apx F-1.**

$$\mathrm{EV_{acute}} = \frac{\mathrm{HEC_{acute}}}{Benchmark\ MOE_{acute}} \times \frac{\mathrm{AT_{HECacute}}}{ED} \times \frac{\mathrm{IR_{resting}}}{\mathrm{IR_{workers}}} =$$

$$\frac{0.95\ \mathrm{ppm}}{30} \times \frac{\frac{24h}{d}}{\frac{8h}{d}} \times \frac{0.6125\,\frac{\mathrm{m^3}}{hr}}{1.25\,\frac{\mathrm{m^3}}{hr}} = 0.047\ \mathrm{ppm}$$

$$EV_{acute}\ \left(\frac{\mathrm{mg}}{\mathrm{m^3}}\right) = \frac{EV\ ppm \times MW}{Molar\ Volume} = \frac{0.047\ \mathrm{ppm} \times 330.4\,\frac{g}{mol}}{24.45\ \frac{L}{mol}} = 0.63\ \frac{\mathrm{mg}}{\mathrm{m^3}}$$

***Intermediate, Non-Cancer Occupational Exposure Value***

The intermediate occupational exposure value ($EV_{intermediate}$) was calculated as the concentration at which the intermediate MOE would equal the benchmark MOE for intermediate occupational exposures using Equation_Apx F-2:

**Equation_Apx F-2.**

$$\mathrm{EV_{intermediate}} = \frac{\mathrm{HEC_{intermediate}}}{Benchmark\ MOE_{\mathrm{intermediate}}} \times \frac{\mathrm{AT_{HEC\ intermediate}}}{ED{*}EF} \times \frac{\mathrm{IR_{resting}}}{\mathrm{IR_{workers}}}$$

$$= \frac{0.95\ \mathrm{ppm}}{30} \times \frac{\frac{24h}{d} \times 30d}{\frac{8h}{d} \times 22d} \times \frac{0.6125\,\frac{\mathrm{m^3}}{hr}}{1.25\,\frac{\mathrm{m^3}}{hr}} = 0.063\ \mathrm{ppm} = 0.86\ \frac{\mathrm{mg}}{\mathrm{m^3}}$$

***Chronic, Non-Cancer Exposure Value***

The chronic occupational exposure value ($EV_{chronic}$) was calculated as the concentration at which the chronic MOE would equal the benchmark MOE for chronic occupational exposures using Equation_Apx F-3:

**Equation_Apx F-3.**

$$\mathrm{EV_{chronic}} = \frac{\mathrm{HEC_{chronic}}}{Benchmark\ MOE_{chronic}} \times \frac{\mathrm{AT_{HEC\ chronic}}}{ED \times EF \times WY} \times \frac{\mathrm{IR_{resting}}}{\mathrm{IR_{workers}}}$$

$$= \frac{0.95\ \mathrm{ppm}}{30} \times \frac{\frac{24h}{d}\times\frac{365d}{y}\times 40\ y \times 0.6125\frac{\mathrm{m^3}}{hr}}{\frac{8h}{d}\times\frac{250d}{y}\times 40\ y \times 1.25\frac{\mathrm{m^3}}{hr}} = 0.068\ \mathrm{ppm} = 0.92\ \frac{\mathrm{mg}}{\mathrm{m^3}}$$

Where:

| | | |
|---|---|---|
| $AT_{hecate}$ | = | Averaging time for the point of departure (POD)/HEC used for evaluating non-cancer acute occupational risk based on study conditions and HEC adjustments (24 h/day). |
| $AT_{HECintermediate}$ | = | Averaging time for the POD/HEC used for evaluating non-cancer intermediate occupational risk based on study conditions and/or any HEC adjustments (24 h/day for 30 days). |
| $AT_{HECchronic}$ | = | Averaging time for the POD/HEC used for evaluating non-cancer chronic occupational risk based on study conditions and/or HEC adjustments (24 h/day for 365 days/year) and assuming the same number of years as the high-end working years (WY, 40 years) for a worker. |
| *Benchmark* $MOE_{acute}$ | = | Acute non-cancer benchmark margin of exposure, based on the total uncertainty factor of 30 |
| *Benchmark* $MOE_{intermediate}$ | = | Intermediate non-cancer benchmark margin of exposure, based on the total uncertainty factor of 30 |
| *Benchmark* $MOE_{chronic}$ | = | Chronic non-cancer benchmark margin of exposure, based on the total uncertainty factor of 30 |
| $EV_{acute}$ | = | Acute occupational exposure value |
| $EV_{intermediate}$ | = | Intermediate occupational exposure value |
| $EV_{chronic}$ | = | Chronic occupational exposure value |
| *ED* | = | Exposure duration (8 h/day) |
| *EF* | = | Exposure frequency (1 day for acute, 22 days for intermediate, and 250 days/year for chronic and lifetime) |
| *HEC* | = | Human equivalent concentration for acute, intermediate, or chronic non-cancer occupational exposure scenarios |
| *IR* | = | Inhalation rate (default is 1.25 $m^3$/h for workers and 0.6125 $m^3$/h assumed from "resting" animals from toxicity studies) |
| *Molar Volume* | = | 24.45 L/mol, the volume of a mole of gas at 1 atm and 25 °C |
| *MW* | = | Molecular weight of DCHP (330.4 g/mole) |
| *WY* | = | Working years per lifetime at the 95th percentile (40 years). |

*Unit conversion:*

1 ppm = 13.51 $mg/m^3$ (see equation associated with the $EV_{acute}$ calculation)