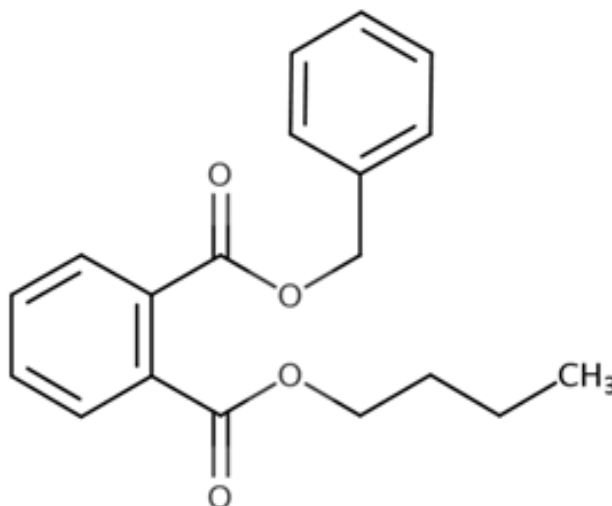




United States
Environmental Protection Agency

Draft Risk Evaluation for Butyl Benzyl Phthalate (BBP)

CASRN 85-68-7



July 2025

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ACKNOWLEDGEMENTS

The Assessment Team gratefully acknowledges the participation, input, and review comments from U.S. Environmental Protection Agency (EPA or the Agency) Office of Pollution Prevention and Toxics (OPPT) and Office of Chemical Safety and Pollution Prevention (OCSPP) senior managers and science advisors. The Agency is also grateful for assistance from EPA contractors General Dynamics Information Technology, Inc. (Contract Nos, HHSN316201200013W and 68HERD24A0001); SRC, Inc. (Contract 68HERH19D0022); ERG (Contract Nos. 68HERD20A0002, GS-00F-079CA, and 68HERC23D0006); Spec Professional Services, LLC (Contract No. 68HERC20D0021); SpecPro Sustainable and Environmental, Inc. (Contract No. 68HERC25D0004); and ICF, Inc. (Contract Nos. 68HERC19D0003 and 68HERC23D0007).

Special acknowledgement is given for the contributions of technical experts from EPA's Office of Research and Development (ORD), including Justin Conley, Christopher Corton, Earl Gray, and Tammy Stoker.

Docket

Supporting information can be found in the public docket, Docket ID ([EPA-HQ-OPPT-2018-0501](#)).

Disclaimer

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EXECUTIVE SUMMARY

Background

EPA evaluated the chemical butyl benzyl phthalate (BBP) under the Toxic Substances Control Act (TSCA). In this draft risk evaluation, the Agency preliminarily determined that BBP presents an unreasonable risk of injury to human health and the environment driven by significant contributions to unreasonable risk to (1) workers from 16 conditions of use (COUs), and (2) the environment from 4 COUs. Two of these COUs have significant contributions to unreasonable risk for both human health and the environment. Of the 38 COUs EPA evaluated, 20 were preliminarily determined to not contribute to unreasonable risk of BBP to human health or the environment. The Agency did not identify risk of injury to consumers or the general population associated with any COU that would drive the unreasonable risk determination for BBP.

The August 2025 Science Advisory Committee on Chemicals ([SACC](#)) peer-review of high priority phthalates includes the draft risk evaluations for diethylhexyl phthalate (DEHP), dibutyl phthalate (DBP), and dicyclohexyl phthalate (DCHP) as well as the draft environmental and human health hazard assessments for BBP and diisobutyl phthalate (DIBP). Recommendations from the SACC—as well as public comments on the draft risk evaluations for BBP, DIBP, DEHP, DBP, and DCHP—will inform the final risk evaluation of BBP, including its determination as to whether BBP presents unreasonable risk to human health or the environment under the COUs.

In December 2019, EPA designated BBP as a high-priority chemical substance for TSCA risk evaluation and in August 2020 released the final scope of the risk evaluation ([U.S. EPA, 2020c](#)). This draft risk evaluation assesses human health risk to workers, including occupational non-users (ONUs), consumers, and the general population exposed to BBP from environmental releases. It also assesses risk to the environment. Manufacturers report BBP production volumes through the Chemical Data Reporting (CDR) rule under the associated CAS Registry Number (CASRN) 85-68-7. The production volume for BBP was approximately 1,000,000 to 20,000,000 pounds (lb) in 2016 to 2019 based on the 2020 CDR data. The Agency has evaluated BBP across its COUs, ranging from manufacture to disposal.

BBP is used primarily as a plasticizer in polyvinyl chloride (PVC) in consumer, commercial, and industrial applications (Section 1.2). It is also used as a stabilizing agent in the manufacturing of adhesives, paints, coatings, rubbers, and non-PVC plastic products. Workers may be exposed to BBP when making these products or otherwise using BBP in the workplace (Section 4.1.1). When it is manufactured or used to make products, BBP can be released into water (Section 3.3.1.1), where because of its physical and chemical properties, most will end up in the sediment of lakes and river. If released into the air (Section 3.3.1.2), BBP will attach to dust particles and be deposited on land or into water. Indoors, BBP has the potential to be released from products over time and to adhere to dust particles (Section 4.1.2). If it does, people could inhale or ingest dust that contains BBP.

Laboratory animal studies have been conducted to determine whether exposure to BBP can cause a range of non-cancer and cancer health effects in people. After reviewing the reasonable available studies, the Agency preliminarily concludes that there is strong evidence that BBP exposure may lead to developmental toxicity (a non-cancer hazard). The most sensitive adverse effects are on the developing male reproductive system, based on studies in rodents, consistent with a disruption of androgen action that results from decreased fetal testicular testosterone—what is known as “phthalate syndrome” (Section 4.2).

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EPA included BBP in a cumulative risk assessment (CRA; Section 4.4) along with five other phthalates¹ that can cause developmental effects in laboratory animals consistent with phthalate syndrome, as described in the *Revised Draft Technical Support Document for the Cumulative Risk Analysis* ([U.S. EPA, 2025ad, 2023d](#)). 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 BBP. These agencies also conducted CRAs of phthalates based on their shared ability to cause phthalate syndrome. Furthermore, independent, expert peer reviewers supported EPA's proposal to conduct a CRA of phthalates under TSCA during the May 2023 meeting of the SACC because humans are co-exposed to multiple toxicologically similar phthalates that cause effects on the developing male reproductive system consistent with phthalate syndrome.

In this draft risk evaluation, the Agency addressed cumulative exposure to phthalates using human biomonitoring data. Note that these cumulative phthalate exposures cannot be attributed to specific COUs or other sources under TSCA. This non-attributable cumulative exposure and risk, representing the national population, was taken into consideration by EPA in its draft risk evaluation for BBP. By taking into account cumulative risk as other authoritative bodies have done, the Agency is confident that it is not underestimating the risk of BBP to human health. EPA is seeking feedback from the SACC and soliciting public comment on the integration of its cumulative risk assessment approach within individual risk evaluations. The CRA also considers differences in the ability of each phthalate to cause effects on the developing male reproductive system. Use of this "relative potency" provides a more robust risk assessment of BBP as well as a common basis for adding risk across the six phthalates—DEHP, DBP, DCHP, DIBP, DINP, and BBP—included in the (revised) CRA. EPA is seeking specific input on its index chemical selection, derivation of relative potency factors (RPFs), index chemical point of departure (POD), and individual BBP POD, which may impact the cumulative risk assessment.

Past assessments of BBP from other governmental agencies that addressed a broad range of uses have concluded that BBP alone or in combination with exposure to other phthalate chemicals may pose a hazard or risk to human health 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 phthalate exposure from children's products as well as from other sources such as personal care and consumer products, diet, and the environment. However, these past assessments did not specifically consider exposure to workers. In this draft risk evaluation EPA preliminarily determined that BBP does not present unreasonable risk to consumers or the general population. In addition, EPA evaluated and has preliminarily identified contributions to unreasonable risk to workers for some manufacturing and processing uses of BBP. Dermal exposure to ONUs was also preliminary determined to contribute to unreasonable risk for four COUs. In the manufacturing and processing COUs, the contribution to unreasonable risk are driven by dermal exposures.

In this draft risk evaluation, EPA evaluated whether manufacturing, processing, distribution in commerce, use, or disposal of BBP presents unreasonable risk to human health or the environment under COUs subject to TSCA. Human or environmental exposure to BBP through uses that are not subject to TSCA (*e.g.*, use in cosmetics, medical devices, and food additives) were not evaluated by the Agency. This is because these uses are excluded from TSCA's definition of "chemical substance." Although EPA is preliminarily determining in this draft risk evaluation that 18 COUs significantly contribute to its draft unreasonable risk determination for BBP, this determination cannot be extrapolated to form conclusions about uses of BBP that are not subject to TSCA and that the Agency did not evaluate.

¹ DEHP, DBP, DCHP, DIBP, and diisononyl phthalate (DINP).

Determining Unreasonable Risk to Human Health

EPA's TSCA existing chemical risk evaluations must determine whether a chemical substance does or does not present unreasonable risk to human health or the environment under its COUs. The unreasonable risk must be informed by the best available science. The Agency, in making the finding of *presents unreasonable risk to human health and the environment*, considers risk-related factors as described in its [2024 risk evaluation framework rule](#) and as required under TSCA ([U.S. EPA, 2024i](#)). Risk-related factors beyond the levels of BBP that can impact the unreasonable risk finding 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 [PESS]), and EPA's confidence in the information used to inform the hazard and exposure values. These considerations are included as part of a pragmatic and holistic evaluation of hazard and exposure to BBP. If an estimate of risk for a specific scenario exceeds the standard risk benchmarks, then the determination of whether those risks significantly contribute to the unreasonable risk of BBP under TSCA is both case-by-case and context-driven. EPA considers all of the aforementioned risk-related factors when making a determination of whether a COU significantly contributes to unreasonable risk.

EPA evaluated the risks to people from being exposed to BBP at work, indoors, and outdoors. In its draft human health evaluation, the Agency used a combination of screening level and more refined approaches to assess how people might be exposed to BBP through breathing or ingesting dust or other particulates as well as through skin contact. Risks are characterized for occupational and consumer exposures to BBP—alone as well as in combination with the measured cumulative phthalate exposure that is experienced by the U.S. population and that cannot be attributed to a specific COU as part of the (revised) CRA.

In determining whether BBP presents an unreasonable risk of injury to human health, EPA considered the following PESS in its assessment: women of reproductive age, pregnant women, infants, children and adolescents, people who frequently use consumer products and/or articles containing high concentrations of BBP, people exposed to BBP in the workplace, people in 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 BBP per body weight (*e.g.*, infants, children, adolescents) while others may experience exposure from multiple sources or higher exposures than others.

EPA considers the weight of scientific evidence to determine confidence levels in underlying data sets and risk estimates for human health (Section 4.3). For the general population, the Agency has robust confidence the risk estimates calculated were conservative and appropriate for a screening level analysis. For workers, EPA has moderate to robust confidence in the risk estimates calculated for inhalation and dermal exposure scenarios and has robust confidence that dermal exposure scenarios represent a conservative upper bound on exposure. For consumers, EPA also has moderate to robust confidence in the risk estimates calculated for inhalation, ingestion, and dermal exposure scenarios and has robust confidence that dermal exposure scenarios represent a conservative upper bound on exposure.

Determining Unreasonable Risk to the Environment

In determining whether BBP presents an unreasonable risk of injury to the environment, EPA considered the following groups of organisms in its assessment: aquatic vertebrates, aquatic invertebrates, benthic invertebrates, aquatic plants and algae, terrestrial mammals, soil invertebrates, and terrestrial plants. The Agency weighed the scientific evidence in order to determine confidence levels in underlying datasets and risk estimates for the environment (Section 5.3). EPA has moderate to robust

confidence in its environmental risk estimates depending on the source of environmental release information for each COU (Section 5.3.6). The Agency has preliminarily determined that BBP presents unreasonable risk of injury to the environment driven by four COUs due to chronic exposure to aquatic vertebrates and algae based on BBP releases to surface water.

Conclusions

EPA is preliminarily determining that of the 38 COUs evaluated, 2 COUs significantly contribute to unreasonable risk of BBP to human health *and* to the environment. Note, the following two COUs do not appear in the lists below for COUs that significantly contribute to the unreasonable risk for human health only and for COUs that significantly contribute to the unreasonable risk to the environment only:

- Manufacturing – domestic manufacturing [dermal exposure for workers, and aquatic vertebrates and algae through surface water]; and
- Processing – incorporation into formulation, mixture, or reaction product – plasticizers (custom compounding of purchased resin; plastic material and resin manufacturing; rubber manufacturing; adhesive manufacturing; paints and coatings manufacturing; ink, toner, and colorant manufacturing) [dermal exposure for workers, and aquatic vertebrates and algae through surface water].

EPA is preliminarily determining that the following 14 COUs significantly contribute to unreasonable risk of BBP to human health *only*:

- Manufacturing – importing [dermal exposure for workers];
- Processing – incorporation into formulation, mixture, or reaction product – laboratory chemical manufacturing [dermal exposure for workers];
- Processing – repackaging [dermal exposure for workers];
- Industrial use – construction, paint, electrical, and metal products – paints and coatings [dermal exposure for workers and ONUs];
- Industrial use – construction, paint, electrical, and metal products – adhesives and sealants [dermal exposure for workers];
- Industrial use – packaging, paper, plastic, toys, hobby products – ink, toner, and colorant products [dermal exposure for workers and ONUs];
- Industrial use – other uses – hydraulic fluid [dermal exposure for workers];
- Industrial use – other uses – castings [dermal exposure for workers];
- Industrial use – other uses – automotive products, fluids [dermal exposure for workers];
- Commercial use – construction, paint, electrical, and metal products – paints and coatings [dermal exposure for workers and ONUs];
- Commercial use – construction, paint, electrical, and metal products – adhesives and sealants [dermal exposure for workers];
- Commercial use – packaging, paper, plastic, toys, hobby products – ink, toner, and colorant products [dermal exposure for workers and ONUs];
- Commercial use – other uses – castings [dermal exposure for workers]; and
- Commercial use – other uses – automotive products, other than fluids [dermal exposure for workers].

EPA is preliminarily determining that the following two COUs significantly contribute to unreasonable risk of BBP to the environment *only*:

- Processing – incorporation into articles – plasticizers (adhesive manufacturing; fabric, textile, apparel, and leather products manufacturing; building and construction materials manufacturing;

plastics product manufacturing; rubber product manufacturing; transportation equipment manufacturing) [aquatic vertebrates through surface water]; and

- Disposal [aquatic vertebrates through surface water].

EPA is preliminarily determining that the following 20 COUs do *not* contribute to unreasonable risk of injury to human health or the environment:

- Processing – recycling;
- Distribution in commerce;
- Industrial use – other uses – automotive articles;
- Commercial use – furnishing, cleaning, treatment/care products – flooring coverings; construction and building materials covering large surface areas including stone, plaster, cement, glass and ceramic articles; fabrics, textiles, and apparel;
- Commercial use – furnishing, cleaning, treatment/care products – fabric, textile, and leather products;
- Commercial use – packaging, paper, plastic, hobby products – packaging (excluding food packaging) and other articles with routine direct contact during normal use, rubber articles; plastic articles (hard); plastic articles (soft);
- Commercial use – packaging, paper, plastic, hobby products – toys, playground, and sporting equipment;
- Commercial use – other uses – laboratory chemicals;
- Commercial use – other uses – automotive articles;
- Consumer use – construction, paint, electrical, and metal products – adhesives and sealants;
- Consumer use – construction, paint, electrical, and metal products – paints and coatings;
- Consumer use – furnishing, cleaning, treatment/care products – fabric, textile, and leather products;
- Consumer use – furnishing, cleaning, treatment/care products – floor coverings; construction and building materials covering large surface areas including stone, plaster, cement, glass and ceramic articles; fabrics, textiles, and apparel;
- Consumer use – packaging, paper, plastic, hobby products – arts, crafts, and hobby materials;
- Consumer use – packaging, paper, plastic, hobby products – toys, playground, and sporting equipment;
- Consumer use – packaging, paper, plastic, hobby products – ink, toner, and colorant products;
- Consumer use – packaging, paper, plastic, hobby products – packaging (excluding food packaging) and other articles with routine direct contact during normal use, rubber articles; plastic articles (hard); plastic articles (soft);
- Consumer use – other uses – automotive products, fluids;
- Consumer use – other uses – automotive articles; and
- Consumer use – other use – novelty articles.

Next Steps and Public Input

This draft risk evaluation and the accompanying technical support documents (TSDs) have been released for public comment. EPA seeks public comment on all aspects of this draft risk evaluation. In particular, the Agency seeks comment on the following:

1. whether and how exposure controls and personal protective equipment (PPE) are used during the manufacture, processing, and use of BBP for each of the COUs;
2. information to inform the extent to which spray applications of BBP are used in industrial and commercial COUs and the volumes of BBP that may be used;

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3. information on the environmental release of BBP under the COUs, including data on the media of release and facility-specific receiving waterbodies;
4. input on the use of Discharge Monitoring Report (DMR) data to inform environmental releases;
5. information on inhalation occupational exposure to BBP under the COUs, including monitoring or personal breathing zone data;
6. input on the dermal occupational exposure scenarios, including any supporting data to inform assumptions regarding duration and surface area of exposure;
7. information to inform the dermal exposure scenarios for ONUs;
8. information to inform the extent to which spray applications of BBP are used in industrial and commercial COUs and the volumes of BBP that may be used;
9. information on the assumptions for inhalation exposure of respirable particles in occupational exposure to BBP, including data on particle formation or size;
10. information to inform assumptions of inhalation of dust/particulate matter in the consumer exposure assessment;
11. integration of its cumulative risk assessment approach within individual risk evaluations, derivation of RPFs, and individual BBP PODs; and
12. any other information that may inform the assumptions used for modeling used to assess the COUs for BBP.

In addition to the draft TSDs (see Appendix C) for the human health and environmental hazard assessments for BBP, the SACC will peer review separate draft risk evaluations for diethylhexyl phthalate (DEHP), dibutyl phthalate (DBP), and dicyclohexyl phthalate (DCHP) during its August 2025 meeting. Recommendations from the SACC, as well as public comments on the draft risk evaluations for DEHP, DBP, and DCHP as well as the draft hazard assessments for BBP will inform the final risk evaluation of BBP—including the Agency determination of whether BBP presents unreasonable risk to human health or the environment under the COUs. If, in the final risk evaluation, the Agency determines that BBP presents unreasonable risk to human health or the environment, EPA will initiate regulatory action so that BBP no longer presents such risk.

1 INTRODUCTION

EPA has evaluated butyl benzyl phthalate (BBP) under the Toxic Substances Control Act (TSCA) section 6(b). BBP is primarily used as a plasticizer in polyvinyl chloride (PVC) in consumer, commercial, and industrial applications—although it is also used in adhesives, sealants, paints, coatings, textiles, and non-PVC plastics as well as other applications. Section 1.1 summarizes the scope of the draft BBP risk evaluation and provides information on production volume, a life cycle diagram (LCD), conditions of use (COUs) under TSCA, and conceptual models used for BBP. Section 1.3 presents the organization of this draft risk evaluation.

Figure 1-1 provides an overview of the major inputs, phases/components, and outputs of the [TSCA risk evaluation process](#), from chemical prioritization to scoping to releasing the final risk evaluation.

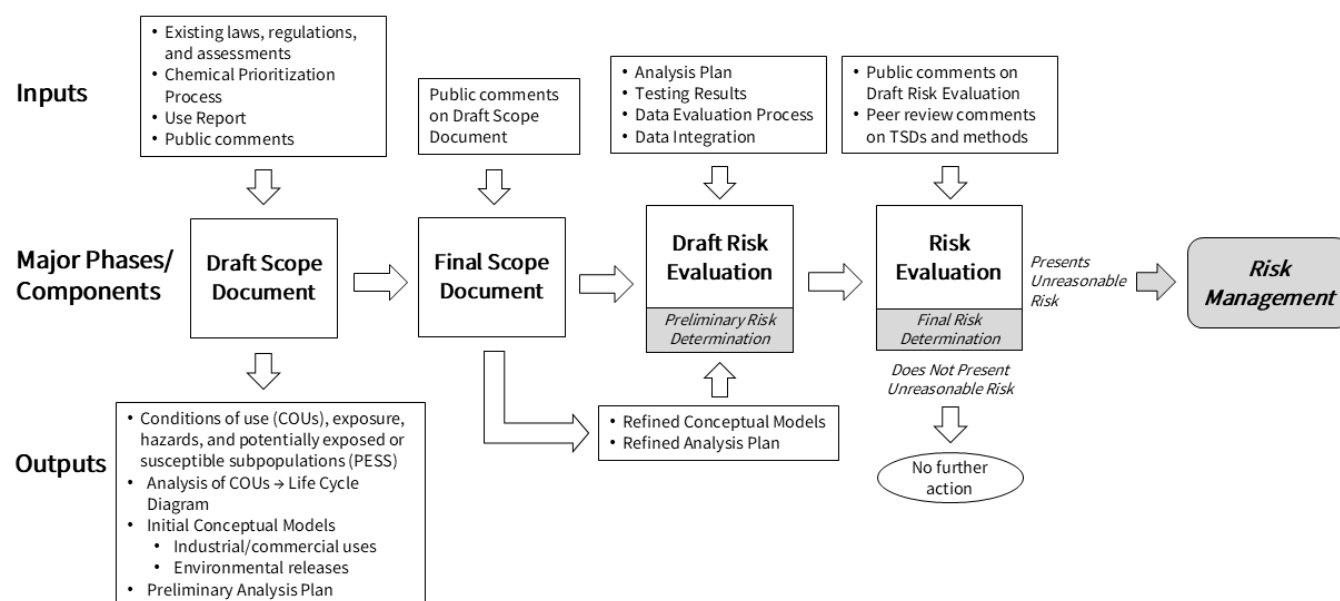


Figure 1-1. Overview of TSCA Existing Chemical Risk Evaluation Process

1.1 Scope of the Risk Evaluation

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

(also called the “draft CRA TSD” or “draft 2023 approach”) ([U.S. EPA, 2023d](#)), the Agency has also authored a draft cumulative risk technical support document for BBP and five other toxicologically similar phthalates (*i.e.*, diethylhexyl phthalate [DEHP], dibutyl phthalate [DBP], diisobutyl phthalate [DIBP], dicyclohexyl phthalate [DCHP], and diisononyl phthalate [DINP]) that are also being evaluated under TSCA based on a common toxicological endpoint (*i.e.*, *phthalate syndrome*, which results from decreased fetal testicular testosterone) ([U.S. EPA, 2025ad](#)). 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 more robust risk assessment of BBP and 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. Further, EPA’s proposal to conduct a CRA of phthalates under TSCA was supported by the Science Advisory Committee on Chemicals (SACC) 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. As described further in Section 4.4, cumulative risk considerations focus on acute duration exposures to the most susceptible subpopulations: female workers and consumers of reproductive age (16–49 years of age) as well as male infants and male children (3–15 years of age) exposed to consumer products and articles.

The draft BBP risk evaluation includes a series of technical support documents (TSDs). Each TSD contains sub-assessments that inform adjacent, “downstream” TSDs/assessments. A basic diagram showing the layout and relationship of these assessments is provided below in Figure 1-2, including which ones evaluate multiple phthalates. High-level summaries of each relevant TSD are presented in this draft risk evaluation; detailed information for each assessment can be found in the corresponding documents. Appendix C includes a list and citations for all TSDs and supplemental files included in the draft risk evaluation for BBP.

These TSDs and supporting documents leveraged the data and information sources already identified in the *Final Scope of the Risk Evaluation for Butyl Benzyl Phthalate (1,2-benzenedicarboxylic acid, 1-butyl 2-(phenylmethyl) ester)*; CASRN 85-68-7 (also referred to as the “final scope document” or “final scope”) ([U.S. EPA, 2020c](#)). OPPT conducted a comprehensive search for reasonably available information to identify relevant BBP data for use in the draft risk evaluation. The approach used to identify specific relevant risk assessment information was discipline-specific and is detailed in *Draft Systematic Review Protocol for Butyl Benzyl Phthalate (BBP)* ([U.S. EPA, 2025ac](#)), or as otherwise noted in the pertinent TSDs and supplemental documents and files.

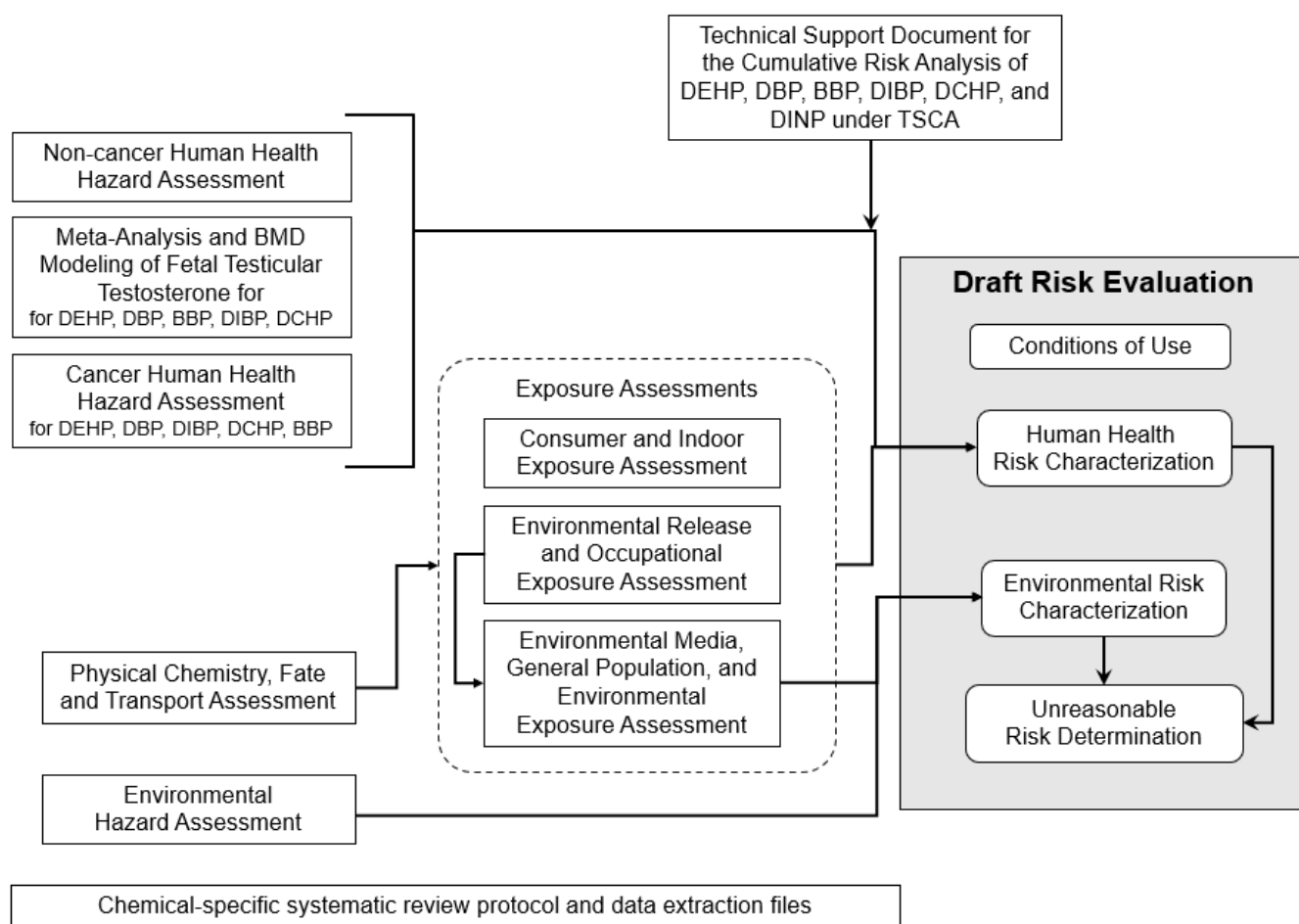


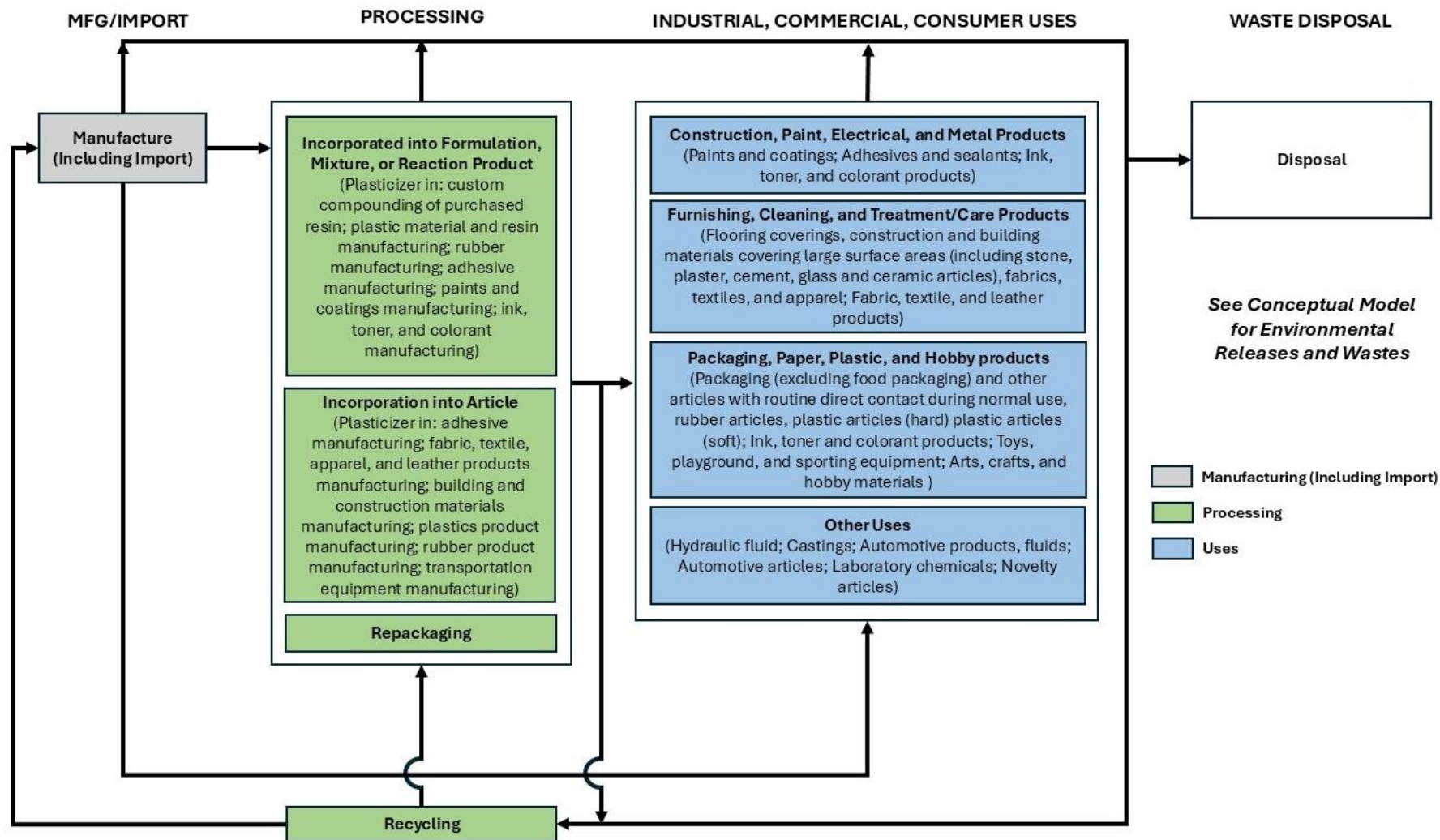
Figure 1-2. Draft Risk Evaluation Document Summary Map

1.1.1 Life Cycle and Production Volume

The LCD shown in Figure 1-3 depicts the COUs that are within the scope of the 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 document, with consolidated and/or expanded processing and use steps. A complete list of updates and explanations of the updates made to COUs for BBP from the release of the final scope document to this draft 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. The Agency collects CDR data approximately every 4 years with the latest collections occurring in 2006, 2012, 2016, 2020, and 2024. The 2024 CDR data was not available to be incorporated into this draft risk evaluation but may be considered in the finalized risk evaluation.

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 CDR descriptions provide a brief overview of the use category, whereas the *Draft Environmental Release and Occupational Exposure Assessment for Butyl Benzyl Phthalate* ([U.S. EPA, 2025t](#)) contains more detailed descriptions (e.g., process descriptions, worker activities, process flow diagrams, equipment illustrations) for each manufacturing, processing, use, and disposal category.

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Figure 1-3. BBP Life Cycle Diagram

See Table 1-1 for categories and subcategories of COUs. Activities related to distribution will be considered throughout the BBP life cycle, as well as qualitatively through a single distribution scenario.

The production volume for BBP between 2016 and 2019, which included manufacturing and imports, was between 1,000,000 to less than 20,000,000 lb based on the latest 2020 CDR data ([U.S. EPA, 2020b](#)). EPA described production volumes as a range to protect production volume data claimed as confidential business information (CBI). For the 2016 and 2020 CDR cycles, 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).

In the 2020 CDR, one site, Polymer Additives Inc., reported the manufacturing of BBP; this manufacturer claimed the production volume (PV) as CBI ([U.S. EPA, 2020b](#)), while two additional sites reported the import of BBP. EPA did not identify other data on current manufacturing sites or production volumes from systematic review. For the manufacturing site identified from CDR, EPA estimated the PV with a uniform distribution with bounds calculated by subtracting the known import volumes from the estimated national aggregate BBP PV from CDR.

CDR estimated a total national aggregate BBP PV between 1,000,000 to less than 20,000,000 lb. EPA subtracted the combined known PV from importers (611,115 lb) from each of these endpoints, resulting in a remaining import PV range of 388,885 to 19,388,885 lb. Therefore, EPA assumes that the possible manufacturing throughput for the one site that indicated manufacturing operations in CDR has a lower bound of 176,395 kg/year and an upper bound of 8,794,650 kg/year. For more information regarding BBP's PV, refer to section 3.1 of the *Draft Environmental Release and Occupational Exposure Assessment for Butyl Benzyl Phthalate (BBP)* ([U.S. EPA, 2025t](#)).

1.2 Conditions of Use Included in the Risk Evaluation

The final scope document ([U.S. EPA, 2020c](#)) 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 BBP included in this draft 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 BBP.

In this draft risk evaluation, EPA made updates to the COUs listed in the final scope document ([U.S. EPA, 2020c](#)). These updates reflect EPA's improved understanding of the COUs based on further outreach, public comments, and updated industry code names under the CDR for 2020. Updates include (1) additions and clarification of COUs based on new reporting in CDR for 2020 or information received from stakeholders; (2) consolidation of redundant COUs from the processing life stage based on inconsistencies found in CDR reporting for BBP processing and uses, and communications with stakeholders about the use of BBP in industry; and (3) correction of typos or edits for consistency. Appendix D provides a complete list of updates to the COUs between the final scope document and the draft risk evaluation and an explanation of these updates. EPA may further refine the COU descriptions for BBP that are included in the draft risk evaluation when the final risk evaluation for BBP is published, based upon further outreach, peer-review comments, and public comments. Table 1-1 presents the revised COUs that were included and evaluated in this draft risk evaluation for BBP.

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Table 1-1. Categories and Subcategories of Use in the Draft Risk Evaluation for BBP

Life Cycle Stage ^a	Category ^b	Subcategory ^c	References
Manufacturing	Domestic manufacturing	Domestic manufacturing	(U.S. EPA, 2020a , 2019b)
	Importing	Importing	(U.S. EPA, 2020a , 2019b)
Processing	Incorporation into formulation, mixture or reaction product	Plasticizers (custom compounding of purchased resin; plastic material and resin manufacturing; rubber manufacturing; adhesive manufacturing; paints and coatings manufacturing; ink, toner, and colorant manufacturing)	(U.S. EPA, 2020a , 2019b , f ; NLM, 2015 ; Ash and Ash, 2009)
		Laboratory chemical manufacturing	(SPEX CertiPrep, 2024 , 2023 , 2021 ; NASA, 2020)
	Incorporation into articles	Plasticizers (adhesive manufacturing; fabric, textile, apparel, and leather products manufacturing; building and construction materials manufacturing; plastics product manufacturing; rubber product manufacturing; transportation equipment manufacturing)	(U.S. EPA, 2020a ; AIA, 2019 ; MEMA, 2019 ; U.S. EPA, 2019b , f ; NLM, 2015 ; Ash and Ash, 2009)
	Repackaging	Repackaging	(U.S. EPA, 2020e)
	Recycling	Recycling	(Lowe et al., 2021)
Distribution in Commerce	Distribution in commerce	Distribution in commerce	
Industrial Use	Construction, paint, electrical, and metal products	Paints and coatings	(AIA, 2019 ; U.S. EPA, 2019b)
		Adhesives and sealants	(U.S. EPA, 2020a ; AIA, 2019 ; U.S. EPA, 2019b)
	Packaging, paper, plastic, hobby products	Ink, toner and colorant products	(Identity Group, 2017 ; NLM, 2015)
	Other uses	Hydraulic fluid	(U.S. EPA, 2020d)
		Castings	(Smooth-On, 2023a ; NASA, 2020 ; U.S. EPA, 2020a)
		Automotive products, fluids	(MEMA, 2019 ; NLM, 2015)
		Automotive articles	(ACC, 2019 ; MEMA, 2019 ; NLM, 2015)

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Life Cycle Stage ^a	Category ^b	Subcategory ^c	References
Commercial Use	Construction, paint, electrical, and metal products	Paints and coatings	(U.S. EPA, 2019b)
		Adhesives and sealants	(U.S. EPA, 2020a , 2019b)
	Furnishing, cleaning, treatment/care products	Flooring coverings; Construction and building materials covering large surface areas including stone, plaster, cement, glass and ceramic articles; fabrics, textiles, and apparel	(U.S. EPA, 2019b)
		Fabric, textile, and leather products	(NLM, 2015)
	Packaging, paper, plastic, hobby products	Packaging (excluding food packaging) and other articles with routine direct contact during normal use, rubber articles; plastic articles (hard); plastic articles (soft)	(AIA, 2019 ; NLM, 2015)
		Ink, toner and colorant products	(NLM, 2015)
		Toys, playground, and sporting equipment	(U.S. EPA, 2024j , k , 2019e , f ; CPSC, 2015a)
	Other uses	Laboratory chemical	(SPEX CertiPrep, 2024 , 2023 , 2021 ; NASA, 2020 ; Sigma-Aldrich, 2019)
		Castings	(Smooth-On, 2023a ; BJB Enterprises, 2022 , 2021a)
		Automotive products, fluids	(Permatex, 2020 ; MEMA, 2019 ; Armored AutoGroup Inc., 2015)
		Automotive articles	(ACC, 2019 ; MEMA, 2019 ; U.S. EPA, 2019f ; NLM, 2015)
Consumer Use	Construction, paint, electrical, and metal products	Paints and coatings	(Ford Motor Company, 2019 ; Multi-Tech Products Corp, 2015)
		Adhesives and sealants	(U.S. EPA, 2020a , 2019b)
	Furnishing, cleaning, treatment/care products	Fabric, textile, and leather products	(NLM, 2015)
		Floor coverings; Construction and building materials covering large surface areas including stone, plaster, cement, glass and ceramic articles; fabrics, textiles, and apparel	(U.S. EPA, 2020a , 2019b)
		Arts, crafts, and hobby materials	(BJB Enterprises, 2022 , 2021a)

Life Cycle Stage ^a	Category ^b	Subcategory ^c	References
Consumer Use	Packaging, paper, plastic, hobby products	Toys, playground, and sporting equipment	(U.S. EPA, 2024j , k , 2019e , f ; CPSC, 2015a)
		Ink, toner, and colorant products	(NLM, 2015)
		Packaging (excluding food packaging) and other articles with routine direct contact during normal use, rubber articles; plastic articles (hard); plastic articles (soft)	(NLM, 2015)
	Other uses	Automotive products, fluids	(Permatex, 2020 ; MEMA, 2019 ; Armored AutoGroup Inc., 2015)
		Automotive articles	(ACC, 2019 ; MEMA, 2019 ; U.S. EPA, 2019f ; NLM, 2015)
		Novelty articles	(Sipe et al., 2023)
Disposal	Disposal	Disposal	
^a Life Cycle Stage Use Definitions (40 CFR 711.3) – “Industrial use” means use at a site at which one 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 refer to both. ^b These categories of COUs appear in the LCD, reflect CDR codes , and broadly represent COUs of BBP in industrial and/or commercial settings. ^c These subcategories represent more specific activities within the LCD stage and category of the COUs of BBP.			

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 BBP. There is potential for exposures to workers and/or ONUs via inhalation and via dermal contact. The conceptual model also includes potential ONU dermal exposure to BBP from 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.

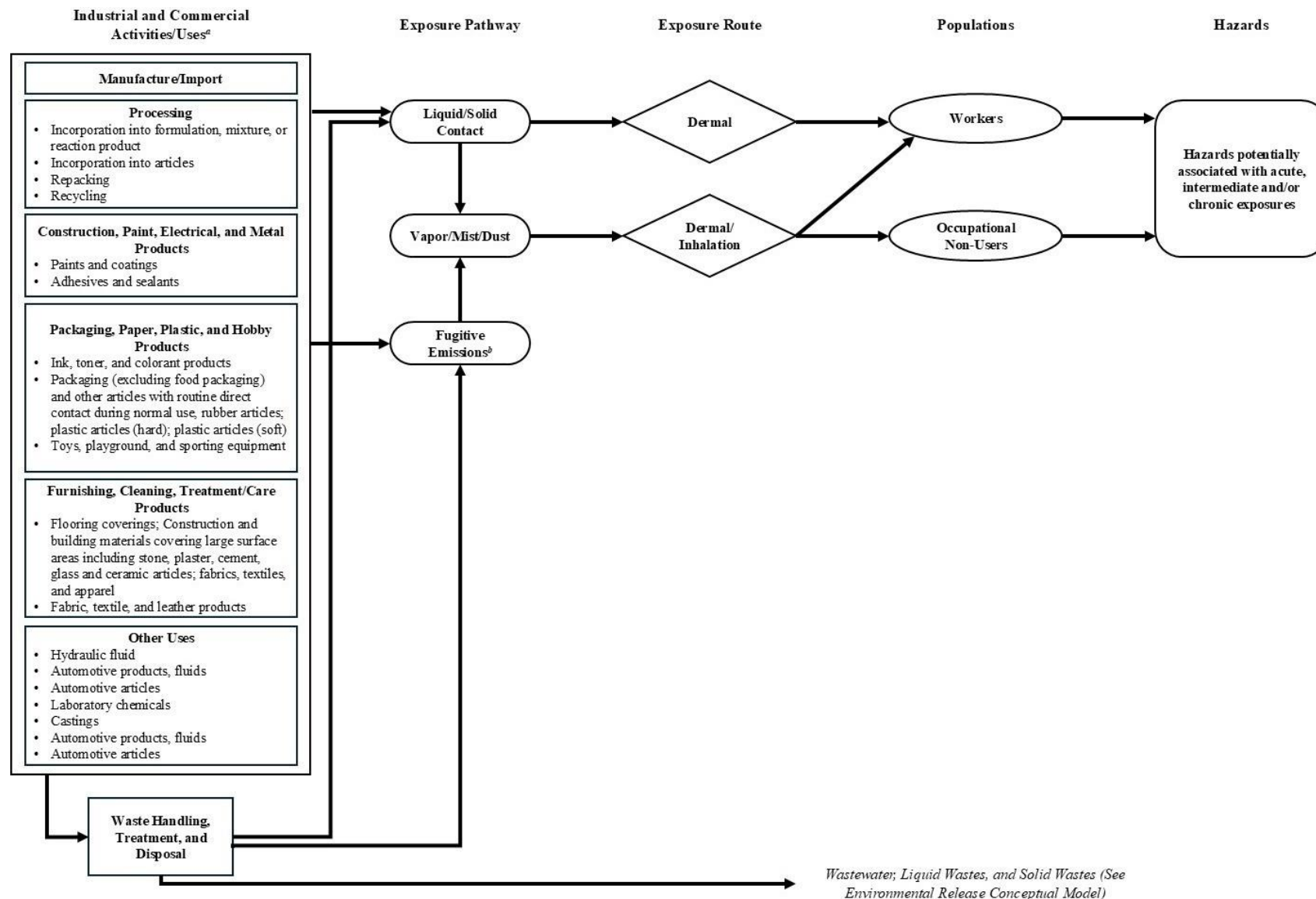


Figure 1-4. BBP Conceptual Model for Industrial and Commercial Activities and Uses: Potential Exposure and Hazards

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

^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, open vessels, and open-ended lines; evaporative losses from surface impoundment and spills; and releases from building ventilation systems.

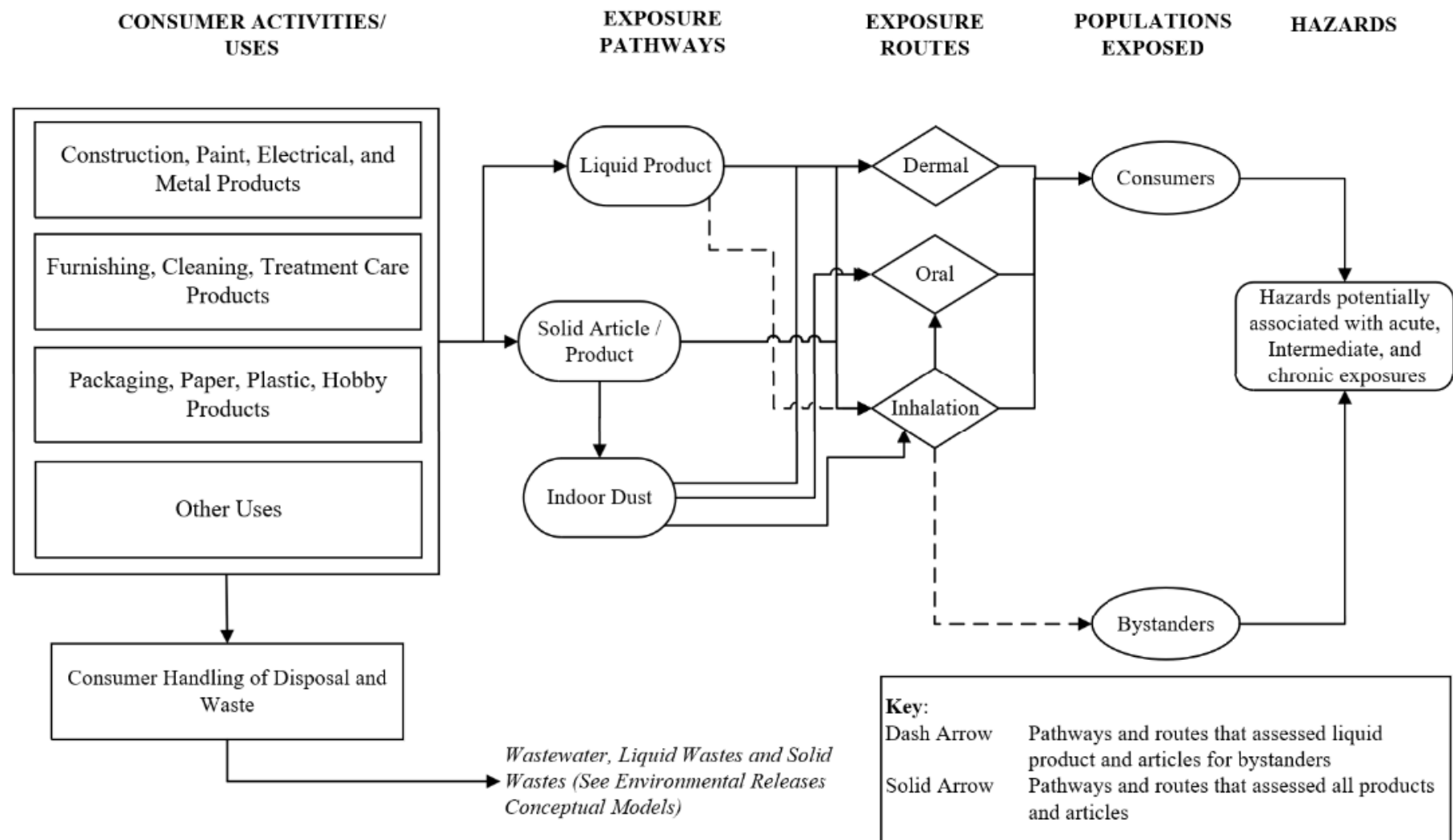


Figure 1-5. BBP Conceptual Model for Consumer Activities and Uses: Potential Exposures and Hazards

The conceptual model presents the exposure pathways, exposure routes, and hazards to human populations from consumer activities and uses of BBP.

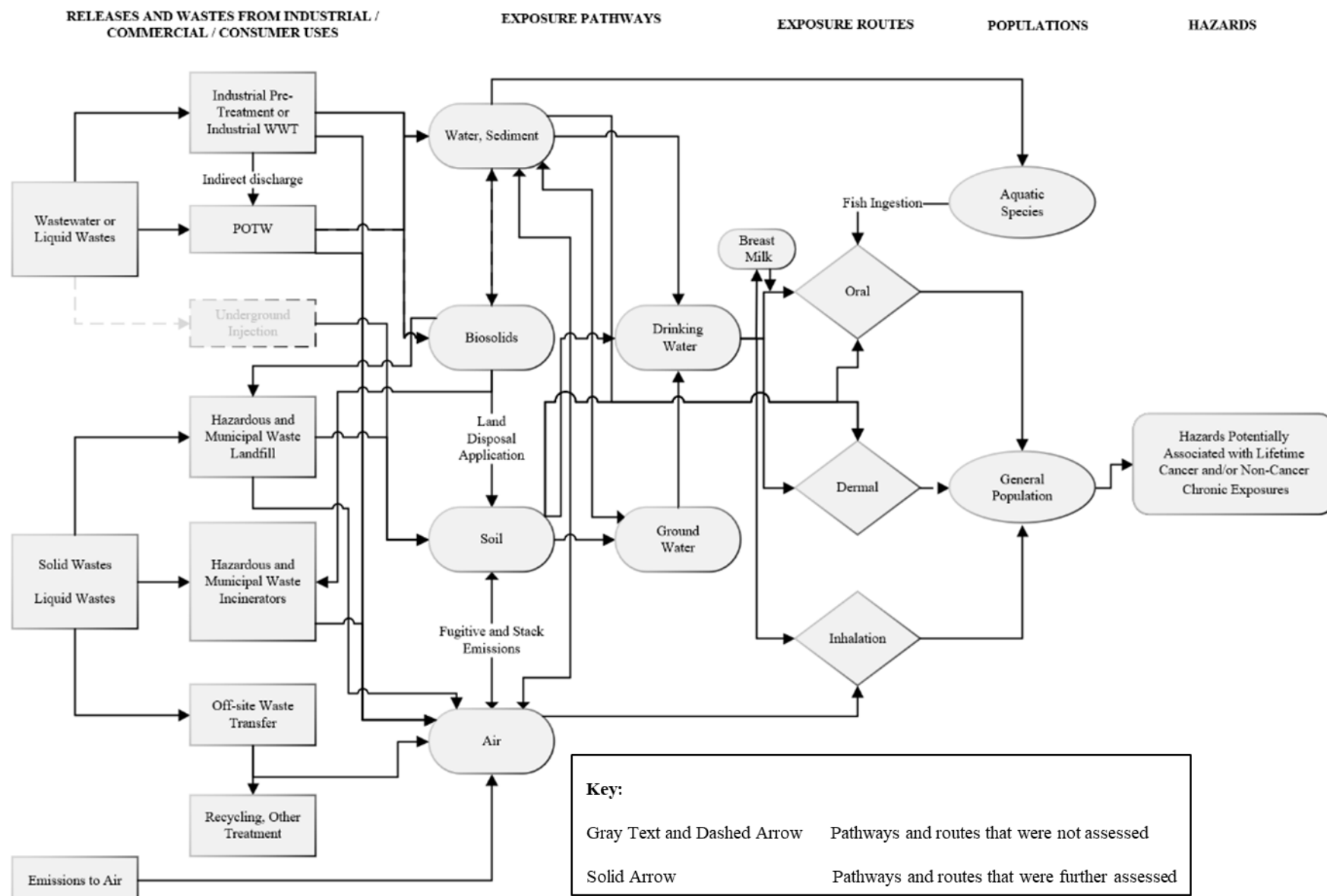


Figure 1-6. BBP Conceptual Model for Environmental Releases and Wastes: General Population Hazards

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 BBP.

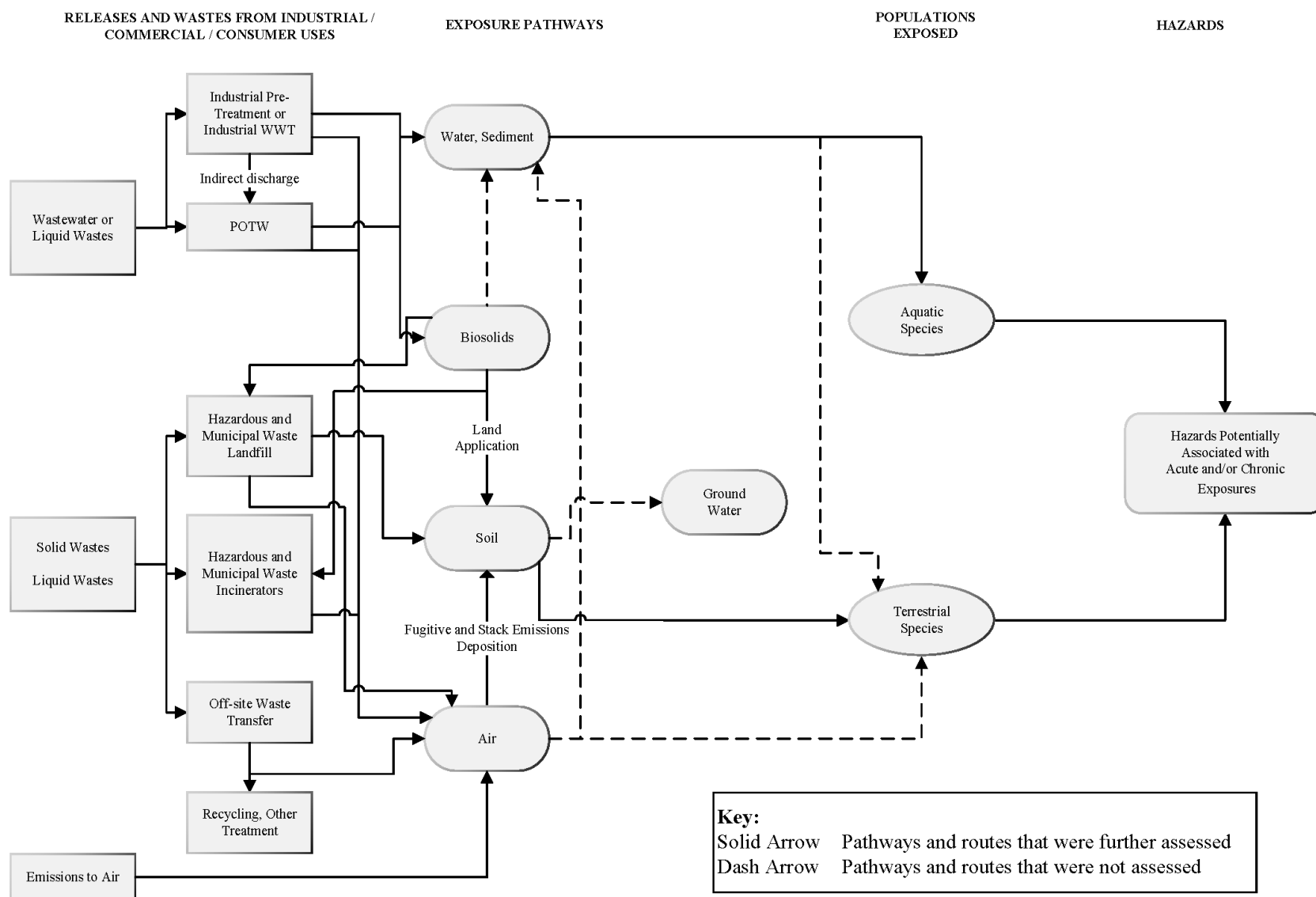


Figure 1-7 BBP Conceptual Model for Environmental Releases and Wastes: Ecological Exposures and Hazards

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 BBP.

1.2.2 Populations and Durations of Exposure Assessed

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

- Workers, including average adult workers, and the subset of women of reproductive age;
- ONUs;
- 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); and
- 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).

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 the 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, 2023d](#)), EPA is focusing its relative potency factor (RPF) analysis and phthalate CRA on populations most relevant to the common hazard endpoint (i.e., reduced fetal testicular testosterone)—specifically women 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 DBP ([U.S. EPA, 2024c](#)), DCHP ([U.S. EPA, 2024d](#)), DEHP ([U.S. EPA, 2024e](#)), BBP ([U.S. EPA, 2025v](#)), DIBP ([U.S. EPA, 2025w](#)), and DINP ([U.S. EPA, 2024h](#)). Additionally, EPA is focusing its RPF and CRA on acute duration exposures. This is because—as described further in the Revised Draft Technical Support Document for the CRA of DEHP, DBP, BBP, DIBP, DCHP, and DINP under TSCA (also called the “draft revised TSD for CRA”) ([U.S. EPA, 2025ad](#))—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. These effects are expected to be protective of the less sensitive health effects in the full population.

1.2.2.1 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 non-risk factors, including an unreasonable risk to a potentially exposed or susceptible subpopulation identified as relevant to the risk evaluation by the Administrator, under the conditions of use.” TSCA section 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 draft 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: women of reproductive age, pregnant women, infants, children and adolescents, people who frequently use consumer products and/or articles containing high concentrations of BBP, people exposed to BBP in the workplace, and tribes whose diets include large amounts of fish. These subpopulations are PESS because some have greater exposure to BBP per body weight (*e.g.*, infants, children, adolescents) or due to age-specific behaviors (*e.g.*, mouthing of toys, wires, and erasers by infants and children, assessed in the consumer exposure scenarios), whereas some experience aggregate or sentinel exposures. EPA also evaluated non-attributable cumulative exposures (*e.g.*, exposures determined from urinary biomonitoring that cannot be tied to a specific source) and cumulative risk to phthalates (*i.e.*, DEHP, DBP, BBP, DIBP, and DINP) 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 considered as part of EPA's cumulative risk calculations for BBP, presented below in Sections 4.4.4 and 4.4.5 for occupational and consumer COUs/OESs (occupational exposure scenarios) for BBP.

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.

1.3 Organization of the Risk Evaluation

This draft risk evaluation for BBP comprises the following five additional major sections and six appendices:

- Section 2 summarizes basic physical and chemical characteristics as well as the fate and transport of BBP.
- Section 3 provides an overview of releases and concentrations of BBP in the environment.
- Section 4 presents the human health risk assessment, including the exposure, hazard, and risk characterization based on the 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 the draft risk evaluation. Finally, it presents cumulative risk estimates from exposure to BBP, DEHP, DBP, DIBP, DCHP, and DINP (Section 4.4) as well as a comparison of the individual BBP risk assessment and the draft 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 BBP. It also discusses assumptions and uncertainties and how they potentially impact the strength of the evidence of the draft risk evaluation.
- Section 6 presents EPA's proposed determination of whether BBP 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 draft risk evaluation.
- Appendix B provides a brief summary of the federal, state, and international regulatory history of BBP.
- Appendix C includes citations for all TSDs and supplemental files included in the draft risk evaluation for BBP.
- Appendix D provides a summary of updates made to COUs for BBP from the final scope document to this draft risk evaluation.
- Appendix E provides descriptions of the BBP COUs evaluated by EPA.
- Appendix F provides the draft occupational exposure value for BBP derived by EPA.

2 CHEMISTRY AND FATE AND TRANSPORT OF BBP

Physical and chemical properties determine the behavior and characteristics of a chemical that inform its condition of use, environmental fate and transport, potential toxicity, exposure pathways, routes, and hazards. Environmental fate and transport include 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 BBP informs the specific exposure pathways, and potential human and environmental exposed populations that EPA considered in this risk evaluation.

In general, under normal environmental conditions BBP is a water-soluble oily liquid that (1) is slightly volatile from water, (2) has low bioaccumulation potential in aquatic and terrestrial organisms, (3) has no apparent biomagnification across trophic levels in aquatic food webs, and (4) is considered readily biodegradable under most aquatic and terrestrial environmental conditions. Sections 2.1 and 2.2 summarize the physical and chemical properties, and environmental fate and transport of BBP, respectively. EPA's *Draft Physical Chemistry and Fate and Transport Assessment for Butyl Benzyl Phthalate (BBP)* ([U.S. EPA, 2025z](#)) provides further details.

2.1 Summary of Physical and Chemical Properties

EPA gathered and evaluated physical and chemical property data and information according to process described in the *Draft Systematic Protocol for Butyl Benzyl Phthalate (BBP)* ([U.S. EPA, 2025ac](#)). 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 *Draft Data Quality Evaluation and Data Extraction Information for Environmental Fate and Transport for Butyl Benzyl Phthalate (BBP)* ([U.S. EPA, 2025i](#)).

Table 2-1. Physical and Chemical Properties of BBP

Property	Selected Value(s) ^a	Reference(s)	Overall Data Quality Rating
Molecular formula	C ₁₉ H ₂₀ O ₄	—	—
Molecular weight	312.37 g/mol	—	—
Physical form	Clear, liquid oil; slight odor	NLM (2015)	High
Melting point	−35 °C	NLM (2015)	High
Boiling point	370 °C	NLM (2015) citing Haynes (2014)	High
Density	1.119 g/cm ³	NLM (2015) citing Haynes (2014)	High
Vapor pressure	8.25E−06 mmHg at 25 °C	NLM (2015) citing Howard et al. (1985)	High
Vapor density	10.8 (air = 1)	NLM (2015)	High
Water solubility	2.69 mg/L at 25 °C	NLM (2015) citing Howard et al. (1985)	High
Octanol:water partition coefficient (log K _{ow})	4.73	NLM (2015)	High
Octanol:air partition coefficient (log K _{OA})	9.2 ^b	U.S. EPA (2017)	High

Property	Selected Value(s) ^a	Reference(s)	Overall Data Quality Rating
Henry's Law constant	7.61E-07 atm·m ³ /mol at 25 °C	Elsevier (2019)	High
Flash point	199 °C	NLM (2015)	High
Autoflammability	233–425 °C	NCBI (2020) ; (ECJRC, 2008, 2007 ; NTP, 1997b)	Medium
Viscosity	55 cP at 20 °C	Elsevier (2019)	High
^a Measured unless otherwise noted.			
^b Information was estimated using EPI Suite™ U.S. EPA (2017) .			

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 water sources, and organic carbon:water partition coefficient (log K_{OC})—are parameters used in the current risk evaluation. In assessing the environmental fate and transport of BBP, EPA considered the full range of results from the available highest quality data sources obtained during systematic review. Information on the full extracted dataset is available in the *Draft Data Quality Evaluation and Data Extraction Information for Environmental Fate and Transport for Butyl Benzyl Phthalate (BBP)* ([U.S. EPA, 2025i](#)). Other fate estimates were based on modeling results from EPI Suite™ ([U.S. EPA, 2012a](#)), a predictive tool for physical and chemical properties and environmental fate estimation. Information regarding the model inputs is available in the *Draft Physical Chemistry and Fate and Transport Assessment for Butyl Benzyl Phthalate (BBP)* ([U.S. EPA, 2025z](#)).

EPA evaluated the reasonably available information to characterize the environmental fate and transport of BBP, the key points of the fate assessment for BBP ([U.S. EPA, 2025z](#)) are summarized below and listed in Table 2-2.

Given the consistent results from numerous high-quality studies, there is robust evidence that BBP:

- will partition to organic carbon and particulate matter in air, with a measured vapor pressure of 8.25×10⁻⁶ mmHg ([NLM, 2015](#); [Howard et al., 1985](#)) and a log K_{OA} of 9.2 ([U.S. EPA, 2017](#));
- will readily biodegrade in aerobic, aqueous environments including during wastewater treatment and in surface waters
 - biodegradation rates of BBP in water will depend on the microbial community, organic matter presence, and previous exposure/adaptation to BBP;
- will readily biodegrade in aerobic surface sediments; however, fractions bound to sediment are expected to present longer persistence until release by a shift in equilibrium;
- is expected to biodegrade under anaerobic conditions; however, this process is expected to generally occur more slowly than under aerobic conditions
 - as with aerobic biodegradation, anaerobic biodegradation rates of BBP likely depend on the microbial community, organic matter presence, and previous exposure/adaptation to BBP;
- will be removed in wastewater treatment plants at 40 to 90 percent, with sorption to sludge and biodegradation both being significant removal mechanisms;
- presents low bioconcentration potential in fish; however, monophthalates (monobutyl and

monobenzyl phthalate) exhibited slightly elevated bioconcentration potential as compared to parent BBP;

- will not biomagnify and will exhibit trophic dilution in aquatic species;
- based on BBP's biodegradation potential, low bioconcentration and biomagnification potentials for BBP is expected to present low bioaccumulation potential in aquatic species;
- is likely to be present in biosolids, although is unlikely to be persistent or mobile in soils after land application of biosolids given its K_{OC} , water solubility, and biodegradation processes;
- will not exhibit substantial mobility to groundwater from soil or landfill environments, and will tend to stay sorbed to solid organics in soil media and landfills; and
- is likely to be found in household dust.

As a result of limited reasonably available studies identified, there is moderate confidence that BBP:

- will not exhibit persistence in air, and will undergo indirect photodegradation by reacting with hydroxyl radicals ($\cdot OH$) in the atmosphere with a half-life of 1.13 to 1.15 days;
- will be removed in conventional drinking water treatment systems;
- may show persistence in surface water, sediment, and soil proximal to continuous points of release in cases where the release rate exceeds the rate of biodegradation;
- does not biodegrade in anaerobic environments;
- will undergo aerobic and anaerobic biodegradation in soil and landfill media under conducive conditions;
- is expected to have a low tendency to migrate to groundwater; however, explicit groundwater fate studies are limited for BBP; and
- will not undergo appreciable hydrolysis in aqueous systems, because biodegradation is expected to occur much more rapidly under most conditions; however, hydrolysis can be important in deep, acidic, thermophilic landfill environments.

Findings with a robust weight of scientific evidence had one or more high-quality studies that were largely in agreement with each other. Findings with a moderate weight of scientific evidence were based on a mix of high- and medium-quality studies that were largely in agreement but varied in sample size and consistency of findings.

Table 2-2. Summary of Environmental Fate Information for BBP

Property or Endpoint	Value(s)	Reference(s)	Overall Data Quality Rating
Direct photolysis (air)	Contains chromophores that absorb light at >290 nm wavelength	NCBI (2020)	High
Direct photolysis (water)	1%/28 days; aqueous solutions of test material were exposed to ca. 251 hours of sunshine in tightly sealed quartz test tubes.	Monsanto (1983c)	High
Indirect photolysis (air)	$t_{1/2} = 23.3$ hours (based on $\cdot OH$ reaction rate constant of $1.10E-11$ $cm^3/mol \cdot sec$ and $1.5E06$ $\cdot OH/cm^3$) ^a	U.S. EPA (2017)	High
	$t_{1/2} = 18$ hours (based on $\cdot OH$ reaction rate constant of $1.1049E-11$ $cm^3/mol \cdot sec$ and $1.5E06$ $\cdot OH/cm^3$; calculation)	Peterson and Staples (2003)	Medium

Property or Endpoint	Value(s)	Reference(s)	Overall Data Quality Rating
Hydrolysis	t _{1/2} at pH 7: 1.4 years at 25 °C (estimated) ^a t _{1/2} at pH 8: 51 days at 25 °C (estimated) ^a	U.S. EPA (2017)	High
	t _{1/2} at pH 5: 1.2 years at 25 °C t _{1/2} at pH 6: 1.6 years at 25 °C t _{1/2} at pH 7: 4.1 years at 25 °C t _{1/2} at pH 8: 1.3 years at 25 °C t _{1/2} at pH 9: 1.1 years at 25 °C	Lertsirisopon et al. (2009)	Medium
Biodegradation	Readily biodegradable (half-life of days to weeks)	Desai et al. (1990) ; U.S. EPA (2017)	High
Wastewater treatment	Expected removal between 40–90%	Salaudeen et al. (2018) ; U.S. EPA (1982) ; Tran et al. (2014)	High
Bioconcentration factor	Low bioconcentration potential (BCF = 1.1–663)	Carr et al. (1997) ; Monsanto (1983a) ; Barrows et al. (1980)	High
Bioaccumulation factor	Low bioconcentration potential (BAF = 40 L/kg estimated; Arnot-Gobas method, upper trophic)	U.S. EPA (2017)	High
Biota sediment accumulation factor	Some sediment bioaccumulation potential (BSAF = 2–20)	Huang et al. (2008) ; Teil et al. (2012)	High
Trophic magnification factor	Trophic dilution (TMF = 0.77)	Mackintosh et al. (2004)	High
Organic carbon:water partition coefficient (Log K _{OC})	Mean soil/sediment log K _{OC} = 4.86 L/kg (n = 4 studies)	Monsanto (1983b) ; Russell and Mcduffie (1986) ; Xu and Li (2009) ; Mackintosh et al. (2006)	High
^a Modeled value using EPI Suite™ (U.S. EPA, 2017).			

3 RELEASES AND CONCENTRATIONS OF BBP IN THE ENVIRONMENT

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

3.1 Approach and Methodology

This section provides an overview of the approach and methodology for assessing releases to the environment from manufacturing, processing, 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 manufacturing, processing, industrial, and commercial uses. Section 3.1.4 describes why releases from down-the-drain and landfill dispels associated with consumer uses were not evaluated quantitatively.

3.1.1 Manufacturing, Processing, Industrial, and Commercial

This subsection describes the grouping of manufacturing, processing, industrial, and commercial COUs into OESs as well as the use of BBP within each OES. Specifically, Section 3.1.1.1 provides a crosswalk of COUs to OESs, and Section 3.1.1.2 provides descriptions for the use of BBP 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 provides a crosswalk between the COUs and OESs and Table 3-2 provides the reverse; a crosswalk of OESs to COUs. 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, EPA defined only a single OES for multiple COUs, whereas 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 *Draft Environmental Release and Occupational Exposure Assessment for Butyl Benzyl Phthalate (BBP)* ([U.S. EPA, 2025t](#)) provides further information on specific OESs.

For the purpose of this draft risk evaluation, distribution in commerce is the transportation of BBP containing products and articles between sites at which BBP manufacturing, processing, and use occurs or the transportation of BBP-containing wastes for recycling or disposal. EPA expects all of the above-mentioned materials to be transported in closed system or otherwise to be transported in a form (*e.g.*, articles containing BBP) such that there is negligible potential for releases except during an incident. Therefore, the Agency did not assess environmental releases of and occupational exposure to BBP as a result of distribution in commerce.

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

COU			OES(s) ^d
Life Cycle Stage ^a	Category ^b	Subcategory ^c	
Manufacturing	Domestic manufacturing	Domestic manufacturing	Manufacturing
	Importing	Importing	Import and repackaging
Processing	Repackaging	Repackaging	Import and repackaging
	Processing – incorporation into formulation, mixture, or reaction product	Plasticizers (custom compounding of purchased resin; plastic material and resin manufacturing; rubber manufacturing; adhesive manufacturing; paints and coatings manufacturing; ink, toner, and colorant manufacturing)	Formulation into adhesives and sealants; Formulation into paints and coatings; Incorporation into other formulation, mixture, or reaction products; Non-PVC material compounding; PVC plastics compounding
		Laboratory chemical manufacturing	Incorporation into other formulations, mixtures, or reaction products
	Processing – incorporation into articles	Plasticizers (adhesive manufacturing; fabric, textile, apparel, and leather products manufacturing; building and construction materials manufacturing; plastics product manufacturing; rubber product manufacturing; transportation equipment manufacturing)	PVC plastics converting; Non-PVC material converting
	Recycling	Recycling	Recycling
Distribution	Distribution in commerce	Distribution in commerce	Distribution in commerce
Industrial Use	Construction, paint, electrical, and metal products	Paints and coatings	Application of paints and coatings
		Adhesives and sealants	Application of adhesives and sealants
	Packaging, paper, plastic, hobby products	Ink, toner and colorant products	Application of paints and coatings
	Other uses	Hydraulic fluids	Use of lubricants and functional fluids
		Castings	Non-PVC material compounding; Non-PVC material converting
		Automotive products, fluids	Use of lubricants and functional fluids
		Automotive articles	Fabrication of final product from articles
Commercial Use	Construction, paint, electrical,	Paints and coatings	Application of paints and coatings

COU			OES(s) ^d
Life Cycle Stage ^a	Category ^b	Subcategory ^c	
Commercial Use	and metal products	Adhesives and sealants	Application of adhesives and sealants
	Furnishing, cleaning, treatment/care products	Floor coverings; Construction and building materials covering large surface areas including stone, plaster, cement, glass and ceramic articles; fabrics, textiles, and apparel	Fabrication of final product from articles
		Fabric, textile, and leather products	Fabrication of final product from articles
	Packaging, paper, plastic, hobby products	Packaging (excluding food packaging) and other articles with routine direct contact during normal use, rubber articles; plastic articles (hard); plastic articles (soft)	Fabrication of final product from articles
		Inks, toner and colorant products	Application of paints and coatings
		Toys, playground, and sporting equipment	Fabrication of final product from articles
	Other uses	Laboratory chemical	Use of laboratory chemicals
		Castings	Non-PVC material compounding; Non-PVC material converting
		Automotive products, fluids	Use of lubricants and functional fluids
		Automotive articles	Fabrication of final product from articles
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 one or more chemicals or mixtures are manufactured (including imported) or processed. – “Commercial use” means the use of a chemical or a mixture containing a chemical (including as part of an article) in a commercial enterprise providing saleable goods or services. – “Consumer use” means the use of a chemical or a mixture containing a chemical (including as part of an article, such as furniture or clothing) when sold to or made available to consumers for their use. – Although EPA has identified both industrial and commercial uses here for purposes of distinguishing scenarios in this document, the Agency interprets the authority over “any manner or method of commercial use” under TSCA section 6(a)(5) to reach both. ^b These categories of conditions of use appear in the life cycle diagram, reflect CDR codes, and broadly represent COUs of BBP in industrial and/or commercial settings. ^c These subcategories represent more specific activities within the life cycle stage and category of the COUs of BBP. ^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 COUs (multiple COUs mapped to single OES), or there may be several ways in which releases/exposures take place for a given COU use (single COU mapped to multiple OESs).			

999 **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
Incorporation into adhesives and sealants	Processing	Incorporation into formulation, mixture, or reaction product	Adhesive manufacturing
Incorporation into paints and coatings	Processing	Incorporation into formulation, mixture, or reaction product	Paints and coatings manufacturing
Incorporation into other formulations, mixtures, and reaction products	Processing	Incorporation into formulation, mixture, or reaction product	Ink, toner, and colorant manufacturing
			Laboratory chemical manufacturing
PVC plastics compounding	Processing	Incorporation into formulation, mixture, or reaction product	Plasticizers (custom compounding of purchased resin; plastic material and resin manufacturing)
PVC plastics converting	Processing	Incorporation into articles	Plasticizers (adhesive manufacturing; fabric, textile, apparel, and leather products manufacturing; building and construction materials manufacturing; plastics product manufacturing; transportation equipment manufacturing)
Non-PVC material compounding	Processing	Incorporation into formulation, mixture, or reaction product	Plasticizers (custom compounding of purchased resin; resin manufacturing; rubber manufacturing)
	Industrial Use	Other uses	Castings
	Commercial Use	Other uses	Castings
Non-PVC material converting	Processing	Incorporation into articles	Plasticizers (adhesive manufacturing; fabric, textile, apparel, and leather products manufacturing; building and construction materials manufacturing; rubber product manufacturing; transportation equipment manufacturing)
	Industrial Use	Other uses	Castings
	Commercial Use	Other uses	Castings
Application of adhesives and sealants	Industrial Use	Construction, paint, electrical, and metal products	Adhesives and sealants
Application of adhesives and sealants	Commercial Use	Construction, paint, electrical, and metal products	Adhesives and sealants

OES ^a	COU		
	Life Cycle Stage ^b	Category ^c	Subcategory ^d
Application of paints and coatings	Industrial Use	Construction, paint, electrical, and metal products	Paints and coatings
		Packaging, paper, plastic, hobby products	Ink, toner and colorant products
	Commercial Use	Construction, paint, electrical, and metal products	Paints and coatings
		Packaging, paper, plastic, hobby products	Ink, toner and colorant products
Use of laboratory chemicals	Commercial Use	Other uses	Laboratory chemical
Use of lubricants and functional fluids	Industrial Use	Other uses	Hydraulic fluids
			Automotive products, fluids
	Commercial Use	Other uses	Automotive products, fluids
Recycling	Processing	Recycling	Recycling
Fabrication of final product from articles	Industrial Use	Other uses	Automotive articles
	Commercial Use	Furnishing, cleaning, treatment/care products	Floor coverings; Construction and building materials covering large surface areas including stone, plaster, cement, glass and ceramic articles; fabrics, textiles, and apparel
			Fabric, textile, and leather products
	Commercial Use	Packaging, paper, plastic, hobby products	Packaging (excluding food packaging) and other articles with routine direct contact during normal use, rubber articles; plastic articles (hard); plastic articles (soft)
			Toys, playground, and sporting equipment
		Other uses	Automotive articles
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 COU (multiple COUs mapped to single OES), or there may be several ways in which releases/exposures take place for a given COU (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 one 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.

OES ^a	COU		
	Life Cycle Stage ^b	Category ^c	Subcategory ^d
– 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 COUs appear in the life cycle diagram, reflect CDR codes, and broadly represent COUs of BBP in industrial and/or commercial settings. ^d These subcategories represent more specific activities within the life cycle stage and category of the COUs of BBP.			

3.1.1.2 Description of BBP Use for Each OES

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

Table 3-3. Description of the Function of BBP for Each OES

OES	Role/Function of BBP
Manufacturing	Formed through the reaction of the monobutyl ester of phthalic acid with benzyl alcohol or by reaction with benzyl chloride in the presence of an acid catalyst. The monobutyl ester can be produced through reaction of phthalic anhydride with <i>n</i> -butyl alcohol, before reaction with benzyl chloride or benzyl alcohol to produce BBP (CPSC, 2015b).
Import and repackaging	BBP is imported domestically for use and/or may be repackaged before shipment to formulation sites.
Incorporation into adhesives and sealants	BBP is a plasticizer in adhesive and sealant products for industrial and commercial use.
Incorporation into paints and coatings	BBP is an additive in paint and coating products for industrial and commercial use.
Incorporation into other formulations, mixtures, or reaction products, not covered elsewhere	BBP is used in the formulation of ink, toner, and colorant products.
PVC plastics compounding	BBP is used as an additive in PVC plastics to increase flexibility.
PVC plastics converting	
Non-PVC material compounding	BBP is used in non-PVC polymers, such as rubber, to increase flexibility.
Non-PVC material converting	
Application of adhesives and sealants	Industrial and commercial sites apply BBP-containing adhesive and sealant products using application equipment such as a caulk gun, syringe, or similar device and then cured to form a final solid product (OECD, 2015a).
Application of paints and coatings	Commercial sites apply BBP-containing paints and coatings using roll, brush, trowel, and spray application methods.
Use of laboratory chemicals	BBP is a laboratory chemical used for laboratory analyses in solid and liquid forms.
Use of lubricants and functional fluids	BBP included in lubricant/hydraulic fluid products are unloaded when ready for changeout at end use sites.
Recycling	BBP is primarily recycled industrially in the form of BBP-containing PVC/plastic waste streams.

OES	Role/Function of BBP
Fabrication of final products from articles	BBP may be found in a wide array of different final articles not found in other OESs such as vinyl floor tiles, vinyl wallpaper, and products used in transportation equipment manufacturing.
Waste handling, treatment, and disposal	Upon fabrication or use of BBP-containing products, residual chemicals are disposed and released to air, wastewater, or disposal facilities.
Distribution in commerce	Distribution in commerce consists of the transportation associated with the moving of BBP-containing products and/or articles between sites manufacturing, processing, and use COUs, or the transportation of BBP containing wastes to recycling sites or for final disposal.

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

The number of release days associated with the releases is included in the release tables for different OES in Section 3 of the *Draft Environmental Release and Occupational Exposure Assessment for Butyl Benzyl Phthalate (BBP)* ([U.S. EPA, 2025t](#)). Unless EPA identified conflicting information, EPA assumed that the number of release days per year for a given release source equals the number of operating days at the facility. EPA used generic Scenarios (GSs), emission scenario documents (ESDs), and other literature sources obtained through systematic review to assess the number of operating days for a given OES. When Monte Carlo modeling was performed to estimate releases, a discrete value or a range of values for the number of release days was input to the Monte Carlo simulation, depending on what is known about the scenario. The model generated the 50th and 95th percentiles of operating days which was associated with the central tendency and high-end estimates of releases respectively. The number of release days used in the assessment is expected to be reasonable since EPA used information directly reported by facilities or information from sources obtained through the Agency's systematic review process.

3.1.3 Daily Release Estimation

For each OES, EPA estimated releases to all media using 2020 CDR data ([U.S. EPA, 2020a](#)), Discharge Monitoring Report (DMR) data ([U.S. EPA, 2022b](#)), GSs and ESDs, and EPA published models as shown in Figure 3-1. If available, EPA used GSs or ESDs to estimate the number of release days, which EPA used to convert between annual release estimates and daily release estimates. EPA used 2020 CDR, DMR, 2020 U.S. Census Bureau County Business Practices, and Monte Carlo modeling data to estimate the number of sites using BBP within an OES. Generally, information for reporting sites in CDR was sufficient to accurately characterize each reporting site's OES. The *Draft Environmental Release and Occupational Exposure Assessment for Butyl Benzyl Phthalate (BBP)* ([U.S. EPA, 2025t](#)) describes EPA's approach and methodology for estimating daily releases and provides detailed facility level results for each OES.

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

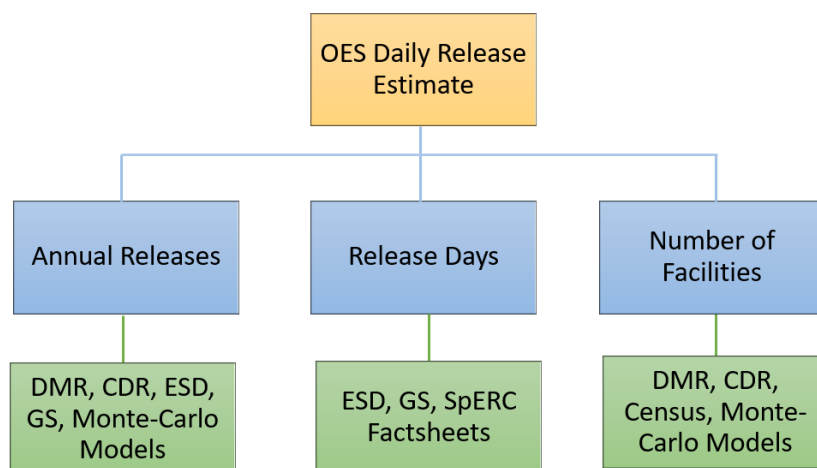


Figure 3-1. Overview of EPA’s Approach to Estimate Daily Releases for Each OES
CDR = Chemical Data Reporting (rule); ESD = emission scenario document; GS = generic scenario; SpERC = specific environmental release category

3.1.4 Consumer Down-the-Drain and Landfills

Environmental releases may occur from consumer products and articles containing BBP via their end-of-life disposal and demolition in the built environment or landfills, as well as from the associated down-the-drain release of BBP. It is difficult for EPA to quantify these end-of-life and down-the-drain exposures due to limited reasonably available information on source attribution of the consumer COUs.

In previous assessments, EPA has considered down-the-drain analysis for consumer product scenarios where it is reasonably foreseen that the consumer product may be discarded directly down-the-drain. For example, adhesives, sealants, paints, coatings, cleaner, waxes, and polishes can be disposed down-the-drain while users wash their hands, brushes, sponges, and other product applying tools. Although EPA acknowledges that there may be BBP releases to the environment via the cleaning and disposal of adhesives, sealants, paints, coatings, and cleaning and furnishing care products, the Agency did not quantitatively assess these products and instead provides a qualitative assessment. A qualitative assessment of consumer product environmental releases is based on landfill and surface water monitoring (measured) data and BBP physical and chemical properties.

BBP-containing products—including adhesives, sealants, paints, coatings, cleaner, waxes, and polishes—are disposed of when users no longer have use for them, or they have reached the product shelf life and are taken to landfills. All solid products and articles listed in Table 4-6 can be disposed in landfills or other waste handling locations that properly manage the disposal of articles like furniture, clothing, and toys. Section 3.2 in the *Draft Environmental Media and General Population Exposure for Butyl Benzyl Phthalate (BBP)* (U.S. EPA, 2024f) summarizes BBP monitoring data identified for landfills. In brief, no studies were identified that reported the concentration of BBP in landfills or in the surrounding areas in the United States, but BBP was identified in sludge in wastewater plants in China, Canada, and the United States. BBP is expected to have a high affinity for particulate ($\log K_{OC} = 3.4$ – 4.2) and organic media ($\log K_{OW} = 4.7$), 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 unlikely that BBP will migrate from landfills via groundwater infiltration. Nearby surface waters, however, may be susceptible to BBP contamination via surface water runoff if it is not captured before mixing with surface water.

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 3-4 presents a summary of these ranges across facilities. See the *Draft Environmental Release and Occupational Exposure Assessment for Butyl Benzyl Phthalate (BBP)* ([U.S. EPA, 2025t](#)) for additional detail on deriving the overall confidence score for each OES. No data were reasonably available for EPA estimate releases for the Fabrication of final products from articles OES and there were no suitable surrogate release data or models; therefore, this release is described qualitatively. Disposal sites handling post-consumer, end-use BBP were not quantifiable due to the wide and disperse use of BBP in PVC and other products. EPA assumed that releases during pre-consumer waste handling, treatment, and disposal are captured in the upstream OESs.

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Table 3-4. Summary of EPA's Daily Release Estimates for Each OES and EPA's Overall Confidence in these Estimates

OES	Category of Discharge, ^b Air Emission, ^c or Transfer for Disposal ^d	Estimated Daily Release Across Sites (kg/site-day) ^a		Estimated Release Frequency Across Sites (days) ^e		Number of Facilities Reporting to CDR ^{fg}	Weight of Scientific Evidence (Confidence) Rating ^h	Sources
		Central Tendency	High- End	Central Tendency	High- End			
Manufacturing	Stack air	0.15	0.28	300		1 – Polymer Additives, Inc., Bridgeport, NJ	Slight to Moderate	CDR, peer- reviewed literature (GS/ESD)
	Fugitive air	2.9E–06	4.9E–06					
	Wastewater, incineration, or landfill	303	566					
Import and repackaging (solid)	Stack air	5.9	25	208	260	1 – Tremco Incorporated, Beachwood, OH	Slight to Moderate	CDR, peer- reviewed literature (GS/ESD)
	Wastewater, incineration, or landfill	30	37					
	Fugitive air, wastewater, incineration, or landfill	7.6	33					
	Incineration or landfill	9.5	33					
Import and repackaging (liquid)	Fugitive air	6.2E–08	1.5E–07	208		1 – M. Argueso & Co., Inc., Muskegon, MI	Slight to Moderate	CDR, peer- reviewed literature (GS/ESD)
	Wastewater, incineration, or landfill	0.31	0.45					
Import and repackaging	Wastewater	6.7E–04	1.2E–03	208		3 reported sites		DMR
Incorporation into adhesives and sealants (solid)	Stack air	2.4E–02	9.9E–02	250		1 – M. Argueso & Co., Inc., Muskegon, MI	Slight to Moderate	CDR, Peer- reviewed literature (GS/ESD)
	Fugitive air	5.4E–12	5.1E–11					
	Incineration or landfill	3.9E–02	0.13					
	Wastewater, incineration or landfill	0.68	1.3					
	Fugitive air, wastewater, incineration or landfill	3.1E–02	0.13					
Incorporation into Adhesives and Sealants (liquid)	Stack air	1.2E–11	9.8E–11	250		2 – Polymer Additives, Inc., Bridgeport, NJ; Tremco Incorporated, Beachwood, OH; 14–71 generic sites	Slight to Moderate	CDR, Peer- reviewed literature (GS/ESD)
	Fugitive air	5.5E–12	5.2E–11					
	Incineration or landfill	3.2	16					
	Wastewater, incineration, or landfill	50	126					
	Fugitive air, wastewater, incineration, or landfill	2.5	15					

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OES	Category of Discharge, ^b Air Emission, ^c or Transfer for Disposal ^d	Estimated Daily Release Across Sites (kg/site-day) ^a		Estimated Release Frequency Across Sites (days) ^e		Number of Facilities Reporting to CDR ^{fg}	Weight of Scientific Evidence (Confidence) Rating ^h	Sources
		Central Tendency	High- End	Central Tendency	High- End			
Incorporation into paints and coatings	Stack air	2.9E-07	2.0E-06	250		1 – Tremco Incorporated, Beachwood, OH; 1 to 9 generic sites	Slight to Moderate	Peer-reviewed literature (GS/ESD)
	Fugitive air	3.1E-07	1.1E-06					
	Wastewater, incineration, or landfill	12	43					
Incorporation into other formulations, mixtures, and reaction products	Stack air	4.6E-07	3.2E-06	250		3 – Polymer Additives, Inc., Bridgeport, NJ; Tremco Incorporated, Beachwood, OH; M. Argueso & Co., Inc., Muskegon, MI; 1 generic site	Slight to Moderate	Peer-reviewed literature (GS/ESD)
	Fugitive air	4.8E-07	1.7E-06					
	Wastewater, incineration, or landfill	4.8E-07	1.7E-06					
	Wastewater	1.2E-03	1.2E-02	250		3 reported sites		DMR
PVC plastics compounding	Fugitive or stack air	8.1E-02	0.16	223	254	1 – Polymer Additives, Inc., Bridgeport, NJ	Slight to Moderate	CDR, Peer- reviewed literature (GS/ESD)
	Stack air	1.2	33					
	Wastewater, incineration, or landfill	90	203					
	Wastewater	41	80					
	Fugitive air, wastewater, incineration, or landfill	9.7	60					
	Incineration or landfill	17	81					
PVC plastics converting	Fugitive or stack air	8.8E-03	5.1E-02	219	251	17-24 generic sites	Slight to Moderate	CDR, Peer- reviewed literature (GS/ESD)
	Stack air	7.4E-02	2.1					
	Wastewater, incineration, or landfill	7.4	18					
	Wastewater	2.5	6.1					
	Fugitive air, wastewater, incineration, or landfill	0.62	4.0					
	Incineration or landfill	7.5	19					

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OES	Category of Discharge, ^b Air Emission, ^c or Transfer for Disposal ^d	Estimated Daily Release Across Sites (kg/site-day) ^a		Estimated Release Frequency Across Sites (days) ^e		Number of Facilities Reporting to CDR ^{f,g}	Weight of Scientific Evidence (Confidence) Rating ^h	Sources
		Central Tendency	High- End	Central Tendency	High- End			
Non-PVC material compounding (solid)	Fugitive or stack air	1.2E−04	2.0E−04	234	280	17–24 generic sites	Slight to Moderate	Peer-reviewed literature (GS/ESD)
	Stack air	4.2E−03	9.2E−02					
	Wastewater, incineration, or landfill	0.34	0.93					
	Wastewater	5.9E−02	0.10					
	Fugitive air, wastewater, incineration, or landfill	3.5E−02	0.16					
	Landfill or incineration	5.9E−02	0.21					
Non-PVC material compounding (liquid)	Fugitive or stack air	1.2E−04	2.0E−04	234	280	17–24 generic sites	Slight to Moderate	Peer-reviewed literature (GS/ESD)
	Stack air	2.1E−03	4.6E−02					
	Wastewater, incineration, or landfill	2.2	6.1					
	Wastewater	5.9E−02	0.10					
	Fugitive air, wastewater, incineration, or landfill	1.8E−02	8.1E−02					
	Landfill or incineration	0.11	2.9E−02					
Non-PVC material converting	Fugitive or stack air	3.3E−04	9.8E−04	219	251	17–24 generic sites	Slight to Moderate	Peer-reviewed literature (GS/ESD)
	Stack air	2.3E−03	4.8E−02					
	Wastewater, incineration, or landfill	0.38	0.77					
	Wastewater	6.4E−02	0.11					
	Fugitive air, wastewater, incineration, or landfill	1.9E−02	8.8E−02					
	Incineration or landfill	0.20	0.36					
Application of adhesives and sealants	Fugitive air	3.7E−07	1.1E−06	232	325	329–2,765 generic sites	Slight to Moderate	Peer-reviewed literature (GS/ESD)
	Incineration or landfill	2.7	11					
	Wastewater, incineration, or landfill	0.92	4.2					
	Wastewater	2.9E−04	3.4E−04	232		1 reported site		DMR

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OES	Category of Discharge, ^b Air Emission, ^c or Transfer for Disposal ^d	Estimated Daily Release Across Sites (kg/site-day) ^a		Estimated Release Frequency Across Sites (days) ^e		Number of Facilities Reporting to CDR ^{fg}	Weight of Scientific Evidence (Confidence) Rating ^h	Sources
		Central Tendency	High- End	Central Tendency	High- End			
Application of paints and coatings (control technology)	Fugitive air	2.9E-07	9.1E-07	257	287	4-32 generic sites	Slight to Moderate	Peer-reviewed literature (GS/ESD)
	Stack air	6.1	23					
	Incineration or landfill	57	218					
	Wastewater, incineration, or landfill	2.2	12					
Application of paints and coatings (no control technology)	Fugitive air	2.9E-07	9.1E-07	257	287	4-32 generic sites	Slight to Moderate	Peer-reviewed literature (GS/ESD)
	Incineration or landfill	2.9	9.7					
	Wastewater, incineration, or landfill	2.2	12					
	Unknown media (air, wastewater, incineration, or landfill)	61	231					
Use of laboratory chemicals (solid)	Stack air	4.5E-06	2.3E-05	235	258	36,873 generic sites	Slight to Moderate	Peer-reviewed literature (GS/ESD)
	Unknown media (air, water, incineration, or landfill)	8.0E-06	3.3E-05					
	Wastewater, incineration, or landfill	2.6E-03	3.2E-03					
	Incineration or landfill	1.1E-05	3.7E-05					
Use of laboratory chemicals (liquid)	Fugitive or stack air	2.3E-10	8.3E-11	235	258	14,597-36,873 generic sites	Slight to Moderate	
	Wastewater, incineration, or landfill	6.8E-03	2.4E-02					
Use of lubricants and functional fluids	Wastewater	46	171	2	4	117-1,392 generic sites	Slight to Moderate	Peer-reviewed literature (GS/ESD)
	Landfill	20	84					
	Recycling	0.70	4.1					
	Fuel blending (incineration)	16	92					
Recycling	Stack air	2.8E-03	1.7E-02	223	254	58 generic sites	Slight to Moderate	Peer-reviewed literature (GS/ESD)
	Fugitive air, water, incineration, or landfill	2.0E-02	6.5E-02					
	Wastewater	1.5E-02	3.1E-02					
	Wastewater, incineration, or landfill	1.3	1.8					

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OES	Category of Discharge, ^b Air Emission, ^c or Transfer for Disposal ^d	Estimated Daily Release Across Sites (kg/site-day) ^a		Estimated Release Frequency Across Sites (days) ^e		Number of Facilities Reporting to CDR ^{fg}	Weight of Scientific Evidence (Confidence) Rating ^h	Sources
		Central Tendency	High- End	Central Tendency	High- End			
Waste handling, treatment, and disposal	Wastewater	2.6E-03	9.7E-02	250		28 reported sites	Moderate to Robust	DMR

^a For modeled results, the presented central tendency and high-end are the 50th and 95th percentile values of the modeled distribution of results. For programmatic data, the presented central tendency is calculated from the median reported release amounts and high-end from the reported maximum release amounts. The specific central tendency and high-end values presented depend on the number of sites with programmatic data. For 6 or more data sites, EPA estimated central tendency and high-end exposures using the 50th and 95th percentile values, respectively. For 3–5 sites, EPA estimated the central tendency and high-end exposures using the 50th percentile and maximum values, respectively. For 2 sites, EPA presented the midpoint and the maximum value. Finally, EPA presented sites with only 1 data point as-is from the programmatic database.

^b Direct discharge to surface water; indirect discharge to non-publicly owned treatment works (POTWs); indirect discharge to POTWs

^c Emissions via fugitive air or stack air, or treatment via incineration

^d Transfer to surface impoundment, land application, or landfills

^e Where available, EPA used industry provided information, ESDs, or GSs to estimate the number of release days for each COU.

^f 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 BBP for each COU. The ranges included reflect the 50th and 95th percentile, or the central tendency and high-end values, respectively.

^g Discharge Monitoring Report (DMR)-reported sites can be found in Section 3 of the *Draft Environmental Release and Occupational Exposure Assessment for Butyl Benzyl Phthalate (BBP)* ([U.S. EPA, 2025t](#)).

^h See Section 3.2.2 for details on EPA’s determination of the weight of scientific evidence (confidence) rating.

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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 3-5 provides the Agency's weight of scientific evidence rating for each OES and reasons for the rating.

EPA integrated numerous evidence streams across systematic review sources to develop environmental release estimates for BBP. 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 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 referred to as the "Draft Systematic Review Protocol") ([U.S. EPA, 2021a](#)) for additional information on weight of scientific evidence conclusions.

Table 3-5 summarizes EPA's overall weight of scientific evidence conclusions for its release estimates for each OES. In general, modeled data had overall quality determinations of medium. As a result, for releases that used GSs/ESDs, the weight of scientific conclusion was moderate, when used in conjunction with Monte Carlo modeling.

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OES	Weight of Scientific Evidence Conclusion in Release Estimates
Manufacturing	EPA found limited reasonably available 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, 2023f), and sources identified through systematic review (including surrogate, industry supplied data for phthalates with similar structures and uses, DINP and DIDP). The Agency used EPA/OPPT models combined with Monte Carlo modeling to estimate releases to the environment, with each medium of release assessed using default parameters from EPA/OPPT models and industry-supplied data. 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 considers the full distributions of input parameters. EPA used facility-specific BBP manufacturing volumes for all facilities that reported this information to CDR and non-BBP-specific operating parameters derived using data from a current U.S. DIDP/DINP manufacturing site that is assumed to be similar to a BBP manufacturing site. This information was assumed to be more accurate than the generic values provided by the EPA/OPPT models. These strengths increase the weight of scientific evidence. The primary limitation of EPA’s approach is the uncertainty regarding whether the release estimates reasonably represent the true distribution of potential releases. In addition, 1 BBP manufacturing site claimed their BBP production volume as CBI for the purpose of CDR reporting; therefore, BBP throughput estimates for this site are based on the national aggregate PV and factoring in the other sites’ reported import volumes. Additional limitations include uncertainties in the representativeness of the surrogate, industry-provided operating parameters for DIDP and DINP and the generic EPA/OPPT models for BBP manufacturing sites. These limitations decrease the weight of scientific evidence. 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 uncertainties discussed above, such as using surrogate parameters, reduced the confidence of the analysis. Therefore, EPA concluded that the weight of scientific evidence for this release estimate is slight to moderate, considering the strengths and limitations of the reasonably available data.
Import and repackaging (liquids and solids)	EPA found limited reasonably available chemical-specific data for liquid and solid BBP for the Import and repackaging OES. The Agency assessed water releases using releases reported to the 2017–2022 DMR, which has a medium overall data quality determination from the systematic review process. EPA modeled releases for other media using 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, 2023f). Specifically, the Agency used EPA/OPPT models and the GS combined with Monte Carlo modeling to estimate releases to the environment for other media. EPA believes a strength of the Monte Carlo modeling approach is that using distributions for the 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 considers a large number of data points (simulation runs). These strengths increase the weight of scientific evidence.

OES	Weight of Scientific Evidence Conclusion in Release Estimates
	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. For water releases based on DMR data, the primary limitation is that the assessment is based on only three sites; EPA did not have additional sources to estimate water releases from this OES. For the modeled releases to other media, 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 BBP. As discussed above, the strength of the analysis includes using data reported to one EPA database. However, several uncertainties discussed above, such as not capturing all release sources, slightly reduced the confidence of the analysis. Therefore, EPA concluded that the weight of scientific evidence for this release estimate is slight to moderate, considering of the strengths and limitations of reasonably available data.
Incorporation into adhesives and sealants (liquids and solids)	EPA found limited reasonably available 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, 2009), which has a high data quality rating based on the systematic review process. EPA based the estimated production volume and number of processing sites on CDR reporting data. 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 allow 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 BBP-specific data on concentrations in adhesive and sealant products, which are more accurate than the generic values provided by the ESD. 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 scientific evidence. 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 BBP into adhesives and sealants. These limitations decrease the weight of scientific evidence. As discussed above, the strength of the analysis includes the combined use of Monte Carlo modeling with the ESD. However, the primary limitation was that it is unknown how well the default values in the ESD represent the facilities currently in operation. Therefore, EPA concluded that the weight of scientific evidence for this release estimate is slight to moderate, considering the strengths and limitations of the reasonably available data.
Incorporation into paints and coatings	EPA found limited reasonably available 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. EPA based the estimated production volume and number of processing sites on CDR reporting data. 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

OES	Weight of Scientific Evidence Conclusion in Release Estimates
	believes a strength of the Monte Carlo modeling approach is that variation in model input values allow 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 BBP-specific data on concentrations in paint and coating products to provide more accurate estimates of BBP 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 scientific evidence. 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 BBP into paints and coatings, particularly for sites formulating other coating types (<i>e.g.</i>, solvent-borne coatings). These limitations decrease the weight of scientific evidence. As discussed above, the strength of the analysis includes the combined use of Monte Carlo modeling with the ESD. However, the primary limitation was that it is unknown how well the default values in the ESD represent the facilities currently in operation. Therefore, EPA concluded that the weight of scientific evidence for this release estimate is slight to moderate, considering the strengths and limitations of the reasonably available data.
Incorporation into other formulations, mixtures, and reaction products	EPA found limited reasonably available chemical specific data for the Incorporation into other formulations, mixtures, and reaction products not covered elsewhere OES. The Agency assessed water releases using releases reported to the 2017–2022 DMR (U.S. EPA, 2022b), which has a medium overall data quality determination from the systematic review process. EPA modeled releases to other media using the Draft GS for the Formulation of Waterborne Coatings (U.S. EPA, 2014a), which has 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 for other media, which were determined using assumptions from the GS and EPA/OPPT models. 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. Monte Carlo modeling also considers a large number of data points (simulation runs) and the full distributions of input parameters. Additionally, EPA used BBP-specific data on concentrations in other formulation, mixture, and reaction products, which are more accurate than the generic values provided in 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 scientific evidence. 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. For water releases based on DMR data, the primary limitation is that the assessment is based on only 3 sites; the Agency did not have additional sources to estimate water releases from this OES. For modeled releases for other media, 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 BBP into other formulations, mixtures, or

OES	Weight of Scientific Evidence Conclusion in Release Estimates
	reaction products. Additionally, no CDR entries provided data for BBP relevant to this formulation OES and there were no other sources to estimate the volume of BBP used in this OES. As a result, 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 BBP facility throughputs, EPA used a range of generic default values in the GS. These limitations decrease the weight of scientific evidence. As discussed above, the strength of the analysis includes the combined use of Monte Carlo modeling with the ESD. However, the primary limitation was that it is unknown how well the default values in the ESD represent the facilities currently in operation. Therefore, EPA concluded that the weight of scientific evidence for this release estimate is slight to moderate, considering the strengths and limitations of the reasonably available data.
PVC plastics compounding	EPA found limited reasonably available chemical specific data for the PVC 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, 2021c), 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. EPA believes a strength of the Monte Carlo modeling approach is that variation in model input values allow 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 scientific evidence. 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 values in the GS consider all types of plastic compounding and may not represent releases from real-world sites that use BBP to compound specific types of PVC plastic materials. In addition, EPA lacks data on BBP-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. These limitations decrease the weight of scientific evidence. As discussed above, the strength of the analysis includes the combined use of Monte Carlo modeling with the ESD. However, the primary limitation was that it is unknown how well the default values in the ESD represent the facilities currently in operation. Therefore, EPA concluded that the weight of scientific evidence for this release estimate is slight to moderate, considering the strengths and limitations of the reasonably available data.
PVC plastics converting	EPA found limited reasonably available chemical specific data for the PVC 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, 2021d). 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. EPA believes a strength of the Monte Carlo modeling approach is that variation in model input values allow for estimation of a range of potential release values that are more likely to capture actual releases than a discrete value.

OES	Weight of Scientific Evidence Conclusion in Release Estimates
	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 scientific evidence. 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 BBP-containing raw material into plastic articles. In addition, the Agency lacks data on BBP-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 national aggregate production volume range for BBP, and production volume ranges of downstream sites. These limitations decrease the weight of scientific evidence. As discussed above, the strength of the analysis includes the combined use of Monte Carlo modeling with the ESD. However, the primary limitation was that it is unknown how well the default values in the ESD represent the facilities currently in operation. Therefore, EPA concluded that the weight of scientific evidence for this release estimate is slight to moderate, considering the strengths and limitations of the reasonably available data.
Non-PVC material compounding (liquid and solid)	EPA found limited reasonably available chemical-specific data for liquid and solid BBP 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, 2021c; OECD, 2004a). 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. EPA believes a strength of the Monte Carlo modeling approach is that variation in model input values allow 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 scientific evidence. 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 BBP; the Agency relied on the GS and ESD to generate concentration estimates. These values may not be representative of actual values from real-world sites that use BBP in non-PVC material compounding. Additionally, no entries in CDR indicated a use relevant to the compounding or converting of non-PVC material and there were no other sources to estimate the volume of BBP used in this OES. As a result, 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 scientific evidence. As discussed above, the strength of the analysis includes the combined use of Monte Carlo modeling with the ESD. However, the primary limitation was that it is unknown how well the default values in the ESD represent the facilities currently in

OES	Weight of Scientific Evidence Conclusion in Release Estimates
	operation. Therefore, EPA concluded that the weight of scientific evidence for this release estimate is slight to moderate, considering the strengths and limitations of the reasonably available data.
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, 2021d; OECD, 2004a). 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. EPA believes a strength of the Monte Carlo modeling approach is that variation in model input values allow 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 scientific evidence. 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 BBP; the Agency 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 BBP into non-PVC articles. Additionally, no entries in CDR indicated a use relevant to non-PVC material compounding or converting and there were no other sources to estimate the volume of BBP or number of sites used in this OES. As a result, 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 overestimate the average release case. These limitations decrease the weight of scientific evidence. As discussed above, the strength of the analysis includes the combined use of Monte Carlo modeling with the ESD. However, the primary limitation was that it is unknown how well the default values in the ESD represent the facilities currently in operation. Therefore, EPA concluded that the weight of scientific evidence for this release estimate is slight to moderate, considering the strengths and limitations of the reasonably available data.
Application of adhesives and sealants	EPA found limited reasonably available chemical specific data for the Application of adhesives and sealants OES. The Agency assessed water releases using releases reported to the 2017–2022 DMR (U.S. EPA, 2022b), which has a medium overall data quality determination from the systematic review process. EPA modeled releases to other media using the ESD on the Use of Adhesives (OECD, 2015b), which has a medium data quality rating based on systematic review. The Agency used EPA/OPPT models and the ESD combined with Monte Carlo modeling to estimate releases for other media, which were determined using assumptions from the GS and EPA/OPPT models. EPA believes a strength of the Monte Carlo modeling approach is that variation in model input values allow 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 BBP-specific data on concentration and application methods for different BBP-containing adhesives and sealant products. These data are more accurate than the generic values provided by the ESD. The safety and product data sheets from which these values were obtained have medium to high data quality ratings from the systematic review process. These strengths increase the weight of scientific evidence.

OES	Weight of Scientific Evidence Conclusion in Release Estimates
	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. For water releases based on DMR data, the primary limitation is that the assessment is based on one reporting site; the Agency did not have additional sources to estimate water releases from this OES. For the modeled releases to other media, the generic default values in the ESD may not represent releases from real-world sites that incorporate BBP into adhesives and sealants. The overall production volume of BBP for this OES was based on CDR data using the same assumptions as the Incorporation into adhesives and sealants OES. EPA lacks data on BBP-specific facility use volume and number of use sites; therefore, EPA based facility throughput estimates and number of sites on industry-specific default throughputs from the ESD, BBP product concentrations, and the overall production volume range from CDR data, which has a reporting threshold of 25,000 lb. These limitations decrease the weight of scientific evidence. As discussed above, the strength of the analysis includes the combined use of Monte Carlo modeling with the ESD. However, the primary limitation was that it is unknown how well the default values in the ESD represent the facilities currently in operation. Therefore, EPA concluded that the weight of scientific evidence for this release estimate is slight to moderate, considering the strengths and limitations of reasonably available data.
Application of paints and coatings	EPA found limited reasonably available 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 spray applied. The Agency believes a strength of the Monte Carlo modeling approach is that variation in model input values allow 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 BBP-specific concentration data for different paints and coatings in the analysis. These data are more accurate than the generic values provided by the GS and ESD. The safety and product data sheets that EPA obtained for these values from have medium to high data quality ratings based on the systematic review process. These strengths increase the weight of scientific evidence. 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 apply BBP-containing paints and coatings. Additionally, EPA assumes spray applications of the coatings, which may not be representative of other coating application methods. In addition, the Agency lacks data on BBP-specific facility use volumes 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 BBP production volume range. These limitations decrease the weight of scientific evidence.

OES	Weight of Scientific Evidence Conclusion in Release Estimates
	As discussed above, the strength of the analysis includes the combined use of Monte Carlo modeling with the ESD. However, the primary limitation was that it is unknown how well the default values in the ESD represent the facilities currently in operation. Therefore, EPA concluded that the weight of scientific evidence for this release estimate is slight to moderate, considering the strengths and limitations of reasonably available data.
Use of laboratory chemicals (liquids and solids)	EPA found limited reasonably available chemical specific data for liquid and solid BBP 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, 2023h), 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 BBP 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 BBP-containing laboratory products to inform product concentrations and material states, which have medium to high data quality ratings from the systematic review process. These strengths increase the weight of scientific evidence. 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 Agency lacks data on BBP-specific laboratory chemical throughput and number of laboratories; therefore, EPA based the number of laboratories and throughput estimates on stock solution throughputs from the Draft GS on the Use of Laboratory Chemicals and on CDR reporting thresholds. Additionally, no entries in CDR indicate laboratory use and there were no other sources to estimate the volume of BBP used in this OES. As a result, 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 overestimate the average release case. These limitations decrease the weight of scientific evidence. As discussed above, the strength of the analysis includes the combined use of Monte Carlo modeling with the Draft GS. However, the primary limitation was that it is unknown how well the default values in the GS represent the facilities currently in operation. Therefore, EPA concluded that the weight of scientific evidence for this release estimate is slight to moderate, considering the strengths and limitations of reasonably available data.
Use of lubricants and functional fluids	EPA found limited reasonably available chemical specific data for the Use of lubricants and functional fluids OES and assessed releases to the environment using the ESD on Lubricants and Lubricant Additives, which has a medium data quality rating based on systematic review (OECD, 2004b). The Agency used EPA/OPPT models combined with Monte Carlo modeling to estimate releases to the environment, with the media of release based on information from the ESD and EPA/OPPT models. The Agency 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 did not identify any lubricant or functional fluid products that contained BBP but identified one DINP-containing functional fluid for use in the Monte Carlo analysis for the risk evaluation for that chemical. Therefore, EPA used products containing DINP as surrogate for concentration

OES	Weight of Scientific Evidence Conclusion in Release Estimates
	and use data in this analysis. The Agency believes that this data provides more accurate estimates than the generic values provided by the ESD. The safety and product data sheets that EPA used to obtain these values have high data quality ratings based on systematic review. EPA based production volumes for the OES on rates cited by the ACC (ACC, 2020a) and referenced the 2003 EU Risk Assessment Report (ECJRC, 2003) for the expected U.S. DINP use rates per use scenario, which have medium to high data quality ratings. These strengths increase the weight of scientific evidence. The primary limitation of EPA’s approach is the use of DINP-specific surrogate data and its uncertainty in the representativeness of estimated release values toward the true distribution of potential BBP releases at all sites in this OES. Additionally, the generic default values in the ESD may not represent releases from real-world sites using BBP-containing lubricants and functional fluids. In addition, EPA lacks information on the specific facility use rate of BBP-containing products and number of use sites; therefore, the Agency estimated the number of sites and throughputs based on CDR, which has a reporting threshold of 25,000 lb and an annual BBP production volume. These limitations decrease the weight of scientific evidence. As discussed above, the strength of the analysis includes the combined use of Monte Carlo modeling with the ESD. However, the primary limitation was that it is unknown how well the default values in the ESD represent the facilities currently in operation. Therefore, EPA concluded that the weight of scientific evidence for this release estimate is slight to moderate, considering of the strengths and limitations of reasonably available data.
Fabrication and final use of 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 reasonably available chemical specific data for the Recycling OES. The Agency assessed releases to the environment from recycling activities using the Revised Draft GS for the Use of Additives in Plastic Compounding (U.S. EPA, 2021c) 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 by considering a large number of data points (simulation runs). 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 U.S. Additionally, the Agency estimated the BBP PVC market share (based on the surrogate market shares from DINP and DIDP) to define an approximate recycling volume of PVC containing BBP. These strengths increase the weight of scientific evidence. 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 BBP. In addition, EPA lacks BBP-specific PVC recycling rates and facility production volume data; therefore, the Agency based throughput estimates on U.S. PVC recycling rates and market share values based on surrogate DINP and DIDP values adjusted for BBP’s smaller overall volume, which may not accurately reflect current U.S. recycling volume. BBP may also be present in

OES	Weight of Scientific Evidence Conclusion in Release Estimates
	non-PVC plastics that are recycled; however, EPA was unable to identify information on these recycling practices. These limitations decrease the weight of scientific evidence. As discussed above, the strength of the analysis includes the combined use of Monte Carlo modeling with the ESD. However, the primary limitation was that it is unknown how well the default values in the ESD represent the facilities currently in operation. Therefore, EPA concluded that the weight of scientific evidence for this release estimate is slight to moderate, considering the strengths and limitations of the reasonably available data.
Waste handling, treatment, and disposal	No data were reasonably available to estimate air and land releases for this OES and there were no suitable surrogate release data or models. Releases to air and land were described qualitatively. EPA assessed water releases for POTW, non-POTW, and remediation sites using releases reported to the 2017–2022 DMR, which has a medium overall data quality determination from the systematic review process (U.S. EPA, 2022b). There were a total of 28 DMR reported releases of BBP to water. A strength of using DMR data is that the Pollutant Loading Tool used to pull the DMR data calculates an annual pollutant load by integrating monitoring period release reports provided to the EPA and extrapolating over the course of the year. However, this approach assumes that the average quantities, concentrations, and hydrologic flows for a given period are representative of other times of the year. As discussed above, the strength of the analysis includes using data reported to 1 EPA database. However, several uncertainties discussed above, such as not capturing all release sources, slightly reduced the confidence of the analysis. Therefore, for water releases, EPA has concluded that the weight of scientific evidence for this release estimate is moderate to robust, consideration of the strengths and limitations of reasonably available data.

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

Manufacturers and importers of BBP submit CDR data to EPA if they meet reporting threshold requirements. A single site provided production volume for BBP in the 2016 to 2019 reporting period and claimed their production volume as CBI. Therefore, EPA needed to mask this CBI with a range from 1,000,000 to less than 20,000,000 lb, resulting in uncertainty in the release estimates. Sites are only required to report production data to CDR if their yearly production volume exceeds 25,000 lb. As a result, some sites that produce or use BBP may not be included in the CDR dataset, and the total production volume for a given OES may be underestimated. The extent to which sites that are not captured in the CDR report releases of BBP into the environment is unknown. The media of release for these sites is also unknown.

CDR information contains a limited amount of information about the downstream use of BBP at facilities, because this information is dependent upon manufactures and importers knowing and reporting how BBP is used downstream; therefore, there is some uncertainty as to the production volume attributed to a given OES. For OESs with limited CDR data, EPA developed potential production volume ranges using reported CDR data, known reporting thresholds, and the national aggregate production volume of 1,000,000 to less than 20,000,000 lb for BBP in 2019. EPA 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. BBP 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.

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

- **Use of Census Bureau for Number of Facilities** – In some cases, EPA estimated the maximum number of facilities for a given OES using data from the U.S. Census. In such cases, EPA determined the maximum number of sites 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 BBP or BBP-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 BBP 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 Estimate** – 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 BBP-specific facility operations, release days may be under or overestimated.
- **Uncertainties Associated with BBP-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 BBP concentrations for products in the OES. However, the extent to which these products represent all BBP-containing products within the OES is uncertain. For OES with

little-to-no product data, EPA estimated BBP concentrations from GSs or ESDs. Due to these uncertainties, the average product concentrations may be under- or overestimated.

3.3 Summary of Concentrations of BBP in the Environment

The environmental release assessment summarized in Section 3.2 and presented in EPA's *Draft Environmental Release and Occupational Exposure Assessment for Butyl Benzyl Phthalate (BBP)* ([U.S. EPA, 2025t](#)) indicate that BBP 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 (Section 4.1.3). Given the physical chemical properties and fate parameters of BBP (Section 2), concentrations of BBP in soil and groundwater from releases to biosolids and landfills were not quantified. Instead, BBP 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. Details on the environmental partitioning and media assessment can be found in *Draft Physical Chemistry and Fate and Transport Assessment for Butyl Benzyl Phthalate (BBP)* ([U.S. EPA, 2025z](#)). Briefly, based on BBP's fate parameters (e.g., Henry's Law constant, log K_{oc}, water solubility, fugacity modeling), EPA anticipates BBP to be predominantly in water, soil, and sediment though BBP may also exist in air. Therefore, EPA quantitatively assessed concentrations of BBP in surface water, sediment, ambient air, and soil from air to soil deposition. Soil and groundwater concentrations of BBP resulting from landfill runoff and leachate were not quantitatively assessed in the screening level analysis, because BBP was expected to have limited persistence potential and mobility in soils receiving biosolids and other solid waste.

Details on the screening level assessment of each environmental pathway can be found in EPA's *Draft Environmental Media, General Population, and Environmental Exposure Butyl Benzyl Phthalate (BBP)* ([U.S. EPA, 2025r](#)). 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, 2019c](#)).

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 is 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 BBP in a given environmental media type. EPA did not estimate environmental concentrations of BBP resulting from all OESs presented in Table 3-1. The OESs resulting in the highest environmental concentration of BBP varied by environmental media as shown in Table 3-6.

Surface water releases modeled from GSs relied on pulling flow statistics from a representative distribution of receiving waterbody flows. The median (P50), 75th percentile (P75), and 90th percentile

(P90) values from the distribution of each flow statistic (7Q10 flow,² 30Q5 flow,³ and harmonic mean [HM⁴]) were applied as the generic scenario flows. Due to the highly skewed nature of these flow distributions, the P50 flows from the respective flow statistic distributions are minimal (for more details, see Section 4 and Appendix B in *Draft Environmental Media, General Population, and Environmental Exposure Butyl Benzyl Phthalate (BBP)* ([U.S. EPA, 2025r](#))). As described in Section 4.1 of *Draft Environmental Media, General Population, and Environmental Exposure Butyl Benzyl Phthalate (BBP)* ([U.S. EPA, 2025r](#)), where EPA has access to programmatic release data for phthalates, pairing the magnitude of release to the actual receiving waterbody flow statistics, with increased annual loading to surface water there is a correlated upward trend in receiving waterbody flow (particularly with respect to the minimum flows observed). With the high-end release values from the highest generic BBP release scenarios exceeding the loading of known releases by multiple orders of magnitude, EPA considers flows from the upper percentiles of the generic flow distributions (*i.e.*, P75 and P90) to be more appropriately paired with the high-end release estimates in this analysis. The concentrations derived from high-end releases combined with the P50 flows from the generic distribution are included in this analysis as a protective starting point of the tiered approach but possibly represent an unlikely confluence of factors leading to conservative surface water concentrations estimates that may not be representative of actual environmental concentrations but are appropriate for a screening level analysis.

Manufacturing without consideration of wastewater treatment efficiency yielded the highest water concentrations using a 7Q10 flow, 30Q5 flow, and HM. However, releases associated with the Manufacturing OES were categorized to multiple release categories and the proportion discharged only to surface water was indeterminable. Therefore, as described in Section 4.1 of *Draft Environmental Media, General Population, and Environmental Exposure Butyl Benzyl Phthalate (BBP)* ([U.S. EPA, 2025r](#)) EPA conservatively assumed that all releases associated with Manufacturing 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 Manufacturing OES represents an upper bound estimate of surface water concentrations appropriate for use in a screening level assessment. EPA also estimated surface water concentrations associated with the PVC plastics compounding which had estimated releases categorized as going only to water. EPA had greater confidence in the estimates associated with PVC plastics compounding. Details on the input assumptions and the confidence of the surface water concentrations can be found in *Draft Environmental Media, General Population, and Environmental Exposure Butyl Benzyl Phthalate (BBP)* ([U.S. EPA, 2025r](#)) and partly in Section 3.3.1.1.

The summary table also indicates whether the high-end estimate was used for environmental or general population exposure assessment, and which flow regimes were selected to screen for risks to human or environmental health. For the screening level analysis, if the high-end environmental media concentrations did not result in potential environmental or human health risk, no further OESs were assessed, and no further refinements were pursued. For the surface water and ambient air pathways, the OESs resulting in the highest estimated water column or ambient air concentrations were carried forward to the human health risk assessment.

For ambient air, the maximum EPA estimated daily release value for BBP was 231 kg/site-day and categorized under the Use of paints and coatings – no spray controls OES with an unknown media of

² 7Q10 is defined as 7 consecutive days of lowest flow over a 10-year period. These flows are used to calculate estimates of chronic surface water concentrations to compare with the COCs for aquatic life ([Versar, 2014](#)).

³ 30Q5 is defined as 30 consecutive days of lowest flow over a 5-year period. These flows are used to determine acute human exposures via drinking water and incidental ingestion and dermal contact via swimming ([Versar, 2014](#)).

⁴ Harmonic mean (HM) 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.

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 and models 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 since because this assumption 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 still 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 3-6 only shows a summary of the highest environmental media concentration resulting for two OESs (Manufacturing; PVC plastics compounding). 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 4.1.3 and 5.3.3, respectively.

Table 3-6. Summary of High-End BBP Concentrations in Various Environmental Media from Environmental Releases Used for Screening Analysis

OES ^a	Release Media	Environmental Media	BBP Concentration	Environmental or General Population
Manufacturing without wastewater treatment ^g	Water	Total water column (7Q10 ^b , median flow)	30,700 µg/L ^f	Environmental risk assessment
		Total water column (7Q10 ^b , P75 flow)	2,260 µg/L	Environmental risk assessment
		Total water column (7Q10 ^b , P90 flow)	75.7 µg/L	Environmental risk assessment
		Median 7Q10 (benthic pore water)	14,900 µg/L	Environmental risk assessment
		Median 7Q10 (benthic sediment)	43,100,000 µg/kg	Environmental risk assessment
PVC plastics compounding without wastewater treatment ^g	Water	Total Water Column (7Q10 ^b , Median Flow)	4,340 µg/L	Environmental risk assessment
		Median 7Q10 (benthic pore water)	2,100 µg/L	Environmental risk assessment
		Median 7Q10 (Benthic Sediment)	6,090,000 µg/kg	Environmental risk assessment
Manufacturing without wastewater treatment ^g	Water	Surface Water (30Q5, ^c median flow)	24,500 µg/L ^f	General population
		Surface Water (harmonic mean, ^d median flow)	17,600 µg/L	General population
PVC plastics compounding without wastewater treatment ^g	Water	Surface water (30Q5, ^c median flow)	2,852 µg/L	General population
		Surface water (harmonic mean, ^d median flow)	2,049 µg/L	General population

OES ^a	Release Media	Environmental Media	BBP Concentration	Environmental or General Population
Use of paints and coatings—no spray control (Stack)	Stack and fugitive air	Daily-averaged total (fugitive and stack, 100 m)	169.76 µg/m ³	General population
		Annual-averaged total (fugitive and stack, 100 m)	166.86 µg/m ³	General population
Use of paints and coatings—no spray control (Stack)	Stack and fugitive air	Total annual particle deposition rate (fugitive and stack, 100 m)	8,296 µ/m ²	Environmental and 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 30Q5 is defined as 30 consecutive days of lowest flow over a 5-year period

^d Harmonic mean (HM) is defined as the inverse mean of reciprocal daily arithmetic mean flow values. These flows represent a long-term average.

^e For generic scenario OESs that do not have a site-specific water body to obtain flow data from, a generic distribution of hydrologic flows was developed from facilities that had been classified under relevant NAICS codes, and which had National Pollutant Discharge Elimination System (NPDES) permits. The 7Q10 P50 is the 50th percentile or median of 7Q10 stream flows of water bodies in this distribution, and the P90 is the 90th percentile of this distribution.

^f Value exceeds BBP limit of water solubility (2,690 µg/L)

^g Values for surface water concentrations are presented here without wastewater treatment as it yielded highest surface water concentration used for screening. Assumptions of wastewater treatment removal are discussed and applied in Section 4.1.3 and 5.1.

3.3.1 Weight of Scientific Evidence Conclusions

Detailed discussion of the strengths, limitations, and sources of uncertainty for presented environmental media concentrations leading to a weight of scientific evidence conclusion can be found in the *Draft Environmental Media, General Population, and Environmental Exposure Butyl Benzyl Phthalate (BBP)* (U.S. EPA, 2025r). The weight of scientific evidence conclusion is summarized below for the modeled concentrations for surface water and ambient air, including ambient air to soil deposition.

3.3.1.1 Surface Water

As shown in Table 3-4, EPA had DMR data for some OES but due to limited reported release data and lack of reasonably available information for facilities discharging BBP to surface waters for all OESs, releases were modeled as generic scenarios, and the high-end estimated releases for each COU were used as an input for surface water modeling. Additionally, due to the lack of reasonably available site-specific release information, a generic distribution of hydrologic flows was developed from facilities that had been classified under relevant North American Industry Classification System (NAICS) codes and that had National Pollutant Discharge Elimination System (NPDES) permits.

For the screening level assessment, EPA utilized releases associated with the Manufacturing and PVC plastics compounding OESs because they resulted in the highest surface water concentrations for use in environmental risk and general population risk. The Agency determined the surface water concentration associated with this 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 used daily release information to estimate surface water concentrations for the general population and environmental exposure assessment. As mentioned in Section 3.2, the Agency estimated a range for daily releases for each OES. EPA was not able to estimate site-specific releases for the Fabrication of final products from articles OES. Disposal sites handling post-consumer, end-use BBP were not

quantifiable due to the wide and disperse use of BBP in PVC and other products. EPA assumed that releases during pre-consumer waste handling, treatment, and disposal are captured in the upstream OESs.

For the screening level assessment, EPA used the release estimates presented in Table 3-4 to model BBP concentrations in different environmental media.

For BBP, daily releases for each OES were estimated using GSs when DMR data was unavailable. Table 3-5 summarized EPA's overall weight of scientific evidence conclusions for its BBP release estimate for each OES. Overall EPA concluded the weight of scientific evidence conclusion was slight to moderate for releases that use GSs/ESDs and moderate for releases reported through DMR.

As shown in Table 3-4 daily releases to water for each OES were reported to the following categories for BBP:

- wastewater;
- wastewater, incineration, or landfill; and
- fugitive air, wastewater, incineration, or landfill.

Only the discharge type categorized as "wastewater" is known to be discharged only to water. For the other categories categorized as releasing to multiple media types, EPA could not differentiate the proportion of BBP released only to surface water. For these generic scenario OESs, there was insufficient data to quantify what portion of a release may be discharged specifically to surface water. Therefore, EPA proceeded with a conservative estimation of environmental concentrations and exposures under the assumption that total amount released for these OES were directly discharged to surface water (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; and Application of paints and coatings OES).

Table 3-7 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 OESs for use in a screening assessment, EPA identified Manufacturing and PVC plastics compounding OES for use in both environmental exposure and general population exposure. The Agency determined this OES 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 BBP prior to release in surface water, and that in the case of the Manufacturing 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. The Agency has only slight confidence in the high-end estimated concentrations for the Manufacturing 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) 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 this analysis were from articles rated medium- or high-quality from this process.

The high-end modeled concentrations in the surface water and sediment exceeded the highest values available from monitoring studies by at least one order of magnitude. Additionally, surface water concentrations estimated using P50 flow exceeded the water solubility of 2.69 mg/L. This confirms the Agency's expectation that modeled concentrations presented here are biased toward overestimation, to be applied as a screening evaluation. EPA began with its high-end modeled concentrations for its screening analysis. However, if refinements were necessary, the Agency considered additional flow values (*i.e.*, P75 and P90), application of wastewater treatment removal, and releases from other OESs. All refinements are discussed in the general population and environmental risk sections in 4.1.3 and 5.3.3, respectively.

Overall, EPA has robust confidence that the high-end estimated surface water concentration modeled using the Manufacturing and PVC plastics compounding OES is appropriate to use in its screening level assessment to assess all other OESs and their associated COUs—including OESs and COUs with releases that could not be quantified.

Table 3-7. BBP 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. Due to the uncertainty around the portion of the release going to surface water, EPA has only slight confidence in the estimated value for this OES, but robust confidence that the estimated concentration represents a high-end value appropriate to supplement the screening analysis for general population exposure.
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.
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 Manufacturing OES. The Agency has slight to moderate confidence in the surface water concentration but robust confidence that this OES represents a conservative surface water concentration appropriate for screening.

OES	Water Release Data Type	Weight of Scientific Evidence for Surface Water Concentrations
Non-PVC materials 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.
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 EPA 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, or reaction products	Generic Scenario (multimedia) and DMR	EPA had reported releases for this OES from DMR. 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.
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 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.
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.
Distribution in commerce	No release data	Release to surface water expected to be negligible. 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
Application of adhesives and sealants	Generic Scenario (multimedia)	No facilities reported releases for this OES, so EPA modeled releases using generic scenarios. Because EPA 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) and DMR	EPA had reported releases for this OES from DMR. 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.
Fabrication of final product from articles	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.
Use of laboratory chemicals	Generic Scenario (multimedia)	No facilities reported releases for this OES, so EPA modeled releases using generic scenarios. Because EPA 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 lubricants and functional fluids	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.
Repackaging	DMR	EPA had reported releases for this OES from DMR. 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.
Waste handling, treatment, and disposal	DMR	EPA had reported releases for this OES from DMR. 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.

3.3.1.2 Ambient Air

EPA used the IIOAC model, previously peer-reviewed methodology for fence-line communities ([U.S. EPA, 2022c](#)) 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 AERMOD (the Agency's regulatory model) that gives EPA greater confidence in the IIOAC results. However, since results from IIOAC are based on the pre-run

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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). The screening level analyses presented in this assessment, 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.

BBP did not have any reported releases in databases EPA typically relies upon for facility-reported release data (e.g., TRI or NEI). Therefore, the screening level analysis for ambient air for BBP 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. EPA uses the maximum EPA estimated daily releases of BBP across all OES/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 the EPA estimated release data used for this screening level assessment are detailed in the *Draft Environmental Release and Occupational Exposure Assessment for Butyl Benzyl Phthalate (BBP)* ([U.S. EPA, 2025t](#)) and carry over to the ambient air exposure assessment. EPA evaluated human health exposures to BBP due to direct inhalation of BBP from the ambient air. EPA also evaluated direct deposition of BBP 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 spray 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 *Draft Environmental Media, General Population, and Environmental Exposure Butyl Benzyl Phthalate (BBP)* ([U.S. EPA, 2025r](#)), 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 BBP, ensures possible exposures are not missed, and retains health protective exposure and associated risks estimates. Given these assumptions, the Agency 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 4.1.3.1—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 BBP 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)

1427 refine the analysis to be more representative of an environmentally-relevant exposure scenario (*e.g.*,
1428 only determine exposures and derive risk estimates based on a single facility reporting both release
1429 types).

1430 **4 HUMAN HEALTH RISK ASSESSMENT**

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

EPA evaluated all reasonably available information to support human health risk characterization of BBP for workers and ONUs, consumers and bystanders, and the general population, including PESS. Exposures to these population groups are described in Section 4.1, human health hazards are described in Section 4.2, and human health risk characterization is described 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). Depending on the OES, dermal and inhalation were primary routes of exposure.
- 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 (Sections 4.1.3).
- EPA assessed non-attributable cumulative exposure to DEHP, DBP, BBP, DIBP, and DINP for the U.S. civilian population using NHANES urinary biomonitoring data and reverse dosimetry (Section 4.4.2).
- EPA applied empirical BBP dermal absorption data from *ex vivo* human skin in a flux-limited model to estimate dermal absorption.

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 BBP in experimental animal models (Section 4.2).
- A non-cancer point of departure (POD) of 12 mg/kg-day (derived from a no-observed-adverse-effect level [NOAEL] = 50 mg/kg-day) was selected to characterize non-cancer risks for acute, intermediate, and chronic durations of exposure. A total uncertainty factor of 30× was selected for use as the benchmark margin of exposure (MOE).
- Under the *Guidelines for Carcinogen Risk Assessment* ([U.S. EPA, 2005](#)), EPA has preliminarily determined that there is *Suggestive Evidence of Carcinogenic Potential* of BBP in rats based on pancreatic cancer. Consistent with the guidelines, EPA did not quantitatively evaluate BBP for cancer risk.
- For the cumulative assessment of BBP, EPA derived draft relative potency factors (RPFs) for the phthalates above based on a common hazard endpoint (*i.e.*, reduced fetal testicular testosterone). Draft RPFs were derived via meta-analysis and benchmark dose (BMD) modeling (Section 4.4.1).

Risk Assessment Key Points

- Dermal exposures drive non-cancer risks to workers in occupational settings (Section 4.3.2).
- High-intensity dermal exposures drive non-cancer risks to consumers (Section 4.3.3).
- For the general population, exposures to BBP through biosolids, landfills, surface water, drinking water, ambient air, and fish ingestion were not determined to be pathways of concern (Section 4.3.4)
- EPA considered PESS throughout the exposure assessment, hazard identification, and dose-response analysis supporting this draft risk evaluation (Section 1.2.2.1).
- EPA considered cumulative risk to workers and consumers through exposure to BBP from individual COUs in combination with cumulative non-attributable national exposure to DEHP, DBP, DIBP, and DINP as estimated from NHANES biomonitoring data (Sections 4.4.4 and 4.4.5).

1431 **4.1 Summary of Human Exposures**

4.1.1 Occupational Exposures

The following subsections briefly describe EPA's approach to assessing occupational exposure and provide exposure assessment results for each OES for BBP. As stated in the *Final Scope of the Risk Evaluation for Butyl Benzyl Phthalate (1,2-benzenedicarboxylic acid, 1-butyl 2-(phenylmethyl) ester)*; CASRN 85-68-7 ([U.S. EPA, 2020c](#)), the Agency assessed the exposure of two occupational exposure groups, which are workers and ONUs. Workers work in close proximity to BBP and may handle BBP whereas ONUs do not directly handle BBP but may be indirectly exposed to it as part of their employment. The Agency evaluated the following exposures: inhalation exposure of workers and ONUs to vapor, mist and dust, dermal exposure of workers to liquid and solids; and dermal exposure of ONUs to mist and dust that deposits on surfaces. The *Draft Environmental Release and Occupational Exposure Assessment for Butyl Benzyl Phthalate (BBP)* ([U.S. EPA, 2025t](#)) 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 document ([U.S. EPA, 2020c](#)), 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 BBP and have direct contact with BBP, whereas ONUs do not directly handle BBP but may be indirectly exposed to it as part of their employment. Where possible, for each condition of use, 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, and Table 3-1 provides a crosswalk between COUs and OESs. The Agency did not identify relevant chemical-specific inhalation exposure monitoring data for all OESs. In the absence of inhalation monitoring data, EPA used inhalation exposure models to estimate central tendency and high-end exposures. For inhalation exposure to dust in occupational settings, the Agency 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 BBP, EPA used a flux-limited dermal absorption values derived from literature sources ([DuPont, 2006a, b](#)) to estimate high-end and central tendency dermal exposures for workers in each OES. The flux-limited approach for solid and liquid likely results in overestimations due to the assumption about excess BBP in contact with skin. Both methods are described in the *Draft Environmental Release and Occupational Exposure Assessment for Butyl Benzyl Phthalate (BBP)* ([U.S. EPA, 2025t](#)).

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 determination of high, medium, or low to relevant data within individual data sources. In addition, the Agency established an overall confidence level for the data when integrated across data sources into the occupational exposure assessment. EPA 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.

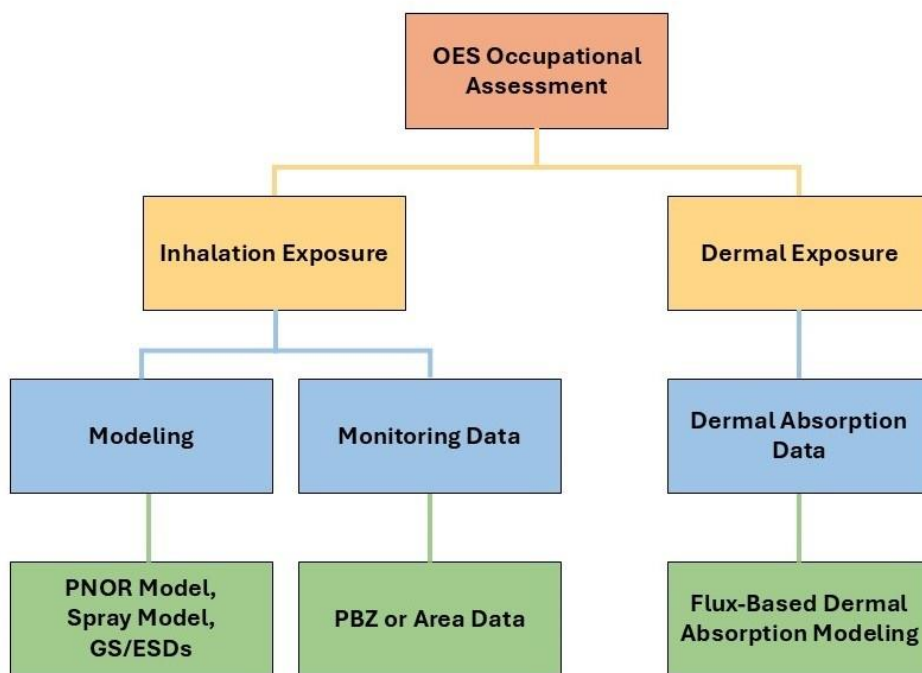


Figure 4-1. Approaches Used for Each Component of the Occupational Assessment for Each OES

ESD = emission scenario document; GS = generic scenario; PBZ = personal breathing zone; PNOR = particulates not otherwise regulated

For inhalation and dermal exposure routes, EPA provided occupational exposure results representative of 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 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. If the full distribution was unknown, the Agency 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 draft risk evaluation, EPA provided 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 statistics 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.

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

OES	Inhalation Exposure											Dermal Exposure			
	BBP Monitoring					Surrogate Monitoring ^{a b}					Modeling		Monitoring		Modeling
	Worker	# Data Points	ONU	# Data Points	Data Quality Ratings ^a	Worker	# Data Points	ONU	# Data Points	Data Quality Ratings	Worker	ONU	Worker	Data Quality Rating	Worker
Manufacturing	✓	5	×	N/A	M	×	N/A	×	N/A	N/A	×	×	✓	M	×
Import and repackaging (liquid)	×	N/A	×	N/A	N/A	✓	5	×	N/A	M	×	×	✓	M	×
Import and Repackaging (solid)	×	N/A	×	N/A	N/A	×	N/A	×	N/A	N/A	✓	×	✓	M	×
Incorporation into adhesives and sealants (liquid)	✓	1	×	N/A	M	×	N/A	×	N/A	N/A	×	×	✓	M	×
Incorporation into adhesives and sealants (solid)	×	N/A	×	N/A	N/A	×	N/A	×	N/A	N/A	✓	×	✓	M	×
Incorporation into paints and coatings	×	N/A	×	N/A	N/A	✓	1	×	N/A	M	✓	×	✓	M	×
Incorporation into other formulations, mixtures, and reaction products not covered elsewhere	×	N/A	×	N/A	N/A	✓	1	×	N/A	M	✓	×	✓	M	×
PVC plastics compounding	×	N/A	×	N/A	N/A	✓	24	×	N/A	M	×	×	✓	M	×
PVC plastics converting	✓	24	×	N/A	M	×	N/A	×	N/A	N/A	×	×	✓	M	×
Non-PVC material compounding	×	N/A	×	N/A	N/A	✓	24	×	N/A	M	×	×	✓	M	×
Non-PVC material converting	×	N/A	×	N/A	N/A	✓	24	×	N/A	M	×	×	✓	M	×
Application of adhesives and sealants	✓	1	×	N/A	M	×	N/A	×	M	N/A	×	×	✓	M	×
Application of paints and coatings	✓	18	×	N/A	M	×	N/A	×	M	N/A	×	×	✓	M	×
Use of laboratory chemicals (liquid)	×	N/A	×	N/A	N/A	✓	5	×	N/A	M	×	×	✓	M	×
Use of laboratory chemicals (solid)	×	N/A	×	N/A	N/A	×	N/A	×	N/A	N/A	✓	×	✓	M	×
Use of lubricants and functional fluids	×	N/A	×	N/A	N/A	×	N/A	×	N/A	N/A	✓	×	✓	M	×

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OES	Inhalation Exposure											Dermal Exposure			
	BBP Monitoring					Surrogate Monitoring ^{a b}					Modeling		Monitoring		Modeling
	Worker	# Data Points	ONU	# Data Points	Data Quality Ratings ^a	Worker	# Data Points	ONU	# Data Points	Data Quality Ratings	Worker	ONU	Worker	Data Quality Rating	Worker
Fabrication of final products from articles	×	N/A	×	N/A	N/A	×	N/A	×	N/A	N/A	✓	×	✓	M	×
Recycling	×	N/A	×	N/A	N/A	×	N/A	×	N/A	N/A	✓	×	✓	M	×
Waste handling, treatment, and disposal	×	N/A	×	N/A	N/A	×	N/A	×	N/A	N/A	✓	×	✓	M	×
ONU = occupational non-user; × = no data available; ✓ = data available															
^a Overall quality determinations for reported data on worker exposure are based on EPA systematic review process and include ratings low (L), medium (M), and high (H) (U.S. EPA, 2021a). The data quality ratings reflect the quality of the data source not confidence in how it was applied in the weight of scientific evidence.															
^b Where EPA was not able to estimate ONU inhalation exposure from monitoring data or models, ONU exposure was assumed to be equivalent to the central tendency experienced by workers for the corresponding OES. Surrogate monitoring data means monitoring data from another similar OES with BBP data was used (as described in Table 4-5).															

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4.1.1.2 Number of 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 lower-end of the range is based on the 50th percentile estimate of the number of sites and the upper end of the range is based on the 95th percentile estimate of the number of sites. For some OESs, the estimated number of facilities is based on the number of reporting sites to the 2020 CDR ([U.S. EPA, 2020b](#)), NEI ([U.S. EPA, 2023a](#)), DMR ([U.S. EPA, 2024a](#)), and TRI databases ([U.S. EPA, 2024l](#)). More information on the method used to estimate the number of workers and ONUs can be found in Section 2 of the *Draft Environmental Release and Occupational Exposure Assessment for Butyl Benzyl Phthalate (BBP)* ([U.S. EPA, 2025t](#)).

Table 4-2. Summary of Total Number of Workers and ONUs Potentially Exposed to BBP per OES

OES	Total Exposed Workers	Total Exposed ONUs	Number of Facilities	Notes
Manufacturing	39	18	1	Number of workers and ONU estimates based on the BLS and U.S. Census Bureau data (U.S. BLS, 2023 ; U.S. Census Bureau, 2015). Number of facilities estimate based on identified sites from CDR.
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, 2023 ; U.S. Census Bureau, 2015). Number of facilities estimate based on identified sites from CDR.
Incorporation into adhesives and sealants	252–1,278	98– 497	14–71	Number of workers and ONU estimates based on the BLS and U.S. Census Bureau data (U.S. BLS, 2023 ; U.S. Census Bureau, 2015). Number of facilities estimate based on results from Monte Carlo modeling.
Incorporation into paints and coatings	14–126	5–45	1–9	Number of workers and ONU estimates based on the BLS and U.S. Census Bureau data (U.S. BLS, 2023 ; U.S. Census Bureau, 2015). Number of facilities estimate based on the minimum reportable range for number of sites in CDR.
Incorporation into other formulations, mixtures, and reaction products not covered elsewhere	51	24	1	Number of workers and ONU estimates based on the BLS and U.S. Census Bureau data (U.S. BLS, 2023 ; U.S. Census Bureau, 2015). Number of facilities estimate based on the ESD on the Formulation of Waterborne Coatings (U.S. EPA, 2014a).
PVC plastics compounding	27	12	1	Number of workers and ONU estimates based on the BLS and U.S. Census Bureau data (U.S. BLS, 2023 ; U.S. Census Bureau, 2015). Number of facilities estimate based on calculations via the Draft Generic Scenario for the Use of Additives in Plastic Compounding (U.S. EPA, 2021c).
PVC plastics converting	180–432	50–120	10–24	Number of workers and ONU estimates based on the BLS and U.S. Census Bureau data (U.S. BLS, 2023 ; U.S. Census Bureau, 2015). Number of facilities estimate based

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OES	Total Exposed Workers	Total Exposed ONUs	Number of Facilities	Notes
				on identified downstream industrial sites from CDR.
Non-PVC material compounding	230–552	60–144	10–24	Number of workers and ONU estimates based on the BLS and U.S. Census Bureau data (U.S. BLS, 2023 ; U.S. Census Bureau, 2015). Number of facilities estimate based on identified downstream industrial sites from CDR.
Non-PVC material converting	230–552	60–144	10–24	Number of workers and ONU estimates based on the BLS and U.S. Census Bureau data (U.S. BLS, 2023 ; U.S. Census Bureau, 2015). Number of facilities estimate based on identified downstream industrial sites from CDR.
Application of adhesives and sealants	18,095–2152,075	5,922–49,770	329–2,765	Number of workers and ONU estimates based on the BLS and U.S. Census Bureau data (U.S. BLS, 2023 ; U.S. Census Bureau, 2015). Number of facilities estimate based on results from Monte Carlo modeling.
Application of paints and coatings	48–384	20–160	4–32	Number of workers and ONU estimates based on the BLS and U.S. Census Bureau data (U.S. BLS, 2023 ; U.S. Census Bureau, 2015). Number of facilities estimate based on results from Monte Carlo modeling.
Use of laboratory chemicals – liquid	14,597–36,873	58,388–147,492	14,597–36,873	Number of workers and ONU estimates based on the BLS and U.S. Census Bureau data (U.S. BLS, 2023 ; U.S. Census Bureau, 2015). Number of facilities estimate based on results from Monte Carlo modeling.
Use of laboratory chemicals – solid	36,873	147,492	36,873	Number of workers and ONU estimates based on the BLS and U.S. Census Bureau data (U.S. BLS, 2023 ; U.S. Census Bureau, 2015). Number of facilities estimate based on results from Monte Carlo modeling.
Use of lubricants and functional fluids	10,296–122,496	2,574–30,624	117–1,392	Number of workers and ONU estimates based on the BLS and U.S. Census Bureau data (U.S. BLS, 2023 ; U.S. Census Bureau, 2015). Number of facilities estimate based on results from Monte Carlo modeling.
Fabrication of final products from articles	N/A			Number of sites data was unavailable for this OES.
Recycling	348	232	58	Number of workers and ONU estimates based on the BLS and U.S. Census Bureau data (U.S. BLS, 2023 ; U.S. Census Bureau, 2015). Number of facilities estimate based on industry data (ENF, 2024).
Waste handling, treatment, and disposal	168	112	28	Number of workers and ONU estimates based on the BLS and U.S. Census Bureau data (U.S. BLS, 2023 ; U.S. Census Bureau, 2015). Number of facilities estimated based

OES	Total Exposed Workers	Total Exposed ONUs	Number of Facilities	Notes
				on identified sites from DMR, which may be an underestimate.
BLS = Bureau of Labor Statistics; CDR = Chemical Data Reporting (rule); DMR = Discharge Monitoring Report; ONU = occupational non-user ^a The central tendency estimate for total exposed ONUs in the Repackaging OES was <0.5, which was rounded up to a minimum of 1. ^b When the number of facilities was estimated from monte carlo simulation, the 50th percentile was the CT and 95th percentile was the HE. The number of workers and ONUs were obtained by multiplying the workers and ONUs for relevant NAICS codes with the number of facilities estimates (CT and HE for ranges).				

4.1.1.3 Summary of Inhalation Exposure Assessment

Table 4-3 presents a summary of inhalation exposure results for the average adult worker based on reasonably available monitoring data and exposure modeling for each OES. This table provides a summary of the 8- and 10-hour time-weighted average (TWA) inhalation exposure estimates, as well as the acute dose (AD), the intermediate average daily dose (IADD), and the chronic average daily dose (ADD). The *Draft Environmental Release and Occupational Exposure Assessment for Butyl Benzyl Phthalate (BBP)* ([U.S. EPA, 2025t](#)) provides exposure results for females of reproductive age and ONUs. This assessment also provides additional details regarding AD, IADD, and ADD calculations along with EPA's approach and methodology for estimating inhalation exposures.

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Table 4-3. Summary of Average Female Workers of Reproductive Age Inhalation Exposure Results for Each OES

OES	Inhalation Estimates (Average Adult Worker)								Data Information		
	8-Hour TWA Exposure: All Routes		AD (mg/kg/day)		IADD (mg/kg/day)		ADD (mg/kg/day)		Type	Source(s)	Rating(s)
	CT	HE	CT	HE	CT	HE	CT	HE			
Manufacturing	0.10	0.46	1.4E-02	6.3E-02	1.0E-02	4.6E-02	9.5E-03	4.3E-02	Monitoring data	(ECJRC, 2007)	Source received a medium rating
Import and repackaging (liquid)	0.10	0.46	1.4E-02	6.3E-02	1.0E-02	4.6E-02	7.9E-03	4.3E-03	Surrogate monitoring data	(ECJRC, 2007)	Source received a medium rating
Import and repackaging (solid)	6.6E-02	1.5	9.1E-03	0.21	5.2E-03	0.14	5.2E-03	0.14	PNOR Model for dust	No monitoring data source	N/A
Incorporation into adhesives and sealants (liquid)	5.0E-02	0.10	6.9E-03	1.4E-02	5.1E-03	1.0E-02	4.7E-03	9.5E-03	Monitoring data	(ECJRC, 2008)	Source received a medium rating
Incorporation into adhesives and sealants (solid)	0.34	3.5	4.6E-02	0.48	3.4E-02	0.35	3.2E-02	0.33	PNOR Model for dust	No monitoring data source	N/A
Incorporation into other formulations, mixtures, or reaction products	5.0E-02	0.10	6.9E-03	1.4E-02	5.1E-03	1.0E-02	4.7E-03	9.5E-03	Surrogate monitoring data	(ECJRC, 2008)	Source received a medium rating
Incorporation into paints and coatings	5.0E-02	0.10	6.9E-03	1.4E-02	5.1E-03	1.0E-02	4.7E-03	9.5E-03	Surrogate monitoring data	(ECJRC, 2008)	Source received a medium rating
Non-PVC materials compounding	0.70	4.2	6.9E-02	0.61	7.2E-02	0.45	6.3E-02	0.42	Surrogate monitoring data	(ECJRC, 2007) (OSHA, 2020)	OSHA CEHD received a high rating; ECJRC source received a medium rating
Non-PVC materials converting	0.70	4.2	6.9E-02	0.61	7.2E-02	0.45	5.9E-02	0.42	Surrogate monitoring data	(ECJRC, 2007) (OSHA, 2020)	OSHA CEHD received a high rating; ECJRC source received a medium rating
PVC plastics compounding	0.71	4.4	9.9E-02	0.61	7.2E-02	0.45	6.0E-02	0.42	Surrogate monitoring data	(ECJRC, 2007) (OSHA, 2020)	OSHA CEHD received a high rating; ECJRC

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OES	Inhalation Estimates (Average Adult Worker)								Data Information		
	8-Hour TWA Exposure: All Routes		AD (mg/kg/day)		IADD (mg/kg/day)		ADD (mg/kg/day)		Type	Source(s)	Rating(s)
	CT	HE	CT	HE	CT	HE	CT	HE			
											source received a medium rating
PVC plastics converting	0.71	4.4	9.9E-02	0.61	7.2E-02	0.45	5.9E-02	0.42	Monitoring data	(ECJRC, 2007) (OSHA, 2020)	OSHA CEHD received a high rating; ECJRC source received a medium rating
Application of adhesives and sealants	2.5E-03	5.0E-03	3.5E-04	6.9E-04	2.5E-04	5.1E-04	2.2E-04	4.7E-04	Surrogate monitoring data	(ECJRC, 2008)	Source received a medium rating
Application of paints and coatings	2.0	22	0.28	3.1	0.21	2.2	0.19	2.1	Monitoring data	(ECJRC, 2007)	Source received a medium rating
Use of laboratory chemicals (liquid)	0.10	0.46	1.4E-02	6.3E-02	1.0E-02	4.6E-02	8.9E-03	4.3E-02	Surrogate monitoring data	(ECJRC, 2007)	Source received a medium rating
Use of laboratory chemicals (solid)	5.7E-04	8.1E-03	7.9E-05	1.1E-03	5.8E-05	8.2E-04	5.1E-05	7.7E-04	PNOR Model for dust	No monitoring data source	N/A
Use of lubricants and functional fluids	2.5E-03	5.0E-03	3.5E-04	6.9E-04	2.3E-05	9.2E-05	1.9E-06	7.6E-06	Surrogate monitoring data	(ECJRC, 2008)	Source received a medium rating
Fabrication or use of final products and articles	9.0E-02	0.81	1.2E-02	0.11	9.1E-03	8.2E-02	8.5E-03	7.7E-02	PNOR Model for dust	No monitoring data source	N/A
Recycling	0.11	1.6	1.5E-02	0.22	1.1E-02	0.16	9.1E-03	0.15	PNOR Model for dust	No monitoring data source	N/A
Waste handling, treatment, and disposal	0.11	1.6	1.5E-02	0.22	1.1E-02	0.16	1.0E-02	0.15	PNOR Model for dust	No monitoring data source	N/A

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4.1.1.4 Summary of Dermal Exposure Assessment

As described in Section 2.4.3 of the *Draft Environmental Release and Occupational Exposure Assessment for Butyl Benzyl Phthalate (BBP)* ([U.S. EPA, 2025t](#)), empirical dermal absorption data from *in vitro* human skin applied in a flux-limited model to estimate dermal absorption. The value of absorptive flux for liquid (*i.e.*, 3.23×10^{-2} mg/cm²/h) was measured Dupont *et al.* ([2006b](#)) using 100 µL/cm² of BBP in acetonitrile applied to *in vitro* human skin. The value of absorptive flux for solids (*i.e.*, 1.113×10^{-4} mg/cm²/h) was measured Dupont *et al.* ([2006a](#)) using BBP film matrix applied to *in vitro* human skin. Both studies received medium study quality ratings during systematic review.

High-end and central tendency dermal exposures to liquids were determined using data from Dupont ([2006b](#)). The study estimated a dermal absorption rate over 8 hours from *in vitro* experiments on human skin samples exposed to BBP in acetonitrile. As discussed in Section 2.4.3.1 of the *Draft Environmental Release and Occupational Exposure Assessment for Butyl Benzyl Phthalate (BBP)* ([U.S. EPA, 2025t](#)), EPA used the steady-state flux (3.23×10^{-2} mg/cm²/h) estimated from Dupont ([2006b](#)) to estimate occupational dermal exposure to liquids or formulations containing BBP. The concentration of the chemical and co-formulants may influence absorption rates, which adds additional uncertainty to these dermal exposure estimates. EPA determined that all data were of acceptable quality without notable deficiencies and integrated all the data into the final exposure assessment.

High-end and central tendency dermal exposures to solids were determined using data from Dupont *et al.* ([2006a](#)). The study exposed human skin samples to a BBP film matrix containing ¹⁴C-BBP occluded parafilm that was directly placed on the skin for 8 hours. This resulted in a dermal absorption estimate for BBP of 0.8906 mg/cm² over an 8-hour period, with a steady-state flux of neat BBP estimated as 3.23×10^{-2} mg/cm²/h. EPA determined that all data were of acceptable quality without notable deficiencies and integrated all the data into the final exposure assessment.

For occupational dermal exposure assessment, EPA assumed a standard 8-hour workday. Because BBP has low volatility and relatively low absorption, it is possible that the chemical remains on the surface of the skin after dermal contact until the skin is washed. So, in absence of exposure duration data, EPA has assumed that absorption of BBP from occupational dermal contact with materials containing BBP may extend up to 8 hours per day ([CEB, 1991](#)). However, if a worker uses proper personal protective equipment (PPE) or washes their hands after contact with BBP or BBP-containing materials, dermal exposure will be reduced. Therefore, the assumption of an 8-hour exposure duration for BBP may lead to overestimation of dermal exposure. Regarding surface area of occupational dermal exposure, EPA assumed a high-end value of 1,070 cm² for male workers and 890 cm² for female workers. These high-end occupational dermal exposure surface area values are based on the mean two-hand surface area for adults in EPA's *Exposure Factors Handbook* ([U.S. EPA, 2011a](#)). For central tendency estimates, EPA assumed the exposure surface area was equivalent to only a single hand (or 1 side of 2 hands) and used half the mean values for two-hand surface areas (*i.e.*, 535 cm² for male workers and 445 cm² for female workers). EPA does not currently have reasonably available information regarding use of PPE or handwashing practices under the COUs, and therefore, these exposure estimates do not reflect use of PPE. Any additional information received during the public comment period on current PPE or hand washing practices would be considered in the final risk evaluation.

Table 4-4 presents a summary of dermal exposure results for the average adult worker. This table provides a summary of the acute potential dose rate (APDR) for occupational dermal exposure estimates, as well as the AD, IADD, and chronic ADD. The *Draft Environmental Release and Occupational Exposure Assessment for Butyl Benzyl Phthalate (BBP)* ([U.S. EPA, 2025t](#)) provides

1566 exposure results for females of reproductive age and ONUs and additional details regarding AD, IADD,
1567 and ADD calculations along with EPA's approach and methodology for estimating dermal exposure.
1568 Details regarding the calculations of values in Table 4-4 can be found in Appendix C of the *Draft*
1569 *Environmental Release and Occupational Exposure Assessment for Butyl Benzyl Phthalate (BBP)* ([U.S.](#)
1570 [EPA, 2025t](#)).

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Table 4-4. Summary of Female Worker of Reproductive Age Dermal Exposure Results for Each OES

OES	Dermal Estimates (Average Adult Worker)									
	Exposure Type ^a		APDR ^b (mg/day)		AD (mg/kg/day)		IADD (mg/kg/day)		ADD (mg/kg/day)	
	Liquid	Solid	CT ^c	HE ^c	CT ^c	HE ^c	CT ^c	HE ^c	CT ^c	HE ^c
Manufacturing	X		115	230	1.6	3.2	1.2	2.3	1.1	2.2
Import and repackaging (solids)		X	0.40	0.79	0.0055	0.011	0.0040	0.008	0.0031	0.0075
Import and repackaging (liquids)	X		115	230	1.6	3.2	1.2	2.3	0.90	2.2
Incorporation into adhesives and sealants (solids)		X	0.40	0.79	0.0055	0.011	0.0040	0.008	0.0037	0.0075
Incorporation into adhesives and sealants (liquids)	X		115	230	1.6	3.2	1.2	2.3	1.1	2.2
Incorporation into paints and coatings	X		115	230	1.6	3.2	1.2	2.3	1.1	2.2
Incorporation into other formulations, mixtures, or reaction products	X		115	230	1.6	3.2	1.2	2.3	1.1	2.2
PVC plastics compounding	X	X	115	230	1.6	3.2	1.2	2.3	1.1	2.2
PVC plastics converting		X	0.40	0.79	0.0055	0.011	0.0040	0.008	0.0033	0.0075
Non-PVC materials compounding	X	X	115	230	1.6	3.2	1.2	2.3	1.0	2.2
Non-PVC materials converting		X	0.40	0.79	0.0055	0.011	0.0040	0.008	0.0033	0.0075
Application of adhesives and sealants	X		115	230	1.6	3.2	1.2	2.3	1.1	2.2
Application of paints and coatings	X		115	230	1.6	3.2	1.2	2.3	1.1	2.2
Use of laboratory chemicals (solids)		X	0.40	0.79	0.0055	0.011	0.0040	0.008	0.0035	0.0075
Use of laboratory chemicals (liquids)	X		6.2	19	0.086	0.26	0.063	0.19	0.055	0.18
Use of lubricants and functional fluids	X		115	230	1.6	3.2	0.11	0.42	0.0087	0.035
Fabrication or use of final products and articles		X	0.40	0.79	0.0055	0.011	0.0040	0.008	0.0037	0.0075
Recycling		X	0.40	0.79	0.0055	0.011	0.0040	0.008	0.0033	0.0075
Waste handling, treatment, and disposal		X	0.40	0.79	0.0055	0.011	0.0040	0.008	0.0037	0.0075
AD = acute dose; ADD = average daily dose; APDR = acute potential dose rate; IADD = intermediate average daily dose										
^a EPA used dermal absorption data from two studies by Dupont et al. (2006a, b) in a flux-limited modeling approach to estimate occupational dermal exposures for liquids and solids.										
^b APDR values are reported for either liquid or solid exposure types as indicated by the “Exposure Type” column										
^c For average adult workers, central tendency (CT) means the surface area of contact was assumed equal to the area of 1 hand (i.e., 535 cm ²) and high-end (HE) means the surface area of contact was assumed equal to the area of 2 hands (i.e., 1,070 cm ²).										

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4.1.1.5 Weight of Scientific Evidence Conclusions for Occupational Exposure

Judgment on the weight of scientific evidence for each OES is based on the strengths, limitations, and uncertainties associated with the exposure estimates. EPA 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 is generated from a generic model with high data quality and some chemical-specific or industry-specific inputs such that the exposure estimate is a reasonable representation of potential sites within the OES. A conclusion of slight is appropriate where there is limited information that does not sufficiently cover all potential exposures within the COU, and the assumptions and uncertainties are not fully known or documented. See the Draft Systematic Review Protocol ([U.S. EPA, 2021a](#)) 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.

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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 used a risk evaluation completed by the European Commission's Joint Research Centre (ECJRC) with worker inhalation exposure data from manufacturing (ECJRC, 2007). The primary strength of this approach is the use of directly applicable monitoring data, which is preferable to other assessment approaches such as modeling or the use of occupational exposure limits (OELs). EPA used personal breathing zone (PBZ) air concentration data pulled from the risk evaluation, which has a medium data quality rating from the systematic review process (ECJRC, 2007). These data were BBP-specific from 2 different BBP manufacturing facilities. These strengths increase the weight of scientific evidence. The ECJRC source (ECJRC, 2007) used samples from literature to develop a task-based exposure estimate for the production of BBP, including 1 exposure estimate each for the filling of truck tankers, drumming, and production. Most of the data points were presented as the mean of a range or as single data points. Two of the tanker truck loading measurements were for approximately 1 hour, but the study indicated that the site received and loaded 3 to 4 trucks per day, with each taking 60 to 90 minutes to fill. EPA built a worker 8-hour TWA accounting for 4 truck fillings, assuming 90 minutes for each and no exposure for the remainder of the shift. The primary limitations of these data include the uncertainty of the representativeness of these data toward the true distribution of inhalation concentrations for this scenario. The ECJRC source provided four datasets focused on loading into various containers and only 1 data point on BBP production from 2 facilities, and it is uncertain whether the measured concentrations and activities accurately represent the entire industry. EPA also assumed 8 exposure hours per day and 250 exposure days per year based on continuous BBP exposure each working day for a typical worker schedule; it is uncertain whether this captures actual worker schedules and exposures. These limitations decrease the weight of scientific evidence. Although the use of monitoring data increases the strength of the analysis, but the few uncertainties discussed in the paragraph above reduces confidence of the analysis. Therefore, based on these strengths and limitations, EPA concluded that the weight of scientific evidence for this assessment is moderate. EPA has slight to moderate confidence in the assessed inhalation exposures for ONUs since it was assumed that ONU exposures are equal to worker central tendency exposures.
Import and repackaging	Due to no relevant OES-specific data reasonably availability on import and repackaging inhalation exposures, EPA used surrogate monitoring data for manufacturing from an ECJRC risk evaluation (ECJRC, 2007) for BBP to estimate worker inhalation exposure to vapors. The primary strength of this approach is the use of monitoring data, which are preferable to other assessment approaches such as modeling or the use of OELs. EPA used PBZ air concentration data pulled from the risk evaluation, which has a medium data quality rating from the systematic review process (ECJRC, 2007). These data were BBP-specific from 2 different BBP manufacturing facilities. EPA utilized the PNOR Model (U.S. EPA, 2021b) to estimate worker inhalation exposure to solid particulates. The respirable particulate concentrations used by the generic model were rated high for data quality from the systematic review process, and the model data is based on 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 Wholesale and Retail Trade NAICS

OES	Weight of Scientific Evidence Conclusion in Exposure Estimates
	codes (NAICS codes 42–45) to assess this OES, which EPA expects to be the most representative subset of the particulate data in the absence of chemical-specific data. The Agency estimated the highest expected concentration of BBP in particulates during import and repackaging using BBP concentration information from CDR reporters, which were also rated high for data quality in the systematic review process (U.S. EPA, 2020a). These strengths increase the weight of scientific evidence. The primary limitation of this approach is uncertainty in the representativeness of the vapor monitoring data and the PNOR Model in capturing the true distribution of inhalation concentrations for this OES. The vapor monitoring data is from 1 source and only represents 2 facilities, and it is uncertain if the activities represented by the data reflect the import and repackaging industry. EPA additionally lacks facility-specific particulate concentrations in air, and the representativeness of the dataset used in the model towards sites that handle BBP is uncertain. Furthermore, the model lacks metadata on worker activities. Finally, EPA assumed 8 exposure hours per day and 208–250 exposure days per year based on continuous BBP exposure during each working day for a typical worker schedule with the exposure days representing the 50th to 95th percentile of the exposure day distribution. It is uncertain whether this assumption captures actual worker schedules and exposures. These limitations decrease the weight of scientific evidence. Although the use of monitoring data increases the strength of the analysis, but few uncertainties discussed in the paragraph above reduces confidence of the analysis. Therefore, based on these strengths and limitations, EPA concluded that the weight of scientific evidence for this assessment is moderate. EPA has slight to moderate confidence in the assessed inhalation exposures for ONUs since it was assumed that ONU exposures are equal to worker central tendency exposures.
Incorporation into adhesives and sealants	EPA used monitoring data from a sealant processing site to assess inhalation exposures to vapor. The primary strength of this approach is the use of monitoring data, which is preferable to other assessment approaches such as modeling or the use of OELs. For the vapor exposure, EPA used PBZ air concentration data found from 1 source with medium data quality rating from the systematic review process to assess inhalation exposures to vapor (ECB, 2007). These data were BBP-specific and from a BBP-containing sealant processing facility. EPA incorporated the generic PNOR Model into the assessment to estimate worker inhalation exposures to solid particulate. The respirable particulate concentrations used by this generic model were rated high for data quality from the systematic review process, and the model data is based on 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 the Agency expects to be the most representative subset of the particulate data for chemical product manufacturing in the absence of BBP-specific data. EPA estimated the highest expected concentration of BBP in particulates during adhesive and sealant manufacturing using BBP 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. The primary limitations of these data include uncertainty in the representativeness of sealant processing vapor data and PNOR Model in capturing the true distribution of inhalation concentrations for this OES. The vapor data is from 1 source and is 1 data point; therefore,

OES	Weight of Scientific Evidence Conclusion in Exposure Estimates
	there is uncertainty in the true distribution of inhalation vapor concentrations for this OES. The sample point is also below the limit of detection (LOD) and the actual exposure concentration is unknown, so EPA used the LOD as an upper limit of exposure. EPA additionally lacks facility-specific particulate concentrations in air, and the representativeness of the dataset used in the model towards sites that handle BBP is uncertain. Further, the model lacks metadata on worker activities. EPA also assumed 8 exposure hours per day and 250 exposure days per year based on continuous BBP exposure each working day for a typical worker schedule; it is uncertain whether this captures actual worker schedules and exposures. These limitations decrease the weight of scientific evidence. Although the use of monitoring data increases the strength of the analysis, but few uncertainties discussed in the paragraph above reduces confidence of the analysis. Therefore, based on these strengths and limitations, EPA concluded that the weight of scientific evidence for this assessment is moderate. EPA has slight to moderate confidence in the assessed inhalation exposures for ONUs since it was assumed that ONU exposures are equal to worker central tendency exposures.
Incorporation into paints and coatings	Due to no relevant reasonably available OES-specific data, EPA used surrogate monitoring data from Incorporation into adhesives and sealants to assess worker inhalation exposures to vapor. The primary strength of this approach is the use of monitoring data, which is preferable to other assessment approaches, such as modeling or the use of OELs. EPA used PBZ air concentration data found from 1 source with medium data quality rating from the systematic review process to assess inhalation exposures to vapor (ECB, 2007). This data was BBP-specific and from a formulation site that is expected to be similar to a site that formulates paints and coatings. EPA incorporated the generic PNOR Model into the assessment to estimate worker inhalation exposures to solid particulates. The respirable particulate concentrations used by the generic model were rated high for data quality from the systematic review process, and the model data is based on 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 BBP-specific data. The Agency estimated the highest expected concentration of BBP in particulates during paint and coating manufacturing using BBP 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. The primary limitations of these data include uncertainty in the representativeness of sealant processing vapor data and PNOR Model in capturing the true distribution of inhalation concentrations for this OES. The vapor data is from 1 source and is 1 data point for the incorporation into adhesives and sealants; therefore, there is uncertainty in the true distribution of inhalation vapor concentrations for this OES. The sample point is also below the LOD and the actual exposure concentration is unknown, so EPA used the LOD as an upper limit of exposure. EPA additionally lacks facility-specific particulate concentrations in air, and the representativeness of the dataset used in the model towards sites that handle BBP is uncertain. Further, the model lacks metadata on worker activities. EPA also assumed 8 exposure hours per day and 250 exposure days per year based on continuous BBP exposure each working day for a typical worker schedule; it is uncertain whether this captures actual worker schedules and exposures. These limitations decrease the weight of scientific evidence.

OES	Weight of Scientific Evidence Conclusion in Exposure Estimates
	Although the use of monitoring data increases the strength of the analysis, but few uncertainties discussed in the paragraph above reduces confidence of the analysis. Therefore, based on these strengths and limitations, EPA concluded that the weight of scientific evidence for this assessment is moderate. EPA has slight to moderate confidence in the assessed inhalation exposures for ONUs since it was assumed that ONU exposures are equal to worker central tendency exposures.
Incorporation into other formulations, mixtures, and reaction products not covered elsewhere	Due to no relevant OES-specific data reasonably available, EPA used surrogate monitoring data from Incorporation into adhesives and sealants to assess worker inhalation exposures to vapor. The primary strength of this approach is the use of monitoring data, which is preferable to other assessment approaches such as modeling or the use of OELs. EPA used PBZ air concentration data found from 1 source with medium data quality rating from the systematic review process to assess inhalation exposures to vapor (ECB, 2007). This data was BBP-specific and from a formulation site that is expected to be similar to a site that formulates other products. EPA incorporated the generic PNOR Model into the assessment to estimate worker inhalation exposures 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 data is based on 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 the Agency expects to be the most representative subset of the particulate data for chemical product manufacturing in the absence of BBP-specific data. EPA estimated the highest expected concentration of BBP in particulates during other incorporative activities using BBP 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. The primary limitations of these data include uncertainty in the representativeness of sealant processing vapor data and use of the generic PNOR Model in capturing the true distribution of inhalation concentrations for this OES. The vapor data is from 1 source and is 1 data point for the incorporation into adhesives and sealants; therefore, there is uncertainty in the true distribution of inhalation vapor concentrations for this OES. The sample point is also below the LOD and the actual exposure concentration is unknown, so EPA used the LOD as an upper limit of exposure. The Agency additionally lacks facility-specific particulate concentrations in air, and the representativeness of the dataset used in the model towards sites that handle BBP is uncertain. Furthermore, the model lacks metadata on worker activities. EPA also assumed 8 exposure hours per day and 250 exposure days per year based on continuous BBP exposure each working day for a typical worker schedule; it is uncertain whether this captures actual worker schedules and exposures. These limitations decrease the weight of scientific evidence. Although the use of monitoring data increases the strength of the analysis, but few uncertainties discussed in the paragraph above reduces confidence of the analysis. Therefore, based on these strengths and limitations, EPA concluded that the weight of scientific evidence for this assessment is moderate. EPA has slight to moderate confidence in the assessed inhalation exposures for ONUs because it was assumed that ONU exposures are

OES	Weight of Scientific Evidence Conclusion in Exposure Estimates
	equal to worker central tendency exposures.
PVC plastics compounding	EPA used PVC plastics compounding and converting monitoring data from the OSHA CEHD dataset to assess dust exposures and from a BBP risk evaluation completed by the ECJRC to estimate vapor exposures. The primary strength of this approach is the use of monitoring data, which is preferable to other assessment approaches such as modeling or the use of OELs. The ECJRC BBP risk evaluation, which has a medium data quality rating, provided PBZ worker exposures to vapor from five different datasets from different plastics compounding and converting facilities (ECJRC, 2007). EPA used PBZ air concentration data from the OSHA CEHD, which has a medium data quality rating from the systematic review process, to assess worker inhalation exposure to dust (OSHA, 2019). Collectively the 2 datasets contain 24 data points and are well characterized. These strengths increase the weight of scientific evidence. The primary limitations of these data include uncertainty in the representativeness of the monitoring data in capturing the true distribution of inhalation concentrations for this OES. Various process and facility data, such as the concentration of BBP in the plastic material and the specific compounding or converting process are not known. In some instances, the data is assumed to be for PVC but could represent other plastic materials. Finally, EPA assumed 8 exposure hours per day and 223 to 250 exposure days per year based on continuous BBP exposure during each working day for a typical worker schedule with the exposure days representing the 50th to 95th percentile of the exposure day distribution. It is uncertain whether this assumption captures actual worker schedules and exposures. These limitations decrease the weight of scientific evidence. Although the use of monitoring data increases the strength of the analysis, but few uncertainties discussed in the paragraph above reduces confidence of the analysis. Therefore, based on these strengths and limitations, EPA concluded that the weight of scientific evidence for this assessment is moderate. EPA has slight to moderate confidence in the assessed inhalation exposures for ONUs because it was assumed that ONU exposures are equal to worker central tendency exposures.
PVC plastics converting	EPA used PVC plastics compounding and converting monitoring data from the OSHA CEHD dataset to assess dust exposures and from a BBP risk evaluation completed by the ECJRC to estimate vapor exposures. The primary strength of this approach is the use of monitoring data, which is preferable to other assessment approaches such as modeling or the use of OELs. The ECJRC BBP risk evaluation, which has a medium data quality rating, provided PBZ worker exposures to vapor from five different datasets from different plastics compounding and converting facilities (ECJRC, 2007). EPA used PBZ air concentration data from the OSHA CEHD, which has a medium data quality rating from the systematic review process, to assess worker inhalation exposure to dust (OSHA, 2019). Collectively the 2 datasets contain 24 data points and are well characterized. These strengths increase the weight of scientific evidence. The primary limitations of these data include uncertainty in the representativeness of the monitoring data in capturing the true distribution of inhalation concentrations for this OES. Various process and facility data, such as the concentration of BBP in the plastic material and the specific compounding or converting process are not known. In some instances, the data is assumed to be for PVC but could represent other plastic materials. Finally, EPA assumed 8 exposure hours per day and 219–250 exposure days per year based on continuous BBP exposure during each working day for a typical worker schedule with the exposure days representing the 50th to 95th percentile of the exposure day distribution. It is uncertain whether this assumption captures actual worker schedules and exposures.

OES	Weight of Scientific Evidence Conclusion in Exposure Estimates
	These limitations decrease the weight of scientific evidence. Although the use of monitoring data increases the strength of the analysis, but few uncertainties discussed in the paragraph above reduces confidence of the analysis. Therefore, based on these strengths and limitations, EPA concluded that the weight of scientific evidence for this assessment is moderate. EPA has slight to moderate confidence in the assessed inhalation exposures for ONUs because it was assumed that ONU exposures are equal to worker central tendency exposures.
Non-PVC materials compounding	Due to no relevant OES-specific data being reasonably available, EPA used surrogate PVC plastics compounding and converting monitoring data from the OSHA CEHD dataset to assess dust exposures and from a BBP risk evaluation completed by the ECJRC to estimate vapor exposures. The primary strength of this approach is the use of monitoring data, which is preferable to other assessment approaches such as modeling or the use of OELs. The ECJRC BBP risk evaluation, which has a medium data quality rating, provided PBZ worker exposures to vapor from 5 different datasets from different plastics compounding and converting facilities (ECJRC, 2007). EPA used PBZ air concentration data from the OSHA CEHD, which has a medium data quality rating from the systematic review process, to assess worker inhalation exposure to dust (OSHA, 2019). Collectively the 2 datasets contain 24 data points and are well characterized. These strengths increase the weight of scientific evidence. The primary limitations of these data include uncertainty in the representativeness of the monitoring data in capturing the true distribution of inhalation concentrations for this OES. Various process and facility data, such as the concentration of BBP in the plastic material and the specific compounding or converting process are not known. In some instances, the data is assumed to be for PVC but could represent other plastic materials. Finally, EPA assumed 8 exposure hours per day and 234–250 exposure days per year based on continuous BBP exposure during each working day for a typical worker schedule with the exposure days representing the 50th to 95th percentile of the exposure day distribution. It is uncertain whether this assumption captures actual worker schedules and exposures. These limitations decrease the weight of scientific evidence. Although the use of monitoring data increases the strength of the analysis, but few uncertainties discussed in the paragraph above reduces confidence of the analysis. Therefore, based on these strengths and limitations, EPA concluded that the weight of scientific evidence for this assessment is moderate. EPA has slight to moderate confidence in the assessed inhalation exposures for ONUs since it was assumed that ONU exposures are equal to worker central tendency exposures.
Non-PVC material converting	Due to no relevant OES-specific data reasonably available, EPA used surrogate PVC plastics compounding and converting monitoring data from the OSHA CEHD dataset to assess dust exposures and from a BBP risk evaluation completed by the ECJRC to estimate vapor exposures. The primary strength of this approach is the use of monitoring data, which is preferable to other assessment approaches, such as modeling or the use of OELs. The ECJRC BBP risk evaluation, which has a medium data quality rating, provided PBZ worker exposures to vapor from five different datasets from different plastics compounding and converting facilities (ECJRC, 2007). EPA used PBZ air concentration data from the OSHA CEHD, which has a medium data quality rating from the systematic review process, to

OES	Weight of Scientific Evidence Conclusion in Exposure Estimates
	assess worker inhalation exposure to dust (OSHA, 2019). Collectively the 2 datasets contain 24 data points and are well characterized. These strengths increase the weight of scientific evidence. The primary limitations of these data include uncertainty in the representativeness of the monitoring data in capturing the true distribution of inhalation concentrations for this OES. Various process and facility data, such as the concentration of BBP in the plastic material and the specific compounding or converting process are not known. In some instances, the data is assumed to be for PVC but could represent other plastic materials. Finally, EPA assumed 8 exposure hours per day and 219–250 exposure days per year based on continuous BBP exposure during each working day for a typical worker schedule with the exposure days representing the 50th to 95th percentile of the exposure day distribution. It is uncertain whether this assumption captures actual worker schedules and exposures. These limitations decrease the weight of scientific evidence. Although the use of monitoring data increases the strength of the analysis, but few uncertainties discussed in the paragraph above reduces confidence of the analysis. Therefore, based on these strengths and limitations, EPA concluded that the weight of scientific evidence for this assessment is moderate. EPA has slight to moderate confidence in the assessed inhalation exposures for ONUs since it was assumed that ONU exposures are equal to worker central tendency exposures.
Application of adhesives and sealants	EPA used monitoring data from a BBP risk evaluation completed by the ECJRC to estimate worker inhalation exposures during the application of adhesives and sealants. The primary strength of this approach is the use of directly applicable monitoring data, which is preferable to other assessment approaches, such as modeling or the use of OELs. EPA used PBZ air concentration data from this source, which has a medium data quality rating from the systematic review process, to assess inhalation exposures (ECJRC, 2007). These strengths increase the weight of scientific evidence. The primary limitations of these data include uncertainty in the representativeness of the vapor monitoring data in capturing the true distribution of inhalation concentrations for this OES, as the dataset only represents sealants and is a single sample. Additionally, the 1 sample is below the LOD, so EPA used the LOD as the upper limit of exposure. Finally, EPA assumed 8 exposure hours per day and 232–250 exposure days per year based on continuous BBP exposure during each working day for a typical worker schedule with the exposure days representing the 50th to 95th percentile of the exposure day distribution. It is uncertain whether this assumption captures actual worker schedules and exposures. These limitations decrease the weight of scientific evidence. Although the use of monitoring data increases the strength of the analysis, but few uncertainties discussed in the paragraph above reduces confidence of the analysis. Therefore, based on these strengths and limitations, EPA concluded that the weight of scientific evidence for this assessment is moderate. EPA has slight to moderate confidence in the assessed inhalation exposures for ONUs since it was assumed that ONU exposures are equal to worker central tendency exposures.

OES	Weight of Scientific Evidence Conclusion in Exposure Estimates
Application of paints and coatings	Due to no relevant OES-specific data reasonably available, EPA used surrogate monitoring data for plastisol coating from a BBP risk evaluation completed by the ECJRC to estimate worker inhalation exposures to vapor and surrogate monitoring data from the ESD on Coating Application via Spray-Painting in the Automotive Refinishing Industry, to estimate inhalation exposures to mists. The primary strength of this approach is the use of monitoring data from a similar activity, which is preferable to other assessment approaches, such as modeling or the use of OELs. To assess worker inhalation exposure to vapor, EPA used 13 PBZ air concentration measurements from 3 use facilities representing BBP use in the application of plastisols from the ECJRC risk evaluation, which has a medium data quality rating from the systematic review process (ECJRC, 2007). To assess worker inhalation exposure to mists, EPA used mist data from the ESD on Coating Application via Spray-Painting in the Automotive Refinishing Industry, which has a medium data quality rating from the systematic review process (OECD, 2011a). The Agency used SDSs and product data sheets from identified BBP-containing products, which have medium to high data quality ratings, to identify product concentrations to apply to the mist data to estimate BBP mist exposures. These strengths increase the weight of scientific evidence. The primary limitation is the lack of BBP-specific mist monitoring data, with the ESD serving as a surrogate source of monitoring data representing the level of exposure that could be expected at a typical work site for the given spray application method. 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 BBP-containing coatings. EPA assessed vapor and mist exposures to BBP over a full 8-hour work shift to estimate the level of exposure, though other activities may result in exposures other than vapor and mist and application duration may be variable depending on the job site. Finally, EPA assumed 8 exposure hours per day and 250 exposure days per year based on continuous BBP exposure during each working day for a typical worker schedule. It is uncertain whether this assumption captures actual worker schedules and exposures. These limitations decrease the weight of scientific evidence. Although the use of monitoring data increases the strength of the analysis, but few uncertainties discussed in the paragraph above reduces confidence of the analysis. Therefore, based on these strengths and limitations, EPA concluded that the weight of scientific evidence for this assessment is moderate. EPA has slight to moderate confidence in the assessed inhalation exposures for ONUs because it was assumed that ONU exposures are equal to worker central tendency exposures.
Use of laboratory chemicals	Due to no relevant OES-specific data reasonably available, EPA used surrogate monitoring data from the BBP Manufacturing OES to estimate worker vapor inhalation exposures to liquids. The primary strength of this approach is the use of monitoring data, which are preferable to other assessment approaches, such as modeling or the use of OELs. EPA used PBZ air concentration data from this source, which has a medium data quality rating, to assess inhalation exposures to vapor (ECJRC, 2007). EPA used the PNOR Model to estimate worker inhalation exposures to solid particulate. A strength of the model is that the respirable PNOR range was refined using OSHA CEHD datasets, which EPA tailored to the Professional, Scientific, and Technical Services NAICS code (NAICS code 54). EPA expects this NAICS code to be the most representative subset of the particulate data for use of laboratory chemicals in the absence of BBP-specific data. EPA estimated the highest expected concentration of BBP in particulates

OES	Weight of Scientific Evidence Conclusion in Exposure Estimates
	during laboratory use using SDSs and product data sheets from identified lab-grade chemicals, which have medium to high data quality ratings. These strengths increase the weight of scientific evidence. The primary limitation of this approach is uncertainty in the representativeness of the manufacturing vapor monitoring data and the PNOR Model in capturing the true distribution of inhalation concentrations for this OES. Furthermore, the OSHA CEHD dataset used in that model is not specific to BBP. Finally, EPA assumed 8 exposure hours per day and 235 to 250 exposure days per year based on continuous BBP exposure during each working day for a typical worker schedule with the exposure days representing the 50th to 95th percentile of the exposure day distribution. It is uncertain whether this assumption captures actual worker schedules and exposures. These limitations decrease the weight of scientific evidence. Although the use of monitoring data increases the strength of the analysis, but few uncertainties discussed in the paragraph above reduces confidence of the analysis. Therefore, based on these strengths and limitations, EPA concluded that the weight of scientific evidence for this assessment is moderate. EPA has slight to moderate confidence in the assessed inhalation exposures for ONUs because it was assumed that ONU exposures are equal to worker central tendency exposures.
Use of lubricants and functional fluids	Due to no relevant OES-specific data reasonably available, EPA used surrogate monitoring data for the Application of adhesives and sealants from a BBP risk evaluation completed by the ECJRC to estimate worker inhalation exposures to vapor. The primary strength of this approach is the use of monitoring data, which are preferable to other assessment approaches, such as modeling or the use of OELs. EPA used PBZ air concentration data from this source, which has a medium data quality rating from the systematic review process, to assess inhalation exposures (ECJRC, 2007). These strengths increase the weight of scientific evidence. The primary limitation of this approach is uncertainty in the representativeness of the Application of adhesives and sealants vapor monitoring data in capturing the true distribution of inhalation concentrations for this OES. Additionally, the vapor monitoring data comes from 1 source and 100% of the data were below the LOD; therefore, the actual exposure concentration is unknown with the LOD used as an upper limit of exposure. EPA also assumed 8 exposure hours per day and 2 to 4 exposure days per year based on a typical equipment maintenance schedule; it is uncertain whether this captures actual worker schedules and exposures. These limitations decrease the weight of scientific evidence. Although the use of monitoring data increases the strength of the analysis, but few uncertainties discussed in the paragraph above reduces confidence of the analysis. Therefore, based on these strengths and limitations, EPA concluded that the weight of scientific evidence for this assessment is moderate. EPA has slight to moderate confidence in the assessed inhalation exposures for ONUs because it was assumed that ONU exposures are equal to worker central tendency exposures.
Fabrication or use of final	EPA utilized the generic PNOR Model to estimate worker inhalation exposure to solid particulate. A strength of the model is that the respirable PNOR range was refined using OSHA CEHD datasets, which EPA tailored to the furniture and related product manufacturing

OES	Weight of Scientific Evidence Conclusion in Exposure Estimates
products and articles	NAICS code (NAICS 337) and the resulting dataset contains 272 discrete sample data points. The systematic review process rated the source high for data quality (OSHA, 2020). EPA estimated the highest expected concentration of BBP in plastic using industry provided data on BBP concentrations in PVC plastics, which has a high for data quality from the systematic review process. These strengths increase the weight of scientific evidence. The primary limitation of this approach is uncertainty in the representativeness of these data towards the true distribution of potential inhalation exposures. Additionally, the representativeness of the CEHD dataset and the identified BBP concentrations in plastics for the fabrication and final use of products or articles is uncertain. EPA lacks facility and BBP-containing product fabrication and use rates, methods, and operating times; therefore, the Agency assumed 8 exposure hours per day and 250 exposure days per year based on continuous BBP exposure each working day for a typical worker schedule. It is uncertain whether this captures actual worker schedules and exposures. These limitations decrease the weight of scientific evidence. Although the use of PNOR Model, which is based on OSHA CEHD monitoring data, increases the strength of the analysis, but few uncertainties discussed in the paragraph above reduces confidence of the analysis. Therefore, based on these strengths and limitations, EPA has concluded that the weight of scientific evidence for this assessment is moderate. EPA has slight to moderate confidence in the assessed inhalation exposures for ONUs because it was assumed that ONU exposures are equal to worker central tendency exposures.
Recycling	EPA utilized the generic PNOR Model to estimate worker inhalation exposure to solid particulates. A strength of the model is that the respirable PNOR range was refined using OSHA CEHD datasets, which EPA tailored to the Administrative and Support and Waste Management and Remediation Services NAICS code (NAICS 56) and the resulting dataset contains 130 discrete sample data points. The systematic review process rated the source high for data quality (OSHA, 2020). EPA estimated the highest expected concentration of BBP in plastic using industry provided data on BBP concentration in PVC plastic, which has a high data quality rating from the systematic review process. These strengths increase the weight of scientific evidence. The primary limitation of this approach is uncertainty in the representativeness of the data toward the true distribution of potential inhalation exposures. Additionally, the representativeness of the CEHD dataset and the identified BBP concentrations in plastics for the fabrication and final use of products or articles is uncertain. EPA lacks facility- and BBP-specific product recycling rates, methods, and operating times; therefore, EPA assumed 8 exposure hours per day and 223 to 250 exposure days per year based on continuous BBP exposure each working day for a typical worker schedule. It is uncertain whether this captures actual worker schedules and exposures. These limitations decrease the weight of scientific evidence. Although the use of PNOR Model, which is based on OSHA CEHD monitoring data, increases the strength of the analysis, but few uncertainties discussed in the paragraph above reduces confidence of the analysis. Therefore, based on these strengths and limitations, EPA has concluded that the weight of scientific evidence for this assessment is moderate. EPA has slight to moderate confidence in the assessed inhalation exposures for ONUs because it was assumed that ONU exposures are

OES	Weight of Scientific Evidence Conclusion in Exposure Estimates
	equal to worker central tendency exposures.
Waste handling, treatment, and disposal	EPA utilized the generic PNOR Model to estimate worker inhalation exposure to solid particulate. A strength of the model is that the respirable PNOR range was refined using OSHA CEHD datasets, which EPA tailored to the Administrative and Support and Waste Management and Remediation Services NAICS code (NAICS 56) and the resulting dataset contains 130 discrete sample data points. The systematic review process rated the source high for data quality (OSHA, 2020). EPA estimated the highest expected concentration of BBP in plastic using industry provided data on BBP concentration in PVC plastic, which have a high data quality rating from the systematic review process. These strengths increase the weight of scientific evidence. The primary limitation of this approach is uncertainty in the representativeness of the data toward the true distribution of potential inhalation exposures. Additionally, the representativeness of the CEHD dataset and the identified BBP concentrations in plastics towards all waste handling, treatment, and disposal is uncertain. EPA lacks facility- and BBP-specific product disposal rates, methods, and operating times; therefore, EPA assumed 8 exposure hours per day and 250 exposure days per year based on continuous BBP exposure each working day for a typical worker schedule. It is uncertain whether this captures actual worker schedules and exposures. The exposure days represent the 50th to 95th percentile range of the distribution of exposure days per year. These limitations decrease the weight of scientific evidence. Although the use of PNOR Model, which is based on OSHA CEHD monitoring data, increases the strength of the analysis, but few uncertainties discussed in the paragraph above reduces confidence of the analysis. Therefore, based on these strengths and limitations, EPA has concluded that the weight of scientific evidence for this assessment is moderate. EPA has slight to moderate confidence in the assessed inhalation exposures for ONUs because it was assumed that ONU exposures are equal to worker central tendency exposures.
Dermal – liquids	EPA used dermal absorption data for neat BBP formulations to estimate occupational dermal exposures to workers (DuPont, 2006b). The tests were performed <i>in vitro</i> on human skin samples over an 8-hour duration. It was acknowledged that variations in chemical concentration and co-formulant components affect the rate of dermal absorption. However, it is assumed that absorption of the neat chemical serves as a reasonable upper bound across chemical compositions. For occupational dermal exposure assessment, EPA assumed a standard 8-hour workday and that the chemical is contacted at least once per day. Because BBP has low volatility and relatively low absorption, it is possible that the chemical remains on the surface of the skin after dermal contact until the skin is washed. So, in absence of exposure duration data, EPA has assumed that absorption of BBP from occupational dermal contact with materials containing BBP may extend up to 8 hours per day (CEB, 1991). However, if a worker uses proper personal protective equipment (PPE) or washes their hands after contact with BBP or BBP-containing materials dermal exposure will be reduced. Therefore, the assumption of an 8-hour exposure duration for BBP may lead to overestimation of dermal exposure. For average adult workers, the surface area of contact was assumed equal to the area of 1 hand (<i>i.e.</i>, 535 cm²), or 2 hands (<i>i.e.</i>, 1,070 cm²), for central tendency exposures, or high-end exposures, respectively (U.S. EPA, 2011a). Other parameters such as frequency and duration of use, and surface area in contact, are well understood and representative. Despite moderate confidence in the estimated values themselves, EPA has robust confidence that the dermal liquid exposure estimates are realistic exposure scenarios.

OES	Weight of Scientific Evidence Conclusion in Exposure Estimates
Dermal – solids	EPA used dermal absorption data from an <i>in vitro</i> absorption study using human skin samples and BBP contained within film (DuPont, 2006a) to estimate occupational dermal exposures of workers and ONUs to solid materials as described in Appendix C.2.1.2 of the <i>Draft Environmental Release and Occupational Exposure Assessment for Butyl Benzyl Phthalate (BBP)</i> (U.S. EPA, 2025t). It is acknowledged that variations in chemical concentration and co-formulant components affect the rate of dermal absorption. For occupational dermal exposure assessment, EPA assumed a standard 8-hour workday and that the chemical is contacted at least once per day. Because BBP has low volatility and relatively low absorption, it is possible that the chemical remains on the surface of the skin after dermal contact until the skin is washed. So, in absence of exposure duration data, EPA has assumed that absorption of BBP from occupational dermal contact with materials containing BBP may extend up to 8 hours per day (CEB, 1991). However, if a worker uses proper PPE or washes their hands after contact with BBP or BBP-containing materials dermal exposure will be reduced. Therefore, the assumption of an 8-hour exposure duration for BBP may lead to overestimation of dermal exposure. For average adult workers, the surface area of contact was assumed equal to the area of 1 hand (<i>i.e.</i>, 535 cm²), or 2 hands (<i>i.e.</i>, 1,070 cm²), for central tendency exposures, or high-end exposures, respectively (U.S. EPA, 2011a). Other parameters such as frequency and duration of use, and surface area in contact, are well understood and representative. Despite moderate confidence in the estimated values themselves, EPA has robust confidence that the exposure estimates are realistic exposure scenarios.

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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 across any data sources and models that were used. 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. As described in Table 4-5, the exposure assessment for each OES was given a confidence rating based on the weight of scientific evidence. A high-level summary of key strengths, limitations, assumptions, and uncertainties across OES for BBP occupational exposure are provided.

Strengths

The exposure scenarios and exposure factors underlying the inhalation and dermal exposure assessments are supported by moderate to robust evidence. Occupational inhalation exposure scenarios were informed by directly applicable monitoring data or surrogate monitoring data. Directly applicable and surrogate monitoring data are the highest tiers in EPA's data hierarchy chart; see Section 2.4 in the *Draft Environmental Release and Occupational Exposure Assessment for Butyl Benzyl Phthalate* ([U.S. EPA, 2025t](#)).

Limitations

The principal limitation of the exposure assessments is uncertainty in the representativeness of the data and models used, because there is limited direct exposure monitoring data for BBP 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 BBP 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 BBP, EPA considered the physical form of BBP during different OESs. BBP can be present in various physical forms such as a powder, mist, paste, or in solution during the various OESs. The Agency assessed each respective OES assuming the physical form of BBP based on available product data, CDR data, and information from applicable GSs/ESDs. Because the physical form of BBP can substantially influence exposures, EPA assumed BBP is present in the physical form that is most prevalent and/or will result in the highest predicted exposures for the given OES.

EPA calculated chronic ADD values assuming workers and ONUs are exposed at the same level for their entire working lifetime, which may result in an overestimate of exposures. Individuals may change jobs during the course of their careers such that they are no longer exposed to BBP, and the actual ADD values become lower than the estimates presented. Assumptions associated with the 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, the representativeness of these estimated parameter distributions is uncertain because these data are often not specific to sites that use BBP. 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 model input parameter. Uncertainties associated with the dermal exposure assessment are described in Table 4-5.

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 *Draft Consumer and Indoor Dust Exposure Assessment for Butyl Benzyl Phthalate (BBP)* (also called "Draft Consumer and Indoor Assessment for BBP") ([U.S. EPA, 2025d](#)) provides additional details on the development of approaches and the exposure assessment results. The consumer exposure assessment evaluated exposures from individual COUs whereas 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 4-6), 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 judgement.
- 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 BBP 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 are used in the indoor dust assessment are selected for their potential to have large surface area for dust collection, roughly larger than 1 m².

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, 2023c](#)). Dermal exposures were estimated outside of CEM using a computational framework implemented within a spreadsheet environment using a flux-limited dermal absorption approach for liquid and solid products. See *Draft Consumer Exposure Analysis for Butyl Benzyl Phthalate (BBP)* ([U.S. EPA, 2025e](#)) for dermal exposure calculations. For each exposure route assessed and for various modeling input parameters (e.g., weight fractions, duration use), EPA used the 10th percentile, average, and 95th percentile value of an input parameter (e.g., weight fraction, surface area), where possible, to characterize low-, medium-, and high-exposure scenarios for a given COU. If only a range was reported, 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 Draft Consumer Assessment for BBP ([U.S. EPA, 2025d](#)) for details about the consumer modeling approaches, sources of data, model parameterization, and assumptions. 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. And second, the high intensity use exposure scenarios are used first to screen for potential risks at the higher range of possible exposures, and to refine if needed.

Exposure via the inhalation route occurs from inhalation of BBP gas-phase emissions or when BBP partitions to suspended particulate from direct use or application of products. However, BBP'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 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 BBP or directly ingesting BBP from migration to saliva. Additionally, ingestion of suspended dust can occur when BBP migrates from article to dust or partitions from gas-phase to suspended dust.

EPA made some adjustments to match CEM's lifestages to those listed in CDC guidelines ([CDC, 2021](#)) and EPA's *A Framework for Assessing Health Risks of Exposures to Children* ([U.S. EPA, 2006](#)). CEM lifestages are re-labeled from this point forward 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 BBP from consumer COUs. For the acute dose rate calculations, an averaging time of 1 day is used representing the scenario-specific exposure duration maximum 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 and iteratively averaged over 1 year. Intermediate dose is the exposure to continuous or intermittent (depending on product) use during a 30-day period, which is roughly 1 month. See Sections 2.2.1 and 2.2.2 and Appendix A in ([U.S. EPA, 2025d](#)) for details about acute, chronic, and intermediate dose calculations. 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.

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

Consumer Condition of Use Category	Consumer Condition of Use Subcategory	Product/Article	Exposure Scenario and Route ^d	Evaluated Routes				
				Inhalation ^e	Dermal	Ingestion		
						Suspended Dust	Settled Dust	Mouthing
Construction, paint, electrical, and metal products	Adhesives and sealants	Adhesives for small projects	Use of product in DIY small-scale home repair activities. Direct contact during use	QL	QT	QL	QL	QL
Construction, paint, electrical, and metal products	Adhesives and sealants	Caulking products	Use of product in DIY home repair activities. Direct contact during use; inhalation of emissions during use	QT	QT	QL	QL	QL
Construction, paint, electrical, and metal products	Adhesives and sealants	Patching and repair products for exterior repairs	Use of product in DIY small-scale home repair activities. Direct contact during use	QL	QT	QL	QL	QL
Construction, paint, electrical, and metal products	Paints and coatings	Touch up auto paint	Paint is applied via a paint marker to small surface areas. No significant potential for exposure identified.	QL	QL	QL	QL	QL
Construction, paint, electrical, and metal products	Paints and coatings	Sealing and refinishing sprays (indoor use)	Use of product in DIY large-scale home repair activities. Direct contact during use; inhalation of emissions during use	QT	QT	QL	QL	QL
Construction, paint, electrical, and metal products	Paints and coatings	Sealing and refinishing sprays (outdoor use)	Use of product in DIY large-scale home repair activities. Direct contact during use; inhalation of emissions during use	QT	QT	QL	QL	QL
Furnishing, cleaning, treatment/care products	Fabrics, textiles, and leather products	Synthetic leather furniture	Direct contact during use; inhalation of emissions/ingestion of airborne particulate; ingestion by mouthing	QT ^b	QT	QT ^b	QT ^b	QT
Furnishing, cleaning, treatment/care products	Fabrics, textiles, and leather products	Synthetic leather clothing	Direct contact during use	QL	QT	QL	QL	QL
Furnishing, cleaning, treatment/care products	Floor coverings; construction and building materials covering large surface areas including stone, plaster, cement, glass and ceramic articles fabrics, textiles, and apparel	Vinyl flooring	Direct contact, inhalation of emissions/ingestion of dust adsorbed chemical	QT ^b	QT	QT ^b	QT ^b	QL
Other uses	Automotive products, fluids	Automotive lubricants	Direct contact during use	QL	QT	QL	QL	QL

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Consumer Condition of Use Category	Consumer Condition of Use Subcategory	Product/Article	Exposure Scenario and Route ^d	Evaluated Routes				
				Inhalation ^a	Dermal	Ingestion		
						Suspended Dust	Settled Dust	Mouthing
Other uses	Automotive products, fluids	Interior car care	Direct contact during use; inhalation of emissions during use	QT	QT	QL	QL	QL
Other uses	Automotive articles	Car mat	Direct contact during use. See routine contact scenario inhalation of emissions / ingestion of dust adsorbed chemical	QT ^b	QT	QT ^b	QT ^b	QL
Other uses	Novelty articles	Adult toys	Direct contact during use; ingestion by mouthing	QL	QT	QL	QL	QT
Packaging, paper, plastic, hobby products	Ink, toner, and colorant products	Inks and dyes	Direct contact during use	QL	QT	QL	QL	QL
Packaging, paper, plastic, hobby products	Toys, playgrounds, and sporting equipment	Children's toys (legacy)	Collection of toys. Direct contact during use; inhalation of emissions/ingestion of airborne particulate; ingestion by mouthing	QT ^b	QT	QT ^b	QT ^b	QT
Packaging, paper, plastic, hobby products	Toys, playgrounds, and sporting equipment	Children's toys (new)	Collection of toys. Direct contact during use; inhalation of emissions/ingestion of airborne PM; ingestion by mouthing	QT ^b	QT	QT ^b	QT ^b	QT
Packaging, paper, plastic, hobby products	Toys, playgrounds, and sporting equipment	Tire crumb, artificial turf	Direct contact during use (particle ingestion via hand-to-mouth)	QT	QT	QT ^c		
Packaging, paper, plastic, hobby products	Packaging (excluding food packaging) and other articles with routine direct contact during normal use, including rubber articles; plastic articles (hard); plastic articles (soft)	Small articles with the potential for semi-routine contact; packaging, including plastic bags and pouches; vinyl shelf liner, bottom surface of shoe, small exterior clothing components, disposable gloves	Direct contact during use	QL	QT	QL	QL	QL
Packaging, paper, plastic, hobby products	Arts, crafts, and hobby materials	Small articles with the potential for semi-routine contact; Modeling clay, jewelry making crafts	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 ^d	Evaluated Routes				
				Inhalation ^a	Dermal	Ingestion		
						Suspended Dust	Settled Dust	Mouthing
DIY= do-it-yourself; QL = qualitative analysis; QT = quantitative analysis CPSIA – Consumer Product Safety Improvement Act of 2008 (CPSIA section 108(a), 15 U.S.C. § 2057c(a);16 CFR 1307.3(a)), Congress permanently prohibited the sale of children’s toys or childcare articles containing concentrations of more than 0.1% BBP. See Section 2.1.1 in U.S. EPA (2025d) for detailed descriptions of data and references. ^a Inhalation scenarios consider suspended dust and gas-phase emissions. ^b Scenario used in Draft Consumer and Indoor Assessment for BBP (U.S. EPA, 2025d) in Section 4. These indoor dust articles scenarios consider the surface area from multiple articles such as toys, while furniture and flooring already have large surface areas. For these articles dust can deposit and contribute to significantly larger concentration of dust than single small articles ^c The tire crumb and artificial turf ingestion route assessment considers all 3 types of ingestions—settled dust, suspended dust, and mouthing altogether—but results cannot be provided separately has it was done for all other articles and products. ^d Model inputs were either CEM default or professional judgment based on manufacturer product information. See Section 2.1 for weight fraction data and references and Section 2.2.3 for CEM inhalation and ingestion parameterization details and Section 2.3 for dermal modeling inputs selection and rationale in U.S. EPA (2025d).								

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Inhalation and Ingestion Exposure Routes Modeling Approaches

Key parameters for articles modeled in CEM Version 3.2 are summarized in detail in Section 2 in the *Draft Consumer and Indoor Dust Exposure Assessment for Butyl Benzyl Phthalate (BBP)* ([U.S. EPA, 2025d](#)). Calculations, sources, input parameters and results are also available in *Draft Consumer Exposure Analysis for Butyl Benzyl Phthalate (BBP)* ([U.S. EPA, 2025e](#)). 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 CEM input parameters Consumer Exposure Model (CEM), Version 3.2 ([U.S. EPA, 2023c](#)), including the following:

- 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).

For each scenario, high-, medium-, and low-intensity use exposure scenarios were developed in which values for duration of use, frequency of use, and surface area were determined based on reasonably available information or professional judgment. 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 if CEM default parameters were not applicable an assumption based on article use descriptions by manufacturers was used, always leaning on conservative values. For example, for all scenarios, the near-field modeling option was selected to account for a small 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 m³ was selected as a standard approach to best represent the consumers' exposures while using a product or article. On the other hand, assuming exposures from a well-mixed room would underestimate consumers' exposures to BBP as the modeling would not estimate concentrations specifically where the product is being used within the room of use. See Section 2.1 for weight fraction selection and Section 2.2.3 for parameterization details in the *Draft Consumer Assessment for BBP* ([U.S. EPA, 2025d](#)).

Dermal Exposure Routes Modeling Approaches

Dermal modeling was conducted outside of CEM. The use of the CEM for dermal absorption, which relies on total concentration rather than aqueous saturation concentration, would greatly overestimate exposure to BBP in liquid and solid products and articles. See U.S. EPA ([2025d](#)) for more details and *Draft Consumer Exposure Analysis for Butyl Benzyl Phthalate (BBP)* ([U.S. EPA, 2025e](#)) for the calculations. EPA used a screening approach with a range of expected uses input parameters for contact surface area and with duration and frequency of contact ranging from conservative to being representative of expected uses. The flux-limited screening dermal absorption approaches for liquid and solid products and articles assumes a constant rate of absorption of BBP in contact with the skin. Dermal flux value (liquid and solid products) were calculated and applied in the corresponding scenario using Dupont ([2006b](#)) for liquid products (3.22×10^{-2} mg/cm²/h) and Dupont ([2006a](#)) for solid products

(1.113×10^{-4} mg/cm²/h). The flux-limited value for liquids is two orders of magnitude larger than for solids, which is expected because solids have a slower migration from article matrix to skin. The flux-limited screening approach provides a representative upper bound of dermal absorption of BBP (see Section 4.1.2.4 for discussion on limitations, strengths, and confidence of this approach). For each product or article, high-, medium-, and low-intensity use 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. Key parameters for the dermal model are shown in Section 2.3 in the Draft Consumer Assessment for BBP U.S. EPA (2025d).

4.1.2.2 Modeling Dose Results for Consumer

This section summarizes the dose estimates from inhalation, ingestion, and dermal exposure to BBP in consumer products and articles. Detailed tables of the dose results for acute, intermediate, and chronic exposures are tabulated in the *Draft Consumer Risk Calculator for Butyl Benzyl Phthalate (BBP)* (U.S. EPA, 2025f). Modeling dose results and data pattern figures for acute, intermediate, and chronic exposures are described in Section 3 in the Draft Consumer Assessment for BBP (U.S. EPA, 2025d).

For young teens (11–15 years), teenagers (15–21 years), and adults (21+ years), dermal contact was a strong driver of exposure to BBP, with the dose received being generally higher than or similar to the dose received from exposure via inhalation or ingestion. This is likely due to the dermal modeling assumption that the supply of the BBP material added to the skin is a constant rate of absorption and not significantly depleted over the course of the product or article's use (Kissel, 2011). This results in a potential overestimation of dose and subsequent risk. The largest dose estimated is for acute and chronic dermal exposure to synthetic leather furniture for all lifestages. Among the younger lifestages (infant to 11 years), the pattern was less clear as these ages were not designated as product users and therefore not modeled for dermal contact with any of the liquid products assessed. Key differences in exposures among lifestages 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 lifestages.

4.1.2.3 Indoor Dust Assessment

Because PVC products are ubiquitous in modern indoor environments, and since BBP is not chemically bound to many consumer products and articles in which it is incorporated, it can leach, migrate or evaporate into indoor air and concentrate in household dust. See Sections 4.1 and 4.2 of the *Draft Consumer and Indoor Dust Exposure Assessment for Butyl Benzyl Phthalate (BBP)* (U.S. EPA, 2025d) for a summary of indoor dust monitoring data that EPA used to confirm the presence of BBP in indoor dust in the residential environment. Exposure to BBP through dust ingestion, dust inhalation, and dermal absorption is a particular concern for young children between the ages of 6 months and 2 years, as they crawl on the ground and pull up on ledges, which increases hand-to-dust contact, and place their hands and objects in their mouths. Exposure to BBP via ingestion of dust was assessed for all articles expected to contribute significantly to dust concentrations due to high surface area (exceeding ~1 m²) for either a single article or collection of like articles as appropriate. In a screening assessment, EPA considered the aggregation of chronic dust ingestion doses, see Section 4.3 in the *Draft Consumer and Indoor Exposure Assessment for Butyl Benzyl Phthalate (BBP)* (U.S. EPA, 2025d). The highest dose was for preschoolers aged 3 to 5 years.

Articles included in the indoor assessment include the following:

- indoor synthetic leather furniture;
- vinyl flooring;
- carpet tiles;

- car mats; and
- children's toys, both legacy and new.

Regarding the mechanism through which exposures or risks to indoor dust may occur (*i.e.*, via migration of BBP from consumer materials to indoor dust), abraded particles are generally assumed to be initially emitted to the air and thereafter may deposit and resuspend from the surfaces. Abraded particles, like suspended and settled particulate, are subject to cleaning and ventilation losses. Abraded particles, both in the suspended and settled phases, are not assumed to be in equilibrium with the air phase. EPA could not predict how much BBP originally in an article would become available in household dust where it may be ingested by infants via hand-to-mouth. Thus, the chemical transfer between particulates and the air phase was kinetically modeled in terms of two-phase mass transfer theory. EPA also assessed indoor dust ingestion from the monitoring literature. The Agency compared the modeling and monitoring values in Section 4.3 of the *Draft Consumer and Indoor Exposure Assessment for Butyl Benzyl Phthalate (BBP)* ([U.S. EPA, 2025d](#)).

Briefly, the aggregated indoor modeling doses and literature indoor air and dust monitoring results were within the same order or magnitude for infants. The aggregated indoor modeling doses are one order of magnitude larger than the literature indoor air and dust doses for lifestages older than 1 year. With an age group-specific margin of error ranging from 5 to 76 depending on the age group. These discrepancies partially stem from differences in the exposure assumptions of the CEM model versus the assumptions made when estimating daily dust intakes in [Özkaynak et al. \(2022\)](#). Another explanation is the assumption that the sum of the indoor dust sources in the CEM-modeled scenario is representative of items found in typical indoor residences. It is likely that individual residences have varying assortments and amounts of the products and articles that are sources of BBP, resulting in lower and higher exposures. For a detailed discussion of COU-specific uncertainties, see Sections 2 and 5 of the *Draft Consumer and Indoor Exposure Assessment for Butyl Benzyl Phthalate (BBP)* ([U.S. EPA, 2025d](#)).

4.1.2.4 Weight of Scientific Evidence Conclusions for Consumer Exposure

Key sources of uncertainty for evaluating exposure to BBP in consumer goods and strategies to address those uncertainties are described in detail in Section 5.1 of the Draft Consumer Assessment for BBP ([U.S. EPA, 2025d](#)). Generally, designation of robust confidence suggests that the supporting scientific evidence weighted against the uncertainties is adequate to characterize exposure assessments. 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 that the supporting evidence weighed against the uncertainties is reasonably adequate to characterize exposure assessments. The designation of slight confidence is assigned when the weight of scientific evidence may (1) not be adequate to characterize the scenario, and (2) in the absence of complete information and there are additional uncertainties that may need to be considered. The designation of slight to moderate confidence suggests that some aspects of the analysis are reasonably adequate but other aspects are not adequate or well understood to characterize the exposure. 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 reflects a balance between using parameters that will represent various populations' use patterns and emphasizing conservative 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 can also alter physical and/or chemical behavior of the product or article. Table 4-7 summarizes the overall uncertainty per COU and includes a discussion of rationale used to assign the overall uncertainty.

The following subsections preceding 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. In general, the confidence to use the results for risk characterization ranges from moderate to robust (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 sometimes limited for weight fractions of BBP in consumer goods. EPA obtained BBP weight fractions in various products and articles from material safety data sheets, databases, and existing literature (see Section 2.1 in the Draft Consumer Assessment for BBP ([U.S. EPA, 2025d](#))). 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 compounding each intensity use scenario with respective high, medium, and low inputs. The screening assessment for dermal exposure largely did not depend on weight fractions as a modeling input. Instead, it was highly dependent on the BBP experimental dermal load applied from literature for liquid products and solid articles. 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 (preferable) 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, methods of application, and skin contact area, are expected to differ. Where possible, high, medium, and low default values from CEM Version 3.2 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 Version 3.2 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 for 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, 2012b](#)). ConsExpo ([U.S. EPA, 2012b](#)) 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 BBP emissions to the environment. For each article modeled for inhalation exposure, low, medium, and high estimates for surface area were calculated (see Section 2.1 in Draft Consumer Assessment for BBP ([U.S. EPA, 2025d](#))). This approach relied on manufacturer-provided dimensions where possible, or values from EPA's *Exposure Factors Handbook* for floor and wall coverings. For small items that might be expected to be present in a home in significant quantities, such as children's toys, aggregate values were calculated for the cumulative surface area for each type of article in the indoor environment. Overall confidence in surface area is *robust* for articles like furniture, wall coverings, flooring, toys because there is a good understanding of the presence and dimensions of these articles in indoor environments.

Human Behavior

CEM Version 3.2 has three different 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 chosen as it is the most protective assumption.

Children's mouthing durations are a source of uncertainty in human behavior. The data used in this assessment are based on a study in which parents observed children (n = 236) aged 1 month to 5 years of age for 15 minutes per session, for 20 sessions (([Smith and Norris, 2003](#))). There was considerable variability in the data due to behavioral differences among children of the same lifestage. For instance, while children aged 6 to 9 months had the highest average mouthing duration for toys at 39 minutes per day, the minimum duration was 0 minutes while the maximum was 227 minutes per day. The observers noted that the items mouthed were made of plastic roughly 50 percent of the mouthing time, but this was not limited to soft plastic items likely to contain significant plasticizer content. In another study, 169 children aged 3 months to 3 years were monitored by trained observers for 12 sessions at 12 minutes each ([Greene, 2002](#)). They reported mean mouthing durations ranging from 0.8 to 1.3 minutes per day for soft plastic toys and 3.8 to 4.4 minutes per day for other soft plastic objects (excluding pacifiers). Thus, it is likely that the mouthing durations used in this assessment provide a health protective estimate for mouthing of soft plastic items likely to contain BBP. EPA assigned a *moderate* confidence associated with the duration of activity for mouthing because the magnitude of the overestimation is not well characterized. Because all other human behavior parameters are well understood, or the ranges used capture use patterns representative of various lifestages, the overall confidence in use patterns is *robust*.

Inhalation and Ingestion Modeling Tool

Confidence in the model used considers whether the model has been peer reviewed and whether it was applied in a manner appropriate to its design and objective. For example, the model used (CEM Version 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 use 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 for consumer exposure modeling is *robust*.

Dermal Modeling of BBP Exposure for Liquids and Solids

Experimental dermal data was identified via the systematic review process to characterize consumer dermal exposures to liquids or mixtures and formulations and solid articles containing BBP (see

Sections 2.3.2 and 2.3.3 in the Draft Consumer Assessment for BBP ([U.S. EPA, 2025d](#)). The confidence in the dermal exposure to liquid and solid products and articles model used in this assessment is *moderate*.

EPA identified only four sets of experimental data related to the dermal absorption of BBP—Elsisi ([1989](#)), Dupont ([2006b](#)), Dupont ([2006a](#)), and Sugino ([2017](#)). Dupont ([2006b](#)) and Dupont ([2006a](#)) were selected for this assessment because they are relatively recent in comparison to Elsisi ([1989](#)) and use human skin in comparison to Elsisi ([1989](#)) and Sugino ([2017](#)) which used *in vivo* rat skin. The two Dupont studies also considered formulations and an experimental setup, which included detailed temperature and humidity controls, rather than a neat chemical study that may have overestimated results.

A source of uncertainty regarding the dermal absorption of BBP from products or formulations stems from the varying concentrations and co-formulants that exist in products or formulations containing BBP. For purposes of this draft risk evaluation, EPA assumes that the absorptive flux of BBP formulations measured from *in vitro* human experiments serves as an upper bound of potential absorptive flux of chemical into and through the skin for dermal contact with all liquid products or formulations and solid articles. Dermal contact with products or formulations that have lower concentrations of BBP can exhibit lower rates of flux since there is less material available for absorption. Conversely, co-formulants or materials within the products or formulations might lead to enhanced dermal absorption—even at lower concentrations, but the magnitude of enhanced dermal absorption is not clear. Therefore, it is uncertain whether the products or formulations containing BBP would result in decreased or increased dermal absorption.

Ingestion via Mouthing

EPA did not identify BBP chemical migration rates to saliva with a correlation to weight fractions of BBP similar to those used in this assessment. A theoretical framework based on physical and chemical properties of BBP as well as the solid matrix material was used to estimate chemical migration rates for BBP. This model was both internally and externally validated against measured diffusion coefficients and shown to have good predictive capability for chemicals with molecular weights between 30 and 1,178 g/mol at temperatures between 4 and 180 °C ([Aurisano et al., 2022](#)), which are well within BBP properties and temperatures during product use. There are two major limitations of the chemical migration rate estimate calculation approach: (1) there is no understanding of the correlation between concentration of BBP in consumer products and the calculated chemical rate, and (2) there are no available data to compare the estimated chemical rate value. These limitations result in a significant level of uncertainty for the estimated chemical migration rate, as the value may also differ among similar items due to variations in chemical makeup and polymer structure. Thus, it is unclear whether the migration rate value is applicable to consumer goods with low weight fractions of BBP. EPA has a *slight to moderate* confidence in the chemical migration rate value in the context of this assessment consumer product considerations and a *slight to moderate* confidence in the overall modeling approach.

Table 4-7. Weight of Scientific Evidence Summary Per Consumer COU

Consumer COU Category and Subcategory	Weight of Scientific Evidence	Overall Confidence
Construction, paint, electrical, and metal products; Adhesives and sealants	Three different scenarios were assessed under this COU for products with differing use patterns for which each scenario had varying number of identified product examples (in parenthesis): Adhesives for small projects (2), caulking products (5), and patching and repair products for exterior repairs (5). Of these three scenarios, adhesives for small projects and patching and repair products for exterior repairs were assessed for dermal exposures only because inhalation	Inhalation – Robust Dermal – Moderate

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Consumer COU Category and Subcategory	Weight of Scientific Evidence	Overall Confidence
	and ingestion would have low exposure potential. The overall confidence in this COU's inhalation exposure estimate is robust because the CEM default parameters represent actual use patterns and location of use. See Section 2.1.2 in U.S. EPA (2025d) for number of products, product examples, and weight fraction data. For dermal exposure, EPA used a dermal flux approach, which was estimated based on BBP <i>in vitro</i> dermal absorption in humans. An overall moderate confidence in dermal assessment of adhesives was assigned. Uncertainties about the effect formulations have in overall absorption increase uncertainty. Other parameters, such as frequency and duration of use and surface area in contact, are well understood and representative, resulting in a moderate overall confidence.	
Construction, paint, electrical, and metal products; Paints and coatings	Three different scenarios were assessed under this COU for products with differing use patterns for which each scenario had varying number of identified product examples (in parenthesis): Touch up auto paint (2), sealing and refinishing sprays (indoor use) (2), and sealing and refinishing sprays (outdoor use) (1). Of these three scenarios, touch up auto paint was not quantitatively assessed because appropriate use of the product avoids dermal contact and due to the small amount used per event inhalation and ingestion exposures are expected to be smaller than the other examples in this COU. The sealing and refinishing sprays indoor and outdoor scenarios were assessed for dermal and inhalation due to the potential large area usage and spray application would facilitate volatilization of the product for inhalation. The overall confidence in this COU's inhalation exposure estimate is robust because the CEM default parameters represent actual use patterns and location of use. See Section 2.1.2 in U.S. EPA (2025d) for number of products, product examples, and weight fraction data. For dermal exposure, EPA used a dermal flux approach, which was estimated based on BBP <i>in vitro</i> dermal absorption in humans. An overall moderate confidence in dermal assessment of paints and coatings was assigned. Uncertainties about the effect formulations have in overall absorption increase uncertainty. Other parameters, such as frequency and duration of use and surface area in contact, are well understood and representative, resulting in a moderate overall confidence.	Inhalation – Robust Dermal – Moderate
Furnishing, cleaning, treatment/care products; Fabrics, textiles, and leather products	Two different scenarios were assessed under this COU for two article types with differing use patterns for which each scenario had also multiple identified article examples (in parenthesis): synthetic leather furniture (2), and synthetic leather clothing (>6). The synthetic leather furniture scenario was part of the indoor assessment and evaluated for all exposure routes. Clothing was assessed for dermal exposures only due to the very low concentration of BBP and limited use from the reported items or similar items, inhalation and ingestion is not expected to be significant. The overall confidence in this COU's inhalation and dust ingestion exposure estimate is robust because the CEM default parameters represent actual use patterns and location of use. See Section 2.1.2 in U.S. EPA (2025d) for number of products, product examples, and weight fraction data. The mouthing parameters used such as duration and surface area for infants to children are very well understood, while older groups have less specific information because mouthing behavior is not expected. The chemical migration value is BBP specific, and the main source of uncertainty are related to article formulation and chemical migration dynamics may not be very well characterized. Specifically, it is unclear whether the migration rate values are applicable to consumer goods with low (<15%) weight fractions of BBP.	Inhalation, and Dust Ingestion – Robust Mouthing – Slight to moderate Dermal – Moderate

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Consumer COU Category and Subcategory	Weight of Scientific Evidence	Overall Confidence
	For dermal exposure, EPA used a dermal flux approach, which was estimated based on BBP <i>in vitro</i> dermal absorption in humans. An overall moderate confidence in dermal assessment of synthetic leather textiles was assigned. Uncertainties about the effect formulations have in overall absorption increase uncertainty. Other parameters, such as frequency and duration of use and surface area in contact, are well understood and representative, resulting in a moderate overall confidence.	
Furnishing, cleaning, treatment/care products; Floor coverings; construction and building materials covering large surface areas including stone, plaster, cement, glass and ceramic articles fabrics, textiles, and apparel	One scenario was assessed under this COU for one article type: vinyl flooring. This scenario was part of the indoor assessment and evaluated for all exposure routes except mothing. The overall confidence in this COU's inhalation and dust ingestion exposure estimate is robust because the CEM default parameters represent actual use patterns and location of use. See Section 2.1.2 in U.S. EPA (2025d) for number of products, product examples, and weight fraction data. For dermal exposure, EPA used a dermal flux approach, which was estimated based on BBP <i>in vitro</i> dermal absorption in humans. An overall moderate confidence in dermal assessment of vinyl flooring was assigned. Uncertainties about the effect formulations have in overall absorption increase uncertainty. Other parameters, such as frequency and duration of use and surface area in contact, are well understood and representative, resulting in a moderate overall confidence.	Inhalation, and Dust Ingestion – Robust Dermal – Moderate
Other uses; Automotive products, fluids	Two different scenarios were assessed under this COU for products with differing use patterns for which each scenario had varying number of identified product examples (in parenthesis): Automotive lubricants (2), and interior car care (1). Of these two scenarios, automotive lubricants were assessed for dermal exposures only because inhalation and ingestion would have low exposure potential. Interior car care product was assessed for dermal and inhalation because the spray application promotes volatilization of the product and inhalation. The overall confidence in this COU's inhalation exposure estimate is robust because the CEM default parameters represent actual use patterns and location of use. See Section 2.1.2 in U.S. EPA (2025d) for number of products, product examples, and weight fraction data. For dermal exposure, EPA used a dermal flux approach, which was estimated based on BBP <i>in vitro</i> dermal absorption in humans. An overall moderate confidence in dermal assessment of fluid automotive products was assigned. Uncertainties about the effect formulations have in overall absorption increase uncertainty. Other parameters, such as frequency and duration of use and surface area in contact, are well understood and representative, resulting in a moderate overall confidence.	Inhalation – Robust Dermal – Moderate
Other uses; Automotive articles	One scenario was assessed under this COU for one article type: car mats. This scenario was part of the indoor assessment and evaluated for all exposure routes except mothing. The overall confidence in this COU's inhalation and dust ingestion exposure estimate is robust because the CEM default parameters represent actual use patterns and location of use. See Section 2.1.2 in U.S. EPA (2025d) for number of products, product examples, and weight fraction data. For dermal exposure, EPA used a dermal flux approach, which was estimated based on BBP <i>in vitro</i> dermal absorption in humans. An overall moderate confidence in dermal assessment of car mats was assigned. Uncertainties about the effect formulations have in overall absorption increase uncertainty. Other parameters, such as frequency and duration of use, and surface area in contact, are well understood and representative, resulting in a moderate overall confidence.	Inhalation, and Dust Ingestion – Robust Dermal – Moderate

PUBLIC RELEASE DRAFT
July 2025

Consumer COU Category and Subcategory	Weight of Scientific Evidence	Overall Confidence
Other uses; Novelty articles	One scenario was assessed under this COU for one article type: adult toys. This scenario was assessed for dermal and mouthing. More than one article input parameter captures the variability in product use represented in the high, medium, and low intensity use estimates, such as mouthing surface area and dermal contact frequency. The overall confidence in this COU dermal and mouthing exposure estimate is moderate. The mouthing parameters used such as duration and surface area for infants to children are very well understood, while older groups have less specific information because mouthing behavior is not expected, hence EPA made some assumptions for adult mouthing surface area are based on available measurements. EPA has moderate confidence that the assumptions were based of reliable adult mouth surface area, but some uncertainties remain on mouthing behavior, duration, and frequency for this COU article examples, adult toys. The chemical migration value is BBP specific, and the main source of uncertainty are related to article formulation and chemical migration dynamics may not be very well characterized. Specifically, it is unclear whether the migration rate values are applicable to consumer goods with low (<15%) weight fractions of BBP. For dermal exposure, EPA used a dermal flux approach, which was estimated based on BBP <i>in vitro</i> dermal absorption in humans. An overall moderate confidence in dermal assessment of adult toys was assigned. Uncertainties about the effect formulations have in overall absorption increase uncertainty. However, other parameters, such as frequency and duration of use and surface area in contact, are well understood and representative, resulting in a moderate overall confidence.	Dermal – Moderate Mouthing – Slight to moderate
Packaging, paper, plastic, hobby products; Ink, toner, and colorant products	One scenario was assessed under this COU for one product type with varying number of identified product examples (in parenthesis): Inks and dyes (2). This scenario was assessed for dermal exposure only because inhalation and ingestion would have low exposure potential. For dermal exposure, EPA used a dermal flux approach, which was estimated based on BBP <i>in vitro</i> dermal absorption in humans. An overall moderate confidence in dermal assessment of inks and dyes was assigned. Uncertainties about the effect formulations have in overall absorption increase uncertainty. Other parameters, such as frequency and duration of use and surface area in contact, are well understood and representative, resulting in a moderate overall confidence.	Dermal – Moderate
Packaging, paper, plastic, hobby products; Toys, playground, and sporting equipment	Three different scenarios were assessed under this COU for various articles with differing use patterns: legacy children’s toys, new children’s toys, and tire crumb. Toys scenarios were included in the indoor assessment for all exposure routes, inhalation, dust ingestion, mouthing, and dermal with varying use patterns and inputs. Tire crumb was also part of the indoor assessment for all exposure routes except mouthing. The overall confidence in this COU’s inhalation and dust ingestion exposure estimate is robust because the CEM default parameters represent actual use patterns and location of use. See Section 2.1.2 in U.S. EPA (2025d) for number of products, product examples, and weight fraction data. The overall confidence in this COU mouthing and dermal exposure assessment is moderate. The mouthing parameters used such as duration and surface area for infants to children are very well understood, while older groups have less specific information because mouthing behavior is not expected. The chemical migration value is BBP specific, and the main source of uncertainty are related to article formulation and chemical migration dynamics may not be very well characterized. Specifically, it is unclear whether the migration rate values are applicable to consumer goods with low (<15%) weight fractions of BBP.	Inhalation and Dust Ingestion – Robust Dermal – Moderate Mouthing – Slight to moderate

Consumer COU Category and Subcategory	Weight of Scientific Evidence	Overall Confidence
	For dermal exposure EPA used a dermal flux approach, which was estimated based on BBP <i>in vitro</i> dermal absorption in humans. An overall moderate confidence in dermal assessment of toys and tire crumb was assigned. Uncertainties about the effect formulations have in overall absorption increase uncertainty. Other parameters, such as frequency and duration of use and surface area in contact, are well understood and representative, resulting in a moderate overall confidence.	
Packaging, paper, plastic, hobby products; Packaging (excluding food packaging) and other articles with routine direct contact during normal use, including rubber articles; plastic articles (hard); plastic articles (soft)	One scenario was assessed under this COU for a collective of small articles with potential for semi-routine contact, such as packaging, including plastic bags and pouches, vinyl shelf liner, bottom surface of shoe, small exterior clothing components, disposable gloves. This scenario was assessed for dermal exposure only because inhalation and ingestion would have low exposure potential. For dermal exposure EPA used a dermal flux approach, which was estimated based on BBP <i>in vitro</i> dermal absorption in humans. An overall moderate confidence in dermal assessment of these articles was assigned. Uncertainties about the effect formulations have in overall absorption increase uncertainty. Other parameters, such as frequency and duration of use and surface area in contact, are well understood and representative, resulting in a moderate overall confidence.	Dermal – Moderate
Packaging, paper, plastic, hobby products; Arts, crafts, and hobby materials	One scenario was assessed under this COU for a collective of small articles with potential for semi-routine contact, such as modeling clay, jewelry making crafts. This scenario was assessed for dermal exposure only because inhalation and ingestion would have low exposure potential. For dermal exposure EPA used a dermal flux approach, which was estimated based on BBP <i>in vitro</i> dermal absorption in humans. An overall moderate confidence in dermal assessment of these articles was assigned. Uncertainties about the effect formulations have in overall absorption increase uncertainty. Other parameters, such as frequency and duration of use and surface area in contact, are well understood and representative, resulting in a moderate overall confidence.	Dermal – Moderate

4.1.3 General Population Exposures

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

EPA began its BBP 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 BBP, this exposure assessment relies upon EPA estimated releases which do not include actual location data for BBP 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, 2019c).

EPA evaluated the reasonably available information for releases of BBP from facilities that manufacture, process, or use BBP under industrial and/or commercial COUs subject to TSCA regulations detailed in the *Draft Environmental Release and Occupational Exposure Assessment for Butyl Benzyl Phthalate (BBP)* ([U.S. EPA, 2025t](#)). Using the release estimates, EPA modeled predicted concentrations of BBP in surface water, sediment, drinking water, and ambient air in the United States. Table 3-6 summarizes the high-end BBP concentrations in environmental media from environmental releases. The reasoning for assessing different pathways qualitatively or quantitatively is briefly discussed below and additional detail can be found in the *Draft Environmental Media, General Population, and Environmental Exposure Butyl Benzyl Phthalate (BBP)* ([U.S. EPA, 2025r](#)).

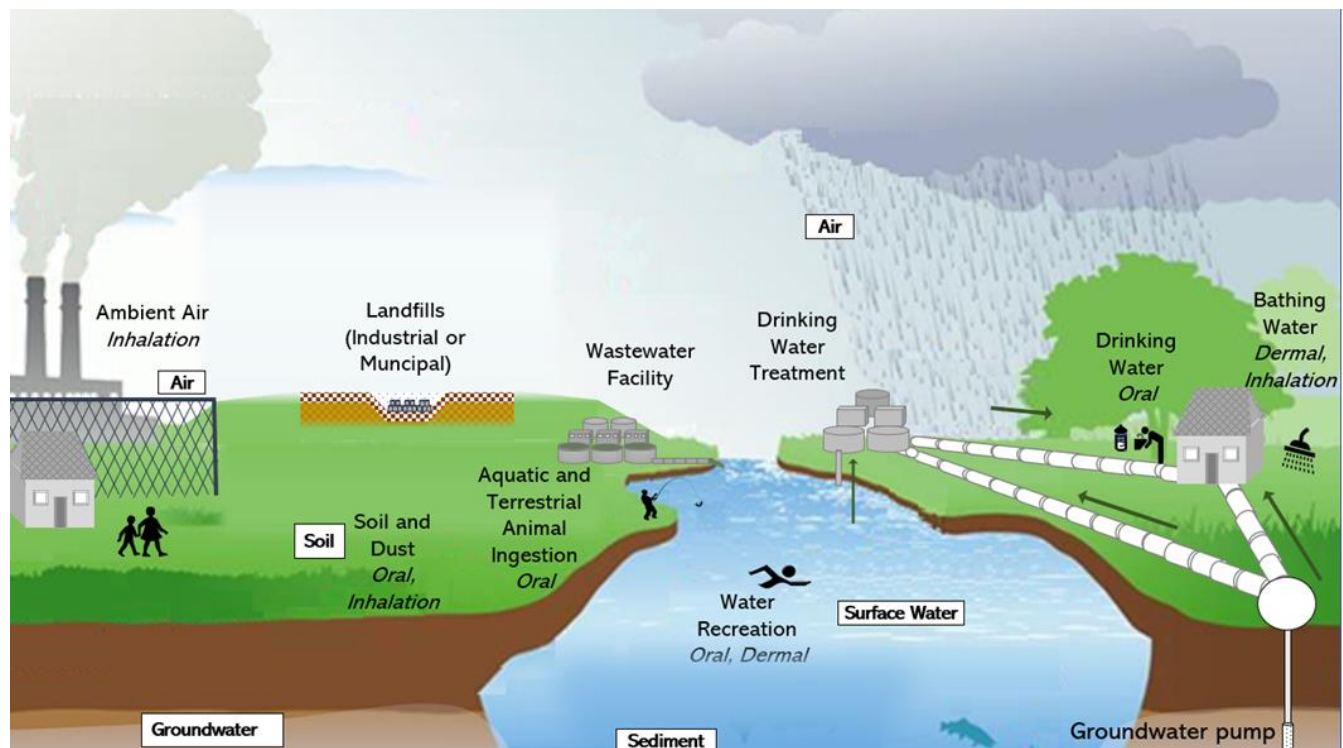


Figure 4-2. Potential Human Exposure Pathways to BBP for the General Population

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

High-end estimates of BBP concentration in the various environmental media presented in the *Draft Environmental Media, General Population, and Environmental Exposure Butyl Benzyl Phthalate (BBP)* ([U.S. EPA, 2025r](#)) were used for screening level purposes in the general population exposure assessment. EPA's *Guidelines for Human Exposure Assessment* ([U.S. EPA, 2019c](#)) 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 OESs/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 4.1.3.1, EPA focused on estimating high-end concentrations of BBP 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 BBP 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 OESs resulting in lower environmental media concentrations were not considered for this screening level assessment. Additionally, EPA considered individuals with the highest intake rate of BBP per body weight 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 lifestage 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 soil or groundwater resulting from BBP release to the environment via biosolids or landfills was not quantitatively assessed because BBP concentrations in the environment resulting from biosolids and landfill releases were not quantified. Due to the high confidence in the biodegradation rates and physical and chemical data, there is robust confidence that BBP will not be mobile and will have low persistence potential in receiving soils, and there is robust confidence that BBP 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 *Draft Environmental Media, General Population, and Environmental Exposure Butyl Benzyl Phthalate (BBP)* ([U.S. EPA, 2025r](#)). For the purpose of a screening level analysis, EPA selected OESs representing those resulting in the highest modeled environmental media concentrations.

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

OES	Exposure Pathway	Exposure Route	Exposure Scenario	Lifestage	Analysis (Quantitative or Qualitative) ^a
All	Biosolids	All scenarios assessed qualitatively			Qualitative
All	Landfills	All scenarios assessed qualitatively			Qualitative
Manufacturing	Surface water	Dermal	Dermal exposure to DBP in surface water during swimming	All	Quantitative
		Oral	Incidental ingestion of DBP in surface water during swimming	All	Quantitative
Manufacturing	Drinking water	Oral	Ingestion of drinking water	All	Quantitative
All	Fish ingestion	Oral	Ingestion of fish for general population	Adults (16 to <70 years) and young toddlers (1–2 years old)	Quantitative

OES	Exposure Pathway	Exposure Route	Exposure Scenario	Lifestage	Analysis (Quantitative or Qualitative) ^a
All			Ingestion of fish for subsistence fishers	Adults (16 to <70 years old)	Quantitative
PVC plastics compounding			Ingestion of fish for tribal populations	Adults (16 to <70 years old)	Quantitative
Use of paints and coatings – no spray controls	Ambient air	Inhalation	Inhalation of BBP in ambient air from industrial releases	All	Quantitative
		Oral	Ingestion of BBP in soil from air to soil deposition resulting from industrial releases	Infants and children (6 months to 12 years)	Quantitative
^a Note that all section references are for the <i>Draft Environmental Media, General Population, and Environmental Exposure Assessment for Dibutyl Phthalate (DBP)</i> (U.S. EPA, 2025g).					

EPA also considered biomonitoring data, specifically urinary biomonitoring data from CDC’s NHANES, to estimate exposure using reverse dosimetry (see Section 4.1.3.2 of this document and Section 11 of the *Draft Environmental Media, General Population, and Environmental Exposure Butyl Benzyl Phthalate (BBP)* ([U.S. EPA, 2025r](#))). Reverse dosimetry, which is a process estimating an external exposure based on biomonitoring data, is a powerful tool for estimating exposure, but reverse dosimetry modeling does not distinguish between routes or pathways of exposure and does not allow for source apportionment (*i.e.*, exposure from COUs cannot be isolated from uses that are not subject to TSCA). Instead, reverse dosimetry provides an estimate of the total dose (or aggregate exposure) responsible for the measured biomarker and can help contextualize the exposure estimates from exposure pathways outlined in Table 4-8 as being potentially underestimated or overestimated.

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 and landfills) qualitatively. Regarding the application of biosolids, once in the soil, BBP is expected to have a high affinity to soil ($\log K_{OC} = 3.2\text{--}4.2$) and organic media ($\log K_{OW} = 4.7$), which would limit mobility from biosolids or biosolid-amended soils. Similarly, high sorption to particulates and organics would likely lead to high retardation, limiting infiltration into and mobility within surrounding groundwater systems. BBP is slightly soluble in water (2.69 mg/L) and has limited potential to leach from biosolids and infiltrate into deeper soil strata. However, it is not expected to migrate as far as groundwater given the minimum depth to groundwater required for biosolids agricultural applications stated in 40 CFR 503. One 1997 study evaluating a variety of phthalates (but not including BBP) reported a leaching potential of one gram of phthalates per ton of refuse in benchtop leaching studies simulating landfill conditions with residential waste ([Bauer and Herrmann, 1997](#)). This suggests that BBP can exist in landfill leachate similarly to other phthalates. However, given the limited expected mobility of BBP in soil, infiltration of BBP in leachate or infiltrating stormwater would be of minimal concern to deeper groundwater systems.

There are limited measured data reasonably available on concentrations of BBP in biosolids or soils receiving biosolids, and there is uncertainty that concentrations used in this analysis are representative of all types of environmental releases relevant to COUs. However, the high-quality biodegradation rates

and physical and chemical properties suggest that BBP will have limited persistence potential and mobility in soils receiving biosolids.

Although based on the biodegradation and hydrolysis data for conditions relevant to landfills, there is high confidence that BBP will persist in landfills, it is unlikely for BBP to be present in landfill leachates and migrate through groundwater. Additionally, there is currently no direct evidence that the general population or surrounding fauna have been directly exposed to BBP through refuse or waste disposed of in landfills. While possible, there has been no data to suggest that BBP is present in environmental compartment adjacent to landfills as the direct result of landfill operations.

Surface Water Pathway – Incidental Ingestion and Dermal Contact from Swimming

EPA conducted modeling of releases to surface water at the point of release for relevant facilities (*i.e.*, in the immediate water body receiving the effluent) to estimate the resulting environmental media concentrations from the assessed COUs. The Agency conducted modeling with the U.S. EPA's Variable Volume Water Model with Point Source Calculator tool (VVWM-PSC) to estimate concentrations of BBP within surface water and to estimate settled sediment in the benthic region of streams. EPA derived acute incidental surface water exposures and acute drinking water exposures from the 30Q5 flow concentrations and derived chronic drinking water exposures from the harmonic mean (HM) flow concentrations. This approach evaluates shorter term exposures with a lower flow scenario, which can result in temporarily increased concentrations, while pairing longer-term exposures with a more average flow rate, following the guidance established in 40 CFR Part 131 for water quality standards. Section 3.3 and the *Draft Environmental Media, General Population, and Environmental Exposure Butyl Benzyl Phthalate (BBP)* ([U.S. EPA, 2025r](#)) detail the estimation of surface water concentrations for use in the screening level assessment.

Releases associated with the Manufacturing OES resulted in the conservative high-end surface water concentrations appropriate for screening level assessments as described in Section 3.3, with 30Q5 water concentrations of 24,500 µg/L without wastewater treatment and 9,310 µg/L when assuming 62 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. These water column concentrations were used to estimate the acute dose rate (ADR) and average daily dose (ADD) from dermal exposure and incidental ingestion of BBP while swimming for adults (21+ years), youths (11–15 years), and children (6–10 years). EPA used information from dermal absorption studies to estimate dermal flux through skin as part of the dermal exposure estimates. Detailed results for all exposures can be found in *Draft Environmental Media, General Population, and Environmental Exposure Butyl Benzyl Phthalate (BBP)* ([U.S. EPA, 2025r](#)). In this section, exposure scenarios leading to the highest modeled dose are shown in Table 4-9.

For the purpose of a screening level assessment, EPA used a margin of exposure (MOE) approach using high-end exposure estimates presented in Table 4-9 as well as the human health hazard values and the benchmark MOE of 30 that includes the total uncertainty factors as presented in Table 4-13 to determine if exposure pathways were pathways of concern for potential non-cancer risks. Acute and chronic points of departure are the same as shown in Table 4-13, so for this assessment, EPA used acute exposure estimates (ADR values) because these were higher than chronic exposure estimates (ADD). MOEs for general population exposure through dermal exposure and incidental ingestion during swimming in untreated surface water for the most exposed lifestage were 49 and 92, respectively (Table 4-9). Based on a screening level assessment, risks for non-cancer health effects are not expected for the surface

water pathway; therefore, exposures due to incidental ingestion and dermal contact from swimming through the surface water pathway is not considered to be a pathway of concern to BBP for the general population.

Surface Water Pathway – Drinking Water

For the drinking water pathway, EPA used modeled surface water concentrations to estimate drinking water exposures. Section 3.3 and the *Draft Environmental Media, General Population, and Environmental Exposure Butyl Benzyl Phthalate (BBP)* ([U.S. EPA, 2025r](#)) detail the estimation of surface water concentrations for use in the screening level assessment. For screening level purposes, EPA used the high-end surface water concentrations resulting from PVC plastics compounding OES as described in Section 3.3 for its drinking water analysis, and focused on the acute drinking water scenario, which would result in greater exposure than the chronic drinking water scenario. COUs mapped to this OES are shown in Table 3-1. EPA calculated ADR and ADD values from drinking water exposure to BBP for various age groups but the most exposed lifestage, infants (birth to <1 year), is shown below. Detailed results for all exposures can be found in *Draft Environmental Media, General Population, and Environmental Exposure Butyl Benzyl Phthalate (BBP)* ([U.S. EPA, 2025r](#)). In this section, exposure scenarios leading to the highest modeled dose are shown in Table 4-9.

The MOE for general population exposure through drinking water exposure was 3 for the drinking water scenario for the lifestage with the highest exposure combined with other conservative assumptions including lack of wastewater treatment, use of acute exposure (ADR), and use of the OES with the highest exposure (Table 4-9). Although the infant (<1 year) MOE is below the benchmark MOE of 30, the likelihood of the high-end release loading in a low flow stream, drinking surface water from a location receiving untreated Manufacturing wastewater, without further drinking water treatment, is unlikely. Additionally, the surface water concentrations estimated for Manufacturing OES at P50 30Q5 flow with wastewater treatment (9.3 mg/L) and without wastewater treatment (24.5 mg/L) highly exceeds the water solubility of 2.69 mg/L, which is a more appropriate upper bound for the exposure scenario. When considering the releases from the Manufacturing OES paired with P75 flows, which may be more representative of the potential receiving water body if assuming a high-end release as represented in the generic scenario (as discussed in Section 3.3), the MOE is 44—even without consideration of wastewater treatment.

Because there is slight confidence in the surface water concentrations associated with the Manufacturing OES because of the conservative assumption of all discharge going directly to surface water, EPA also considered the PVC plastic compounding OES. EPA has greater confidence in the surface water concentrations associated with the PVC plastic compounding OES as described in Section 3.3.1.1 and has robust confidence that it is also appropriate for screening analysis. Acute MOEs were above the benchmark for PVC plastic compounding OES at P50 30Q5 flows when assuming wastewater treatment and P75 30Q5 flows even without applying wastewater treatment.

This draft assessment assumes that concentrations at the point of intake for the drinking water system are equal to the concentrations in the receiving waterbody 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 distance 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 BBP concentrations prior to releasing finished drinking water to customers. Therefore, based on screening level analysis, with MOEs below the benchmark only occurring at the highest end of

conservatively estimated exposures with an unlikely confluence of factors, risks for non-cancer health effects are not expected for the drinking water pathway either for an acute or chronic exposure scenario; therefore, the drinking water pathway is not considered to be a pathway of concern to BBP for the general population.

Table 4-9. General Population Surface Water and Drinking Water Exposure Summary

OES ^a	Water Column Concentrations	Incidental Dermal Surface Water ^c		Incidental Ingestion Surface Water ^d		Drinking Water ^e	
	30Q5 Conc. (µg/L)	ADR (mg/kg-day)	Acute MOE (Benchmark MOE = 30)	ADR (mg/kg-day)	Acute MOE (Benchmark MOE = 30)	ADR (mg/kg-day)	Acute MOE (Benchmark MOE = 30)
Manufacturing ^a <i>without wastewater treatment</i> (P50 flow rate with high-end release)	24,500	2.47E-01	49	1.31E-01	92	3.46	3
Manufacturing ^a <i>with wastewater treatment</i> (P50 flow rate with high-end release)	9,310	—	—	—	—	1.31	9
Manufacturing ^a <i>without wastewater treatment</i> (P75 flow rate with high-end release)	1,920	—	—	—	—	2.71E-01	44
PVC plastics compounding ^a <i>without wastewater treatment</i> (P50 flow rate with high-end release)	2,852	1.4E-02	417	1.53E-02	786	4.0E-01	30
PVC plastics compounding ^a <i>with wastewater treatment</i> (P50 flow rate with high-end release)	1,084	—	—	—	—	1.53E-01	78
PVC plastics compounding ^a <i>without wastewater treatment</i> (P75 flow rate with high-end release)	223	—	—	—	—	3.1E-02	381
Highest monitored surface water ^b	40	4.0E-04	30,000	2.1E-04	560,000	5.6E-03	2,125

ADR = acute dose rate; MOE = margin of exposure; OES = occupational exposure scenario; 30Q5 = 30 consecutive days of lowest flow over a 5-year period

^a Table 3-1 provides a crosswalk of industrial and commercial COUs to OES.

^b [NWQMC \(2021\)](#) reported the highest monitored surface water concentration does not correspond directly to 30Q5

^c Most exposed age group: Adults (21+ years)

^d Most exposed age group: Youths (11–15 years)

^e Most exposed age group: Infants (birth to <1 year)

Fish Ingestion

The key parameters to estimate human exposure to BBP via fish ingestion are the surface water concentration, bioaccumulation factor (BAF), and fish ingestion rate. Surface water concentrations for BBP associated with a particular COU were modeled using VVWM-PSC as described in Section 3.2. 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 BBP 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 7 of the *Draft Environmental Media, General Population, and Environmental Exposure Butyl Benzyl Phthalate (BBP)* ([U.S. EPA, 2025r](#)).

EPA evaluated exposure and potential risk to BBP 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 in Sections 7.2 and 7.3 of the *Draft Environmental Media, General Population, and Environmental Exposure Butyl Benzyl Phthalate (BBP)* ([U.S. EPA, 2025r](#)). Only the fish ingestion rate changes across the different populations; the surface water concentration and BAF remain the same. ADR and ADD values from fish ingestion exposure to BBP were calculated for all populations and multiple age groups and can be found in Section 7 of the *Draft Environmental Media, General Population, and Environmental Exposure Butyl Benzyl Phthalate (BBP)* ([U.S. EPA, 2025r](#)), but 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 *Draft Environmental Media, General Population, and Environmental Exposure Butyl Benzyl Phthalate (BBP)* ([U.S. EPA, 2025r](#)).

For the screening level analysis, EPA used BBP's water solubility as an upper limit of BBP concentration in surface water to estimate BBP concentration in fish tissue. EPA also incorporated the highest modeled surface water concentrations based on releases by the PVC plastics compounding OES when refinements were needed. As described in Section 3.3.1.1, OESs releasing to multiple media types had high uncertainties associated with estimates in the surface water concentration estimates when considering the use of generic scenarios to estimate releases, pairing with unknown receiving waterbody flows, and the lack of data to apportion releases to specific media types. This led to low confidence in the surface water concentrations associated with OESs such as Manufacturing as further described in the drinking water section above where it was initially considered. Therefore, the Manufacturing OES was not used for screening because of high uncertainties and low confidence in proportioning what fraction of a release is discharged to water. However, exposure and risk estimates using the Manufacturing OES that discharges to multiple media types and resulted in higher surface water concentrations than PVC plastics compounding were calculated for informational purposes only (see *Draft Fish Ingestion Risk Calculator for Butyl Benzyl Phthalate [BBP]* ([U.S. EPA, 2025u](#))).

Conservative exposure estimates based on the water solubility limit resulted in screening level risk estimates below the benchmark. Therefore, EPA refined its evaluation by using modeled surface water concentrations that are based on the highest estimated 95th percentile release for the PVC plastics

compounding OES, as well as the P50, P75, and P90 flow metrics from the distribution. Risk estimates for tribal populations are below the benchmark based on the current 95th percentile ingestion rate and the P50 flow without considering wastewater treatment (Table 4-10). This scenario represents the high-end of the estimated release distribution discharged to the lower end of the distribution of receiving waterbodies, resulting in high concentrations with no wastewater treatment assumptions applied. However, due to the general trend of the largest releasing facilities typical discharging to larger receiving waterbodies, as discussed in Section 4 of the *Draft Environmental Media, General Population, and Environmental Exposure Butyl Benzyl Phthalate (BBP)* ([U.S. EPA, 2025r](#)), the higher flow metrics (*i.e.*, P75 and P90) are expected to be more representative of the flow conditions associated with high-end releases from the BBP generic scenarios (see Section 3.3 for more details). The more refined exposure estimates using higher flow rates did not result in risk estimates below the benchmark for tribal populations based on current mean and high-end (*i.e.*, 95th percentile) fish ingestion rate. Additionally, when considering an expected wastewater treatment removal of 62 percent, even at the P50 flow, the MOE was above benchmark for tribal populations. Therefore, EPA concludes that exposure to BBP via fish ingestion is not a concern for the general population, subsistence fishers, or tribal populations for PVC plastic compounding. Because MOEs were not below the benchmark for the PVC plastic compounding OES, which resulted in the highest exposure scenario, no other OES and their corresponding COUs are expected to result in risk estimates below the benchmark.

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 (2.69 mg/L)	2.91E-01	41	1.18	10
Modeled surface water concentration for PVC plastics compounding, P50 harmonic mean flow without wastewater treatment (2.05 mg/L)	2.22E-01	54	8.96 E-01	13
Modeled surface water concentration for PVC plastics compounding, P50 harmonic mean flow with wastewater treatment (7.79 E-01 mg/L)	8.43E-02	142	3.40E-01	35
Modeled surface water concentration for PVC plastics compounding, P75 harmonic mean flow without wastewater treatment (1.53E-01 mg/L)	1.66E-02	724	6.69E-02	179
Modeled surface water concentration for PVC plastics compounding, P90 harmonic mean flow without wastewater treatment (3.48E-03 mg/L)	3.77E-04	31,849	1.52E-03	7,889
ADD = average daily dose; ADR = acute dose rate; MOE = margin of exposure ^a The 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 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, 2022c](#)).

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 BBP 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, 2019g](#)). 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 BBP from the ambient air at three distances from the releasing facility (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 *Draft Environmental Release and Occupational Exposure Assessment for Butyl Benzyl Phthalate (BBP)* ([U.S. EPA, 2025t](#)) 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 lifestages expected to be highly exposed based on exposure factors can be found in the *Draft Ambient Air Exposure Assessment for Benzyl Butyl Phthalate (BBP)* ([U.S. EPA, 2025b](#)). Inhalation exposure to BBP from ambient air is expected to be much higher than exposure to BBP 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 BBP was 231 kg/site-day. This value was categorized under the Use of paints and coatings – no spray 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). Since 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. EPA 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 BBP attributable to both fugitive and stack releases. While this captures the highest release of each type possible, it may overestimate total exposure of the general population to BBP.

The highest 95th percentile modeled daily average concentration used to derive acute non-cancer risk estimates for fugitive releases was $150 \mu\text{g}/\text{m}^3$ and for stack releases was $19.76 \mu\text{g}/\text{m}^3$. These concentrations occurred at 100 m from the releasing facility and together result in a total exposure from facility releases of $169.76 \mu\text{g}/\text{m}^3$.

The highest 95th percentile modeled annual average concentration used to derive chronic risk estimates for fugitive releases was 150 µg/m³ and for stack releases was 16.86 µg/m³. These concentrations occurred at 100 m from the releasing facility and together result in a total exposure from facility releases of 166.86 µg/m³.

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 *Draft Non-Cancer Human Health Hazard Assessment for Butyl Benzyl Phthalate (BBP)* ([U.S. EPA, 2025v](#)) and is based on an 80 kg adult. Based on the 95th percentile air concentrations, MOEs for general population exposure through inhalation of ambient air are 377 for acute and 384 for chronic (compared to a benchmark of 30) for an adult. Because the HEC was derived for adults, MOEs for other lifestages were not calculated. However, considering similar or smaller inhalation rates for younger lifestages 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 lifestages 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 (greater than an order of magnitude). Therefore, EPA concludes exposure to BBP via the ambient air pathway, inhalation route is not a concern for the general population for the Use of paints and coatings – no spray controls OES. Because MOEs were not below the benchmark for the Use of paints and coatings – no spray 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 BBP via the ambient air pathway, inhalation route is not a concern for the general population.

Table 4-11. General Population Ambient Air Inhalation 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 spray controls	169.76	377	166.86	384
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 BBP, the MOE for the Oral HED is 5,716,312. 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 Daily Intake Estimates for the U.S. Population Using NHANES Urinary Biomonitoring Data

In addition to using the screening level approach to calculate sentinel exposures to the general population from TSCA releases, EPA also analyzed urinary biomonitoring data from the CDC's NHANES dataset to provide context for aggregate exposures in the U.S. non-institutionalized civilian population. Details are provided in Section 11 of *Draft Environmental Media, General Population, and Environmental Exposure Butyl Benzyl Phthalate (BBP)* ([U.S. EPA, 2025r](#)) but are summarized below.

The NHANES dataset reports urinary concentrations for 15 phthalate metabolites specific to individual phthalate diesters. EPA analyzed data for mono-benzyl phthalate (MBzP) measured in 1999 to 2018 NHANES cycles, which is a major metabolite of and specific to BBP in humans. Urinary metabolite levels reported in the most recent NHANES survey (*i.e.*, 2017–2018) were used to calculate daily intake of BBP for various demographic groups reported within NHANES (Table 4-12) using reverse dosimetry. Median daily intake estimates of BBP across demographic groups ranged from 0.08 to 0.22 µg/kg-day, whereas 95th percentile daily intake estimates ranged from 0.34 to 2.46 µg/kg-day. The highest daily intake value estimated was for male toddlers (3 to <6 years old) and was 2.46 µg/kg-day at the 95th exposure percentile.

Using these exposure estimates, EPA calculated MOEs ranging from 55,000 to 150,000 at the 50th percentile and 4,900 to 35,000 at the 95th percentile across demographic groups using the acute/intermediate/chronic POD (*i.e.*, an HED of 12,000 µg/kg-day) based on effects on the developing male reproductive system consistent with phthalate syndrome (Table 4-13). The lowest calculated MOE of 4,900 was for male toddlers (aged 3 to <6 years), based on the 95th percentile exposure estimate. All calculated MOEs at the 50th and 95th percentiles were above the benchmark of 30, indicating that aggregate exposure to BBP alone does not pose a risk to the non-institutionalized, U.S. civilian population.

General population exposure estimates calculated herein from exposure to ambient air, surface water, fish ingestion, and soil from TSCA releases are not directly analogous to daily intake values estimated via reverse dosimetry from NHANES. Whereas NHANES may be used to provide context for aggregate exposures in the U.S. population, NHANES is not expected to capture exposures from specific TSCA COUs that may result in high-dose exposure scenarios (*e.g.*, occupational exposures to workers), as compared to EPA's general population exposure assessment that evaluates sentinel exposures for specific exposure scenarios corresponding to TSCA releases. However, as a screening level analysis, media specific general population exposure estimates calculated herein were compared to daily intake values calculated using reverse dosimetry of NHANES biomonitoring data. Comparison of the values shows that many of the exposure estimates resulting from incidental dermal contact or ingestion of surface water (assuming no wastewater treatment) (Table 4-9), and ingestion of fish for adults in tribal populations (assuming heritage ingestion rate) (Table 4-10) exceed the total daily intake values estimated using NHANES (Table 4-12).

Exposure estimates for the general population via ambient air, surface water, and drinking water resulting from TSCA releases quantified in this document are likely overestimates. This is because exposure estimates from individual pathways exceed the total intake values calculated from NHANES measured even at the 95th percentile of the U.S. population for all ages. Furthermore, this is consistent with the U.S. CPSC's conclusion that BBP exposure comes primarily from diet for women, infants, toddlers, and children and that the outdoor environment is not a major source of exposure to BBP ([CPSC, 2014](#)). Thus, although the general population exposure estimates calculated using a screening

level approach likely represent an overestimation of exposure, in no case did MOEs for these sentinel exposures fall below the benchmark MOE of 30, indicating no need for further refinement.

Table 4-12. Daily Intake Values and MOEs for BBP Based on Urinary Biomonitoring from the 2017–2018 NHANES Cycle

Demographic	50th Percentile Daily Intake (95% CI) (µg/kg-day)	95th Percentile Daily Intake (95% CI) (µg/kg-day)	50th Percentile MOE (Benchmark = 30)	95th Percentile MOE (Benchmark = 30)
All	0.12 (0.11–0.14)	0.85 (0.68–1.01)	100,000	14,000
Females	0.12 (0.1–0.14)	0.83 (0.54–1.11)	100,000	14,000
Males	0.13 (0.11–0.15)	0.85 (0.57–1.12)	92,000	14,000
White non-Hispanic	0.15 (0.12–0.18)	0.87 (0.54–1.2)	80,000	14,000
Black non-Hispanic	0.14 (0.11–0.16)	0.94 (0.63–1.24)	86,000	13,000
Mexican-American	0.11 (0.08–0.13)	0.78 (0.57–0.99)	109,000	15,000
Other	0.11 (0.09–0.13)	0.62 (0.23–1)	109,000	19,000
Above poverty level	0.18 (0.15–0.22)	1.15 (0.7–1.6)	67,000	10,000
Below poverty level	0.12 (0.1–0.14)	0.79 (0.56–1.01)	100,000	15,000
Toddlers (3 to <6 years)	0.22 (0.18–0.26)	1.74 (0.88–2.6)	55,000	7,000
Children (6 to <11 years)	0.14 (0.11–0.17)	0.85 (0.49–1.22)	86,000	14,000
Adolescents (12 to <16)	0.12 (0.07–0.16)	0.55 (0.26–0.83)	100,000	22,000
Adults (16+ years)	0.09 (0.07–0.11)	0.37 (0.28–0.47)	130,000	32,000
Male toddlers (3 to <6 years)	0.22 (0.15–0.3)	2.46 (0.84–4.07)	55,000	4,900
Male children (6 to <11 years)	0.16 (0.11–0.2)	0.84 (0.4–1.29)	75,000	14,000
Male adolescents (11 to <16 years)	0.14 (0.1–0.18)	0.64 ^a	86,000	19,000
Male adults (16+ years)	0.1 (0.07–0.12)	0.34 ^a	120,000	35,000
Female toddlers (3 to <6 years)	0.2 (0.14–0.27)	1.61 (0.72–2.5)	60,000	7,500
Female children (6 to <11 years)	0.12 (0.08–0.17)	0.88 (0.27–1.48)	100,000	14,000
Female adolescents (11 to <16 years)	0.1 (0.03–0.17)	0.53 (N/A) ^a	120,000	23,000
Women of reproductive age (16–49 years)	0.08 (0.06–0.11)	0.42 (0–0.85)	150,000	29,000
Female adults (16+ years)	0.08 (0.06–0.11)	0.42 (0–0.85)	150,000	29,000

^a 95% confidence intervals (CI) could not be calculated due to small sample size or a standard error of zero.

4.1.3.3 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—all of which are discussed in detail for ambient air, surface water, drinking water, and fish ingestion in the *Draft Environmental Media, General Population, and Environmental Exposure Butyl*

Benzyl Phthalate (BBP) ([U.S. EPA, 2025r](#)). EPA summarized its weight of scientific evidence using the following confidence descriptors: robust, moderate, slight, or indeterminate. The Agency used general considerations (*i.e.*, relevance, data quality, representativeness, consistency, variability, and 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 BBP 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 *Draft Environmental Media, General Population, and Environmental Exposure Butyl Benzyl Phthalate (BBP)* ([U.S. EPA, 2025r](#)). 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 draft 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 4.1.3.2 using NHANES data adding further confidence that the exposure estimates captured high-end exposure scenarios and were 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 potentially more susceptible for various reasons including their higher exposure per body weight, immature metabolic systems, and the potential for chemical toxicants to disrupt sensitive developmental processes. Reasonably available information from studies of experimental animal models also indicates that BBP is a developmental toxicant ([U.S. EPA, 2025v](#)). EPA considered exposure and hazard information, as well as pharmacokinetic models, to determine the most appropriate approach to evaluate infant exposure to BBP from human milk ingestion. Based on the evidence below, the Agency concluded that the most appropriate approach is to use human health hazard values that are based on fetal and infant effects following maternal exposure during the gestational and/or perinatal period. In other words, exposure and risk estimates from maternal exposure are expected to be protective of nursing infants as well.

BBP has the potential to accumulate in human milk because of its small mass (312.4 Daltons or g/mol) and lipophilicity ($\log K_{OW} = 4.73$). EPA identified nine biomonitoring studies, one of which is a U.S. study ([Hartle et al., 2018](#)), from reasonably available information that investigated if BBP or its metabolites were present in human milk. In the U.S. study, BBP was measured in 21 samples collected in the Mother's Milk Bank in California. The concentrations ranged from 1.59 to 83.2 ng/g lipid weight (lw) with a mean of 25.08 ng/g ([Hartle et al., 2018](#)). 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 COUs to overall exposure cannot be determined.

EPA considered infant exposure to BBP through human milk because the available biomonitoring data demonstrate that BBP can be present in human milk and hazard data demonstrate that the developing

male reproductive system may be particularly susceptible to the effects of BBP. Because of the possibility for BBP to be present in human milk, EPA explored the potential to model milk concentrations and concluded that there is insufficient information (*e.g.*, there are no sensitive and specific half-life data) available to support modeling of the milk pathway. The Agency also concluded that modeling is not needed to adequately evaluate risks associated with exposure through milk because the POD used in this assessment is based on male reproductive effects resulting from maternal exposures throughout sensitive phases of development. EPA therefore has confidence that the risk estimates calculated based on maternal exposures are protective of a nursing infant's greater susceptibility during this unique lifestage whether due to sensitivity or greater exposure per body weight. Further discussion of the human milk pathway is provided in the *Draft Environmental Media, General Population, and Environmental Exposure Butyl Benzyl Phthalate (BBP)* ([U.S. EPA, 2025r](#)).

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 draft BBP 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, and fish ingestion) to BBP exposure were identified for the general population.

EPA did not consider aggregate exposure scenarios across COUs because the Agency did not find any evidence to support such an aggregate analysis after considering the reasonably available information, 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).” For this draft 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. If 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 Hazard

4.2.1 Background

EPA evaluated reasonably available information of human health hazards associated with exposure to BBP. The Agency summarizes the use of reasonably available information to identify the non-cancer hazards associated with exposure to BBP and the PODs to be used to estimate risks from BBP exposures in the *Draft Non-Cancer Human Health Hazard Assessment for Butyl Benzyl Phthalate (BBP)* ([U.S. EPA, 2025v](#)). EPA summarizes the cancer and genotoxicity hazards associated with exposure to BBP in the *Draft Cancer Human Health Hazard Assessment for Di(2-ethylhexyl) Phthalate (DEHP), Dibutyl Phthalate (DBP), Diisobutyl Phthalate (DIBP), Butyl Benzyl Phthalate (BBP) and Dicyclohexyl Phthalate (DCHP)* ([U.S. EPA, 2025c](#)).

4.2.2 Non-Cancer Human Health Hazards of BBP

The majority of toxicokinetic data for BBP is derived from oral exposure studies. Toxicokinetic data on non-oral routes of exposure remains limited. Following oral exposure, BBP undergoes rapid hydrolysis into monobutyl phthalate (MBP) and monobenzyl phthalate (MBzP), followed by metabolism into hippuric acid and other identified minor metabolites, including glucuronidated MBP and MBzP metabolites. Whereas hippuric acid is the major BBP urinary metabolite in rats, MBzP is the predominant metabolite detected in human urine following oral exposure. BBP is rapidly absorbed by the gastrointestinal tract and generally undergo hepatic metabolism and biliary excretion, along with some distribution throughout many bodily compartments. BBP metabolites appear to have short half-lives, and there is no evidence for tissue accumulation. Available data suggest most orally administered dose of BBP is excreted through urine within 24 hours, albeit at excessively high doses, major fecal elimination is observed, potentially associated with saturated oral absorption. As stated in the *Draft Non-Cancer Human Health Hazard Assessment for Butyl Benzyl Phthalate (BBP)* ([U.S. EPA, 2025v](#)), EPA will assume an oral and inhalation absorption of 100 percent. For dermal absorption, EPA is proposing the use of dermal absorption data from *in vitro* studies ([DuPont, 2006a, b](#)) to estimate the dermal flux of BBP, as further described in summaries of occupational (Section 4.1.1), consumer (Section 4.1.2), and general population exposure (Section 4.1.3)

EPA identified effects on the developing male reproductive system as the most sensitive and robust non-cancer hazard associated with oral exposure to BBP in experimental animal models. Effects on the developing male reproductive system were also identified as the most sensitive and robust non-cancer effect following oral exposure to BBP by existing assessments of EPA ([2002b](#)), U.S. CPSC ([2014, 2010b](#)), Health Canada ([Health Canada, 2020](#); [EC/HC, 2015b](#); [2015](#); [EC/HC, 2000](#)), ECHA ([2017a, b, 2014, 2010, 2008b](#)), NICNAS ([2015](#)), European Chemicals Bureau (ECB) ([2007](#)), European Food Safety Authority (EFSA) ([2019](#)); California Office of Environmental Health Hazard Assessment (OEHHA) ([2012](#)), and the National Academies of Sciences, Engineering, and Medicine (NASEM) ([2017](#)). EPA also considered epidemiologic evidence qualitatively as part of hazard identification and characterization. However, epidemiologic evidence for BBP was not considered further for dose response analysis due to limitations and uncertainties in exposure characterization. Use of epidemiologic evidence qualitatively is consistent with phthalates assessment by Health Canada, U.S. CPSC, NICNAS, ECHA, and NASEM.

EPA identified 14 oral exposure studies (all in rats) that have investigated developing male reproductive system effects of BBP following gestational and/or perinatal exposure ([Gray et al., 2021](#); [Spade et al., 2018](#); [Debartolo et al., 2016](#); [Schmitt et al., 2016](#); [Ahmad et al., 2014](#); [Furr et al., 2014](#); [Howdeshell et al., 2008](#); [Aso et al., 2005](#); [Tyl et al., 2004](#); [Wilson et al., 2004](#); [Ema et al., 2003](#); [Ema and Miyawaki, 2002](#); [Gray et al., 2000](#); [Nagao et al., 2000](#)). Three studies were multi-generation reproduction studies of

BBP oral exposure ([Aso et al., 2005](#); [Tyl et al., 2004](#); [Nagao et al., 2000](#)). Across available studies, the most sensitive effects identified by EPA include effects on the developing male reproductive system consistent with a disruption of androgen action and development of phthalate syndrome. EPA is proposing a POD of 50 mg/kg-day (human equivalent dose [HED] of 12 mg/kg-day) based on phthalate syndrome-related effects on the developing male reproductive system (e.g., organ-level outcomes such as decreased anogenital distance [AGD]; decreased fetal testicular testosterone; testicular histopathology) to estimate non-cancer risks from oral exposure to BBP for acute, intermediate, and chronic durations of exposure in this draft risk evaluation. The proposed POD was derived from four co-critical prenatal exposure studies of BBP that support a no-observed-adverse-effect level (NOAEL) of 50 mg/kg-day ([Tyl et al., 2004](#)) and consensus lowest-observable-adverse-effect level (LOAEL) of 100 mg/kg-day ([Ahmad et al., 2014](#); [Furr et al., 2014](#); [Aso et al., 2005](#)). Across the co-critical studies, one multi-generational study identified a NOAEL of 50 mg/kg-day based on decreased AGD ([Tyl et al., 2004](#)), and the other three studies support a LOAEL of 100 mg/kg-day based upon decreased AGD, reduced *ex vivo* fetal testicular testosterone production, and slight increases in testicular pathology (i.e., decreased epididymal and prostate weight, decreased sperm count and motility, decreased epididymal germ cells, and testes softening) ([Ahmad et al., 2014](#); [Furr et al., 2014](#); [Aso et al., 2005](#)). The latter studies support the identified NOAEL.

The Agency has performed $\frac{3}{4}$ -body weight scaling to yield the HED and is applying the animal to human extrapolation factor (i.e., interspecies extrapolation; UF_A) of $3\times$ and a within human variability extrapolation factor (i.e., intraspecies extrapolation; UF_H) of $10\times$. Thus, a total UF of $30\times$ is applied for use as the benchmark MOE. Based on the strengths, limitations, and uncertainties of these studies, *EPA reviewed the weight of scientific evidence and has robust overall confidence in the proposed POD based on decreased AGD and related phthalate syndrome effects for use in characterizing risk from exposure to BBP for acute, intermediate, and chronic exposure scenarios.* The applicability and relevance of this POD is considered for all exposure durations (acute, intermediate, and chronic), as discussed in the *Draft Non-Cancer Human Health Hazard Assessment for Butyl Benzyl Phthalate (BBP)* ([U.S. EPA, 2025v](#)). Risk estimates based on the selected POD are relevant for women of reproductive age and males at any lifestage. Decreased AGD and phthalate syndrome effects (i.e., decreased fetal testicular testosterone) are the most sensitive endpoints. Additionally, there is epidemiological evidence that BBP exposure can adversely affect the developing male reproductive system consistent with phthalate syndrome in males of any age, and that BBP exposure at higher concentrations can cause other health effects in females as well (e.g., liver and kidney toxicity) (see the *Draft Non-Cancer Human Health Hazard Assessment for Butyl Benzyl Phthalate (BBP)* ([U.S. EPA, 2025v](#))). Therefore, EPA considers the proposed POD to be relevant across sex, lifestage, and durations. The Agency's proposed non-cancer POD for BBP will be peer reviewed by the SACC in 2025 and EPA will take into consideration SACC's recommendations for the final risk evaluation.

No data are reasonably available for the dermal or inhalation routes that are suitable for deriving route-specific PODs. Therefore, EPA is using the acute/intermediate/chronic oral POD to evaluate risks from dermal and inhalation exposure to BBP. For the dermal route, EPA accounted for differences in absorption in dermal exposure estimates in the draft risk evaluation for BBP. For the inhalation route, EPA is extrapolating the oral HED to an inhalation human equivalent concentration (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](#)). Table 4-13 summarizes EPA's selection of the oral HED and inhalation HEC values used to estimate non-cancer risk from acute/intermediate/chronic exposure to BBP in this draft risk evaluation of BBP.

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Exposure Scenario	Target Organ System	Species	Duration	POD (mg/kg-day)	Effects	HEC ^a (mg/m ³) [ppm]	HED ^a (mg/kg-day)	Benchmark MOE ^b	References (TSCA Study Quality Rating) ^c
Acute, Intermediate, Chronic	Developing male reproductive system	Rat	Multi-generational or 5–8 days during gestation	NOAEL = 50	Phthalate syndrome-related effects; for example: • ↓AGD • ↓ fetal testicular testosterone • ↓ reproductive organ weights • Leydig cell effects • ↓ mRNA and/or protein expression of steroidogenic genes; ↓INSL3	64.2 [5.03]	12	UF _A = 3 UF _H = 10 Total UF = 30	(Tyl et al., 2004) (Medium); (Ahmad et al., 2014) (Medium); (Furr et al., 2014) (High); (Aso et al., 2005) (Medium)

AGD = anogenital distance; HEC = human equivalent concentration; HED = human equivalent dose; INSL3: insulin-like 3; LOAEL = lowest-observed-adverse-effect level; MOE = margin of exposure; NOAEL = no-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 50 mg/kg-day.

^b EPA used allometric body weight scaling to the ³/₄-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. EPA used a default intraspecies (UF_H) of 10× to account for variation in sensitivity within human populations.

^c Tyl et al. (2004) support a NOAEL of 50 mg/kg-day based on decreased AGD and decreased reproductive organ weights in a multi-generational study at 250 mg/kg-day (LOAEL); the remaining effects listed reached statistical significance at higher doses (most of which are not considered adverse in isolation). Ahmad et al. (2014), Furr et al. (2014), and Aso et al. (2005) reflect supporting phthalate syndrome-related effects (e.g., reduced *ex vivo* testicular testosterone production or testicular histopathological changes) at LOAEL = 100 mg/kg-day.

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4.2.3 Cancer Human Health Hazards of BBP

Information pertaining to the genotoxicity and carcinogenicity of BBP is summarized in the *Draft 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, 2025c](#)). BBP has been evaluated for genotoxicity in a number of *in vitro* and *in vivo* test systems. Overall, reasonably available data support the conclusion that BBP is not likely to be mutagenic.

BBP has been evaluated for carcinogenicity by NTP in six chronic oral exposure studies, including five studies of F344/N rats and one of B6C3F1 mice ([NTP, 1997a, b, 1982](#)). BBP showed no carcinogenic activity in male or female B6C3F1 mice exposed to up to 1,800 mg/kg-day BBP through the diet for 2 years ([NTP, 1982](#)). Pancreatic adenomas and carcinomas represent a progression from pre-neoplastic pancreatic acinar cell hyperplasia. In male F344/N rats, treatment with 500 mg/kg-day BBP in the diet for 2 years caused a consistent and statistically significant increase in incidence of hyperplasia and pancreatic acinar cell tumors (PACTs) in two studies ([NTP, 1997a, b](#)). Marginal (statistically non-significant) increases in pancreatic acinar cell tumors were also observed in high-dose (*i.e.*, 1,200 mg/kg-day BBP) female F344/N rats in two studies ([NTP, 1997a, b](#)). Overall, EPA considers that the evidence supports the conclusion that chronic oral exposure to BBP induces PACTs in F344/N rats. As discussed further in the *Draft Cancer Human Health Hazard Assessment for DEHP, DBP, BBP, DIBP, and DCHP* ([U.S. EPA, 2025c](#)), read-across to other toxicologically similar phthalates such as DEHP and DBP that also induce PACTs in rats provides additional evidence to support the conclusion that phthalates, including BBP, can cause PACTs in rats, supporting EPA's conclusion.

Under the *Guidelines for Carcinogen Risk Assessment* ([U.S. EPA, 2005](#)), EPA reviewed the weight of scientific evidence for the carcinogenicity of BBP and has preliminarily determined that there is *suggestive evidence of carcinogenic potential* of BBP in rodents. According to those guidelines, a descriptor of *suggestive evidence* is appropriate “when the weight of evidence is suggestive of carcinogenicity; a concern for potential carcinogenic effects in humans is raised, but the data are judged not sufficient for a stronger conclusion. This descriptor covers a spectrum of evidence associated with varying levels of concern for carcinogenicity, ranging from a positive cancer result in the only study on an agent to a single positive cancer result in an extensive database that includes negative studies in other species.” EPA's determination is based on evidence of pancreatic acinar cell adenomas in male and female F344/N rats (only statistically significant in males), which was observed only in rats and not supported by further mechanistic or human data. Furthermore, in accordance with the *Guidelines for Carcinogen Risk Assessment* ([U.S. EPA, 2005](#)), when there is *Suggestive Evidence*, “the Agency generally would not attempt a dose-response assessment, as the nature of the data generally would not support one.” Therefore, EPA is not conducting a dose-response assessment for BBP or evaluating BBP for carcinogenic risk to humans.

Further information can be found in the *Draft 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, 2025c](#)).

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 4-14.

Table 4-14. Exposure Scenarios, Populations of Interest, and Hazard Values

Population of Interest and Exposure Scenario	Workers Male and female adolescents and adults (16+ years) and women of reproductive age directly working with BBP under light activity (breathing rate of 1.25 m ³ /h) (for further details see U.S. EPA (2025t)) <u>Exposure Durations</u> • <i>Acute</i> – 8 hours for a single workday • <i>Intermediate</i> – 8 hours per workday for 22 days per 30-day period • <i>Chronic</i> – 8 hours per workday for 250 days per year for 31 or 40 working years <u>Exposure Routes</u> • Inhalation and dermal (includes direct contact with products and mist and dust deposited on surfaces when appropriate for the COU)
	Occupational Non-Users Male and female adolescents and adults (16+ years old) indirectly exposed to BBP within the same work area as workers (breathing rate of 1.25 m ³ /h) (for further details see U.S. EPA (2025t)) <u>Exposure Durations</u> • <i>Acute, Intermediate, and Chronic</i> – same as workers <u>Exposure Routes</u> • Inhalation, dermal (for COUs where mist and dust deposited on surfaces but not direct product contact)
	Consumers Male and female infants (<1 year), toddlers (1–2 years), preschooler (3–5 years), middle childhood (6–10 years), young teens (11–15 years), teenagers (16–20 years), and adults (21+ years) exposed to BBP through product or article use (for further details see U.S. EPA (2025d)) <u>Exposure Durations</u> • <i>Acute</i> – 1 day exposure • <i>Intermediate</i> – 30-day period • <i>Chronic</i> – number of days per year specific to product and article use pattern <u>Exposure Routes</u> • Inhalation, dermal, and oral
	Bystanders Male and female infants (<1 year), toddlers (1–2 years), and preschooler (3–5 years), middle childhood (6–10 years) incidentally exposed to BBP through product use (for further details see U.S. EPA (2025d)) <u>Exposure Durations</u> • <i>Acute</i> – 1 day exposure • <i>Intermediate</i> – 30-day period • <i>Chronic</i> – number of days per year specific to product and article use pattern <u>Exposure Routes</u> • Inhalation

Population of Interest and Exposure Scenario	General Population Male and female infants, children, youth, and adults exposed to BBP through drinking water, surface water, ambient air, and fish ingestion (for further details see (U.S. EPA, 2025r)) <u>Exposure Durations</u> • <i>Acute</i> – Exposed to BBP continuously for a 24-hour period • <i>Chronic</i> – Exposed to BBP continuously for up to 78 years <u>Exposure Routes</u> • Inhalation, dermal, and oral (depending on exposure scenario)
	National Population Children aged 3–5, 6–11 years, and 11 to <16 years; male and female adults 16+ years; and women of reproductive age (16–49 years of age) exposed to DEHP, DBP, BBP, DIBP, and DINP through all exposure pathways and routes as measured through urinary biomonitoring (<i>i.e.</i>, NHANES) (for further details see the draft revised TSD for CRA (U.S. EPA, 2025ad)) <u>Exposure Durations</u> • Durations not easily characterized in urinary biomonitoring studies • Likely between acute and intermediate because 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. <u>Exposure Routes</u> • NHANES urinary biomonitoring data provides an estimate of aggregate exposure (<i>i.e.</i>, exposure through oral, inhalation, and dermal routes)
Health Effects, Concentration and Time Duration	Non-Cancer Acute/Intermediate/Chronic Value Sensitive health effect: Developmental toxicity (<i>i.e.</i>, effects on the developing male reproductive system consistent with phthalate syndrome) (for further details see (U.S. EPA, 2025v)) HEC Daily, continuous (assumes breathing rate of 0.6125 m³/h and 24 hours/day for continuous exposure (U.S. EPA, 2011a)) = 64.2 mg/m³ (5.03 ppm) HED Daily = 12 mg/kg-day; dermal and oral Total UF (benchmark MOE) = 30 (UF_A = 3; UF_H = 10) Hazard Relative Potency Relative potency factors for DEHP, DBP, BBP, DIBP, DCHP, and DINP were derived based on reduced fetal testicular testosterone. DBP was selected as the index chemical (for further details see (U.S. EPA, 2025ad)). RPF_{DEHP} = 0.84 RPF_{DBP} = 1 (index chemical) RPF_{BBP} = 0.52 RPF_{DIBP} = 0.53 RPF_{DCHP} = 1.66 RPF_{DINP} = 0.21 Index chemical (DBP) POD = HED Daily = 2.1 mg/kg-day Total UF (benchmark MOE) = 30 (UF_A = 3; UF_H = 10)
DBP = dibutyl phthalate; DEHP = diethylhexyl phthalate; DIBP = diisobutyl phthalate; DINP = dicyclohexyl phthalate; HEC = human equivalent concentration; MOE = margin of exposure; NHANES = National Health and Nutrition Examination Survey; POD = point of departure; RPF = relative potency factor; UF = uncertainty factor	

4.3.1.1 Estimation of Non-Cancer Risks from Exposure to BBP

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

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

Where:

<i>MOE</i>	=	Margin of exposure for acute, intermediate, or chronic risk comparison (unitless)
<i>Non-Cancer Hazard Value (POD)</i>	=	HEC (mg/m ³) or HED (mg/kg-day)
<i>Human Exposure</i>	=	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 BBP

As described in Section 4.1.5, EPA considered aggregate risk from exposure to BBP 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 below.

Equation 4-2. Total Margin of Exposure Calculation

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

Where:

<i>Total MOE</i>	=	Margin of exposure for aggregate scenario (unitless)
<i>MOE_{Oral}</i>	=	Margin of exposure for oral route (unitless)
<i>MOE_{Dermal}</i>	=	Margin of exposure for dermal route (unitless)
<i>MOE_{Inhalation}</i>	=	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 MOEs used to characterize non-cancer risk for workers from inhalation and dermal exposures, as well as aggregated exposures to BBP from individual BBP OESs and COUs across routes. MOEs are calculated for all exposed workers based on the BBP-derived PODs described in Section 4.2.2, as shown in (Table 4-17). This section provides discussion and characterization of risk

estimates for workers, including women of reproductive age and ONUs, for the various OESs and COUs.

Manufacturing

For the manufacture of BBP, dermal exposure to liquids is expected to be the dominant route of exposure. MOEs for high-end acute, intermediate, and chronic dermal exposure ranged from 3.5 to 5.5 (benchmark = 30) for average adult workers and women of reproductive age, while high-end inhalation MOEs for the same populations and exposure scenarios ranged from 190 to 306. The central tendency MOEs for the same populations and exposure scenarios ranged from 869 to 1,402 for inhalation exposure and 7.0 to 11 for dermal exposure. Aggregation of inhalation and dermal exposures led to negligible differences in risk when compared to risk estimates from dermal exposure alone. It was assumed that ONU inhalation exposures are equal to worker central tendency exposures (MOE > benchmark). Dermal exposure is not expected for ONUs in this OES.

The high-end and central tendency worker inhalation exposure results for this OES are based on one study that presented five data points for inhalation exposures to BBP during the manufacturing process. EPA used these data, which were provided in a risk evaluation conducted by the European Commission, Join Research Centre (ECJRC), to estimate inhalation exposure for this OES ([ECJRC, 2007](#)). ECJRC used samples from literature to develop a task-based exposure estimate for the production of BBP, including one exposure estimate each for the filling of truck tankers, drumming, and production. Most of the data points were presented as the mean of a range or as single data points. Two of the tanker truck loading measurements were for approximately 1 hour, but the study indicated that the site received and loaded three to four trucks per day, with each taking 60 to 90 minutes to fill. EPA built a worker 8-hour TWA accounting for four truck fillings, assuming 90 minutes for each and no exposure for the remainder of the shift. With five data points, the Agency characterized the data by taking the 95th percentile and the 50th percentile of the combined dataset to represent the high-end and central tendency. The underlying data had a medium data quality rating.

There is uncertainty about how well these data represent the true distribution of inhalation concentrations in this scenario. There is also uncertainty based on the lack of reasonably available ONU exposure data, for which EPA used central tendency worker exposure as surrogate data for inhalation exposures. Finally, there are only five data points used for the inhalation assessment. EPA also used the conservative assumption of 8 exposure hours per day and 250 exposure days per year based on continuous BBP exposure each working day for a typical worker schedule; it is uncertain whether this captures actual worker schedules and exposures.

As described in Section 4.1.1.4, EPA assumed dermal exposure to BBP occurred over a standard 8-hour workday and that BBP is contacted once per day with no use of proper PPE or handwashing. EPA also assumed a high-end (2-hand surface) value of 1,070 and 890 cm² for male and female workers, respectively. For central tendency estimates, EPA used half of the two-hand surface areas (*i.e.*, 535 cm² for male workers and 445 cm² for female workers). These conservative assumptions may lead to overestimation of dermal exposure. The value of absorptive flux for liquid (*i.e.*, 3.23×10^{-2} mg/cm²/h) was taken from Dupont *et al.* ([2006b](#)) of BBP applied to *in vitro* human skin. The concentration of the chemical and co-formulants may influence absorption rates, which adds additional uncertainty to these dermal risk estimates. A more detailed description of the strengths and uncertainties in the dermal exposure estimate for workers is provided in Section 4.1.1.5.1 and Table 4-5.

Due to limited inhalation data points and uncertainties present in the representativeness of the skin permeability data in the dermal exposure estimate, EPA used the central tendency values of exposure to

represent worker exposures within the COUs covered under the Manufacturing OES (*i.e.*, Manufacturing COU: Domestic manufacturing).

Import and Repackaging (Solids)

BBP is expected to be repackaged in both solid and liquid formulations. For the repackaging of solid BBP, inhalation exposure from dust generation is expected to be the dominant route of exposure, although neither the dermal nor the inhalation routes show risk. In support of this conclusion, MOEs for high-end acute, intermediate, and chronic inhalation exposure ranged from 58 to 93 for average adult workers and women of reproductive age, whereas high-end dermal MOEs for the same populations and exposure scenarios ranged from 1,008 to 1,601 (benchmark = 30). The central tendency MOEs for the same populations and exposure scenarios ranged from 1,317 to 2,552 for inhalation exposure and 2,015 to 3,848 for dermal exposure. Aggregation of inhalation and dermal exposures led to negligible differences in risk when compared to risk estimates from inhalation exposure alone. It was assumed that ONU inhalation and dermal exposures are equal to worker central tendency exposures (MOE > benchmark).

EPA estimated worker inhalation exposures using 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 NAICS codes starting with 45 (Wholesale and Retail Trade). EPA multiplied these dust concentrations by the industry provided maximum BBP concentration imported (*i.e.*, 30%) to estimate BBP particulate concentrations in the air. 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 BBP in workplace dust is the same as the maximum concentration of imported BBP. However, it is likely that the concentration of BBP in workplace dust is less than the concentration of BBP in the imported product due to the likelihood that the workplace dust contains a variety of constituents.

As described in Section 4.1.1.4, EPA assumed dermal exposure to BBP occurred over a standard 8-hour workday and that BBP is contacted once per day with no use of proper PPE or handwashing. EPA also assumed a high-end (2-hand surface) value of 1,070 and 890 cm² for male and female workers, respectively. For central tendency estimates, EPA used half of the two-hand surface areas (*i.e.*, 535 cm² for male workers and 445 cm² for female workers). These conservative assumptions may lead to overestimation of dermal exposure. The value of absorptive flux for solids (*i.e.*, 1.113×10⁻⁴ mg/cm²/h) was taken from Dupont *et al.* ([2006a](#)) of BBP in a film applied to *in vitro* human skin. A more detailed description of the strengths and uncertainties in the dermal exposure estimate for workers is provided in Section 4.1.1.5.1 and Table 4-5.

Due to the uncertainty in BBP concentration in workplace dust, EPA used central tendency values of exposure to represent worker exposures within the COUs covered under the Import and repackaging OES (*i.e.*, Manufacture COU: Importing).

Import and Repackaging (Liquids)

For the repackaging of liquid BBP, dermal exposure from liquid contact is expected to be the dominant route of exposure. In support of this conclusion, MOEs for high-end acute, intermediate, and chronic inhalation exposure ranged from 190 to 306 for average adult workers and women of reproductive age,

while high-end dermal MOEs for the same populations and exposure scenarios ranged from 3.5 to 5.5 (benchmark = 30). The central tendency MOEs for the same populations and exposure scenarios ranged from 869 to 1,685 for inhalation exposure and 7.0 to 13 for dermal exposure. Aggregation of inhalation and dermal exposures led to negligible differences in risk when compared to risk estimates from dermal exposure alone.

The high-end and central tendency worker inhalation exposure results for this OES are based on surrogate data from one study that presented five data points for inhalation exposures to BBP during the manufacturing process. EPA used these data, which were provided in a risk evaluation conducted by the ECJRC, to estimate inhalation exposure for this OES ([ECJRC, 2007](#)). ECJRC used samples from literature to develop a task-based exposure estimate for the production of BBP, including one exposure estimate each for the filling of truck tankers, drumming, and production. Most of the data points were presented as the mean of a range or as single data points and EPA treated them in the same way that EPA did in the Manufacturing OES. There is uncertainty in these estimates based on the following: (1) how well these data represent the true distribution of inhalation concentrations in this scenario, (2) the lack of ONU exposure data (and EPA used worker data as surrogate data), and (3) that there are only five data points used for the inhalation assessment.

As described in Section 4.1.1.4, EPA assumed dermal exposure to BBP occurred over a standard 8-hour workday and that BBP is contacted once per day with no use of proper PPE or handwashing. EPA also assumed a high-end (2-hand surface) value of 1,070 and 890 cm² for male and female workers, respectively. For central tendency estimates, EPA used half of the two-hand surface areas (*i.e.*, 535 cm² for male workers and 445 cm² for female workers). These conservative assumptions may lead to overestimation of dermal exposure. The value of absorptive flux for liquid (*i.e.*, 3.23×10⁻² mg/cm²/h) was taken from Dupont *et al.* ([2006b](#)) of BBP applied to *in vitro* human skin. The concentration of the chemical and co-formulants may influence absorption rates, which adds additional uncertainty to these dermal risk estimates. A more detailed description of the strengths and uncertainties in the dermal exposure estimate for workers is provided in Section 4.1.1.5.1 and Table 4-5.

Due to limited inhalation data points and uncertainties present in the representativeness of the skin permeability data in the dermal exposure estimate, EPA used the central tendency values of exposure to represent worker exposures within the COUs covered under the Import and repackaging OES (*i.e.*, Manufacturing COU: Importing; Processing COU: Repackaging).

Incorporation into Adhesives and Sealants (Solids)

For the incorporation of solid BBP into adhesive and sealant formulations, inhalation exposure from generated dust is expected to be the dominant route of exposure. In support of this, MOEs for high-end acute, intermediate, and chronic inhalation exposure ranged from 25 to 40 for average adult workers and women of reproductive age, whereas high-end dermal MOEs for the same populations and exposure scenarios ranged from 1,008 to 1,601 (benchmark = 30). The central tendency MOEs for the same populations and exposure scenarios ranged from 259 to 417 for inhalation exposure and 2,015 to 3,201 for dermal exposure. Aggregation of inhalation and dermal exposures led to negligible differences in risk when compared to risk estimates from inhalation exposure alone.

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 BBP concentration in the raw material (*i.e.*, 30%) to estimate BBP particulate concentrations in the air.

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 assume that the concentration of BBP in workplace dust is the same as the maximum concentration of the BBP raw material. However, it is likely that workplace dust contains a variety of constituents and that the concentration of BBP in workplace dust is less than the concentration of BBP in the raw material.

As described in Section 4.1.1.4, EPA assumed dermal exposure to BBP occurred over a standard 8-hour workday and that BBP is contacted once per day with no use of proper PPE or handwashing. EPA also assumed a high-end (2-hand surface) value of 1,070 and 890 cm² for male and female workers, respectively. For central tendency estimates, EPA used half of the two-hand surface areas (*i.e.*, 535 cm² for male workers and 445 cm² for female workers). These conservative assumptions may lead to overestimation of dermal exposure. The value of absorptive flux for solids (*i.e.*, 1.113×10⁻⁴ mg/cm²/h) was taken from Dupont *et al.* (2006a) of BBP in a film applied to *in vitro* human skin. A more detailed description of the strengths and uncertainties in the dermal exposure estimate for workers is provided in Section 4.1.1.5.1 and Table 4-5.

Due to uncertainty in BBP concentration in workplace dust, EPA used central tendency values of exposure to represent worker exposures within the COUs covered under the Incorporation into adhesives and sealants OES (*i.e.*, Processing COUs: Plasticizer [adhesive, paint and coating, printing ink, and all other basic inorganic chemical manufacturing]).

Incorporation into Adhesives and Sealants (Liquids)

For the incorporation of liquid BBP into adhesive and sealant formulations, dermal exposure from liquid contact is expected to be the dominant route of exposure. In support of this, MOEs for high-end acute, intermediate, and chronic inhalation exposure ranged from 869 to 1,402 for average adult workers and women of reproductive age, while high-end dermal MOEs for the same populations and exposure scenarios ranged from 3.5 to 5.5 (benchmark = 30). The central tendency MOEs for the same populations and exposure scenarios ranged from 1,738 to 2,803 for inhalation exposure and 7.0 to 11 for dermal exposure. Aggregation of inhalation and dermal exposures led to negligible differences in risk when compared to risk estimates from dermal exposure alone.

High-end and central tendency inhalation exposures were estimated using vapor inhalation monitoring data for sealant manufacturing from data collated in the risk evaluation conducted by ECJRC (2007). The data assessed by the ECJRC consisted of a single short-term personal breathing zone sample (the ECJRC data also contained three area monitoring non-detect measurements which were not considered in this assessment) taken from one sealant manufacturing site during the addition of BBP to the reaction vessel. The sample indicated an air concentration below 0.10 mg/m³, which EPA interpreted to be the LOD. With the sample at or below the LOD, EPA assessed inhalation exposures as a range from zero to the LOD. EPA estimated the high-end exposure as equal to the LOD and the central tendency as the midpoint (*i.e.*, half the LOD or 0.05 mg/m³). This source received a medium data quality rating in systematic review.

There is uncertainty about how well these data represent the true distribution of inhalation concentrations in this scenario. The uncertainty is a result of the lack of reasonably available ONU exposure data, for which EPA used worker data as surrogate data, and that there is only a single personal breathing zone data points used for the inhalation assessment that was below the LOD. EPA also

assumed 8 exposure hours per day and 250 exposure days per year based on continuous BBP exposure each working day for a typical worker schedule; it is uncertain whether this captures actual worker schedules and exposures.

As described in Section 4.1.1.4, EPA assumed dermal exposure to BBP occurred over a standard 8-hour workday and that BBP is contacted once per day with no use of proper PPE or handwashing. EPA also assumed a high-end (2-hand surface) value of 1,070 and 890 cm² for male and female workers, respectively. For central tendency estimates, EPA used half of the two-hand surface areas (*i.e.*, 535 cm² for male workers and 445 cm² for female workers). These conservative assumptions may lead to overestimation of dermal exposure. The value of absorptive flux for liquid (*i.e.*, 3.23×10⁻² mg/cm²/h) was taken from Dupont *et al.* (2006b) of BBP applied to *in vitro* human skin. The concentration of the chemical and co-formulants may influence absorption rates, which adds additional uncertainty to these dermal risk estimates. A more detailed description of the strengths and uncertainties in the dermal exposure estimate for workers is provided in Section 4.1.1.5.1 and Table 4-5.

Due to limited inhalation data points and uncertainties present in the representativeness of the skin permeability data in the dermal exposure estimate, the 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 (liquids) OES (*i.e.*, Processing COUs: Plasticizer [adhesive, paint and coating, printing ink, and all other basic inorganic chemical manufacturing]).

Incorporation into Formulation (Paints and Coatings/Other Formulations)

The approaches for assessing exposures for the incorporation of BBP into Paint and coating formulations OES and the incorporation of BBP into other formulations OES are identical and therefore consolidated here. For both OES, dermal exposure from liquid contact is expected to be the dominant route of exposure. In support of this, MOEs for high-end acute, intermediate, and chronic inhalation exposure ranged from 869 to 1,402 for average adult workers and women of reproductive age, while high-end dermal MOEs for the same populations and exposure scenarios ranged from 3.5 to 5.5 (benchmark = 30). The central tendency MOEs for the same populations and exposure scenarios ranged from 1,738 to 2,803 for inhalation exposure and 7.0 to 11 for dermal exposure. Aggregation of inhalation and dermal exposures led to negligible differences in risk when compared to risk estimates from dermal exposure alone. The same discussion under the Incorporation into adhesives and sealants (liquids) OES on limitations and strengths of the assessment of inhalation exposures to vapors and under the Manufacturing OES for dermal exposure to neat liquids apply to these OES.

The high-end and central tendency inhalation exposures for this OES are based on surrogate data from the Incorporation into adhesives and sealants (liquids) OES that were estimated using vapor inhalation monitoring data for sealant manufacturing from data collated in the risk evaluation conducted by ECJRC (2007). The data assessed by the ECJRC consisted of a single short-term personal breathing zone sample (the ECJRC data also contained 3 area monitoring non-detect measurements that were not considered in this assessment) taken from one sealant manufacturing site during the addition of BBP to the reaction vessel. The sample indicated an air concentration below 0.10 mg/m³, which EPA interpreted to be the LOD. With the sample at or below the LOD, EPA assessed inhalation exposures as a range from zero to the LOD. EPA estimated the high-end exposure as equal to the LOD and the central tendency as the midpoint (*i.e.*, half the LOD or 0.05 mg/m³). This source received a medium data quality rating in systematic review.

There is uncertainty about how well these data represent the true distribution of inhalation concentrations in this scenario, the lack of ONU exposure data, for which EPA used worker data as

surrogate data, and that there are only four data points used for the inhalation assessment that were all below the LOD. EPA also assumed 8 exposure hours per day and 250 exposure days per year based on continuous BBP exposure each working day for a typical worker schedule; it is uncertain whether this captures actual worker schedules and exposures.

As described in Section 4.1.1.4, EPA assumed dermal exposure to BBP occurred over a standard 8-hour workday and that BBP is contacted once per day with no use of proper PPE or handwashing. EPA also assumed a high-end (2-hand surface) value of 1,070 and 890 cm² for male and female workers, respectively. For central tendency estimates, EPA used half of the two-hand surface areas (*i.e.*, 535 cm² for male workers and 445 cm² for female workers). These conservative assumptions may lead to overestimation of dermal exposure. The value of absorptive flux for liquid (*i.e.*, 3.23×10⁻² mg/cm²/h) was taken from Dupont *et al.* (2006b) of BBP applied to *in vitro* human skin. The concentration of the chemical and co-formulants may influence absorption rates, which adds additional uncertainty to these dermal risk estimates. A more detailed description of the strengths and uncertainties in the dermal exposure estimate for workers is provided in Section 4.1.1.5.1 and Table 4-5.

Due to limited inhalation data points and uncertainties present in the representativeness of the skin permeability data in the dermal exposure estimate, the 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 [adhesive, paint and coating, printing ink, and all other basic inorganic chemical manufacturing]).

PVC Plastics Compounding

For PVC plastics compounding involving BBP, dermal and inhalation exposure routes are both expected to significantly contribute to exposures at the high-end prediction ranges. In support of this, MOEs for high-end acute, intermediate, and chronic inhalation exposure ranged from 20 to 32 for average adult workers and women of reproductive age, while high-end dermal MOEs for the same populations and exposure scenarios ranged from 3.5 to 5.5 (benchmark = 30). The central tendency MOEs for the same populations and exposure scenarios ranged from 122 to 220 for inhalation exposure and 6.9 to 12 for dermal exposure. Aggregation of inhalation and dermal exposures led to lower MOEs compared to either individual route; MOEs for high-end acute, intermediate, and chronic aggregated exposure ranged from 3.0 to 4.6 for average adult workers and women of reproductive age, while the central tendency MOEs for the same populations and exposure scenarios ranged from 6.6 to 12 for aggregated exposure

The high-end and central tendency worker inhalation exposure results for this OES are based on surrogate data from two data sets; one risk evaluation conducted by the ECJRC that consists of 44 data points on vapor exposures to BBP during PVC plastics converting and four full-shift monitoring samples expected to be for sampled dust in OSHA'S CEHD database. Some of the monitoring data were for sites that did both compounding and converting, and EPA included them in this OES. The ECJRC used samples from literature to develop a task-based exposure estimate for the production of BBP. Of the 44 data points, EPA determined that 20 were full-shift worker PBZ data and based the vapor inhalation exposure assessment on those metrics (ECJRC, 2007). With 20 data points, EPA characterized the vapor inhalation data by taking the 95th percentile and the 50th percentile of the combined dataset to represent the high-end and central tendency. The CEHD dataset does not describe individual worker tasks for each sample, but all samples were collected over 5 to 7 hours and are expected to represent a full 8-hour shift. With four data points available, EPA defined the high-end for the dataset as the maximum and central tendency as the median value. The samples are expected to represent worker exposures to dust, though they may also represent vapor. EPA assessed both vapor and dust datasets together, so there may be

some duplication of vapor exposure, though dust is expected to be the predominant inhalation exposure type. These data sources had medium data quality ratings.

As described in Section 4.1.1.4, EPA assumed dermal exposure to BBP occurred over a standard 8-hour workday and that BBP is contacted once per day with no use of proper PPE or handwashing. EPA also assumed a high-end (2-hand surface) value of 1,070 and 890 cm² for male and female workers, respectively. For central tendency estimates, EPA used half of the two-hand surface areas (*i.e.*, 535 cm² for male workers and 445 cm² for female workers). These conservative assumptions may lead to overestimation of dermal exposure. The value of absorptive flux for solids (*i.e.*, 1.113×10⁻⁴ mg/cm²/h) was taken from Dupont *et al.* (2006a) of BBP in a film applied to *in vitro* human skin. A more detailed description of the strengths and uncertainties in the dermal exposure estimate for workers is provided in Section 4.1.1.5.1 and Table 4-5.

Due to limited inhalation data points and uncertainties present in the representativeness of the skin permeability data in the dermal exposure estimate, the 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 – incorporation into formulation, mixture, or reaction product COUs: Plasticizer (custom compounding of purchased resin; plastic material and resin manufacturing).

PVC Plastics Converting

For PVC plastics converting, inhalation exposure from dust generation is expected to be the dominant route of exposure. In support of this, MOEs for high-end acute, intermediate, and chronic inhalation exposure ranged from 20 to 32 for average adult workers and women of reproductive age, while high-end dermal MOEs ranged from 1,008 to 1,601 (benchmark = 30). For central tendency, MOEs for the same population and exposure scenarios ranged from 122 to 224 for inhalation exposure and 2,015 to 3,654 for dermal exposures. Aggregation of inhalation and dermal exposures led to negligible differences in risk when compared to risk estimates from inhalation exposure alone.

High-end and central tendency inhalation exposures were estimated using vapor inhalation monitoring data for 2 datasets; 1 risk evaluation conducted by the ECJRC that consists of 44 data points on vapor exposures to BBP during PVC plastics converting and 4 full-shift monitoring samples expected to be for sampled dust in OSHA'S CEHD database. Some of the monitoring data were for sites that did both compounding and converting, and EPA included them in this OES. The ECJRC used samples from literature to develop a task-based exposure estimate for the production of BBP. Of the 44 data points, EPA determined that 20 were full-shift worker PBZ data and based the vapor inhalation exposure assessment on those metrics (ECJRC, 2007). With 20 data points, EPA characterized the vapor inhalation data by taking the 95th and 50th percentile of the combined dataset to represent the high-end and central tendency. The CEHD dataset does not describe individual worker tasks for each sample, but all samples were collected over 5 to 7 hours and are expected to represent a full 8-hour shift. With four data points available, EPA defined the high-end for the dataset as the maximum and central tendency as the median value. The samples are expected to represent worker exposures to dust, though they may also represent vapor. Because EPA assessed both vapor and dust datasets together, there may be some duplication of vapor exposure, although dust is expected to be the predominant inhalation exposure type. These data sources had medium data quality ratings.

There is uncertainty about how well these data represent the true distribution of inhalation concentrations in this scenario and in the lack of ONU exposure data, for which EPA used worker data as surrogate data. EPA also assumed 8 exposure hours per day and 219 to 250 exposure days per year

based on continuous BBP exposure each working day for a typical worker schedule; it is uncertain whether this captures actual worker schedules and exposures.

As described in Section 4.1.1.4, EPA assumed dermal exposure to BBP occurred over a standard 8-hour workday and that BBP is contacted once per day with no use of proper PPE or handwashing. EPA also assumed a high-end (2-hand surface) value of 1,070 and 890 cm² for male and female workers, respectively. For central tendency estimates, EPA used half of the two-hand surface areas (*i.e.*, 535 cm² for male workers and 445 cm² for female workers). These conservative assumptions may lead to overestimation of dermal exposure. The value of absorptive flux for solids (*i.e.*, 1.113×10⁻⁴ mg/cm²/h) was taken from Dupont *et al.* (2006a) of BBP in a film applied to *in vitro* human skin. A more detailed description of the strengths and uncertainties in the dermal exposure estimate for workers is provided in Section 4.1.1.5.1 and Table 4-5.

Due to limited inhalation data points and uncertainties present in the representativeness of the skin permeability data in the dermal exposure estimate, the 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 – incorporation into articles COUs: Plasticizer [adhesive manufacturing; fabric, textile, apparel, and leather products manufacturing; building and construction materials manufacturing; plastics product manufacturing; transportation equipment manufacturing]).

Non-PVC Materials Compounding

For non-PVC materials compounding involving BBP, dermal and inhalation exposure routes are both expected to significantly contribute to exposures at the high-end prediction ranges, with dermal exposure being slightly dominant in its risk contribution. In support of this, MOEs for high-end acute, intermediate, and chronic inhalation exposure ranged from 20 to 32 for average adult workers and women of reproductive age, while high-end dermal MOEs for the same populations and exposure scenarios ranged from 3.5 to 5.5 (benchmark = 30). The central tendency MOEs for the same populations and exposure scenarios ranged from 122 to 210 for inhalation exposure and 6.9 to 12 for dermal exposure. Aggregation of inhalation and dermal exposures led to lower MOEs compared to either individual route; MOEs for high-end acute, intermediate, and chronic aggregated exposure ranged from 3.0 to 4.6 for average adult workers and women of reproductive age, while the central tendency MOEs for the same populations and exposure scenarios ranged from 6.6 to 11 for aggregated exposure

The high-end and central tendency worker inhalation exposure results for this OES are based on surrogate data from 2 datasets; 1 risk evaluation conducted by the ECJRC that consists of 44 data points on vapor exposures to BBP during PVC plastics converting and 4 full-shift monitoring samples expected to be for sampled dust in OSHA'S CEHD database. Some of the monitoring data were for sites that did both compounding and converting, and EPA included them in this OES. The ECJRC used samples from literature to develop a task-based exposure estimate for the production of BBP. Of the 44 data points, EPA determined that 20 were full-shift worker PBZ data and based the vapor inhalation exposure assessment on those metrics (ECJRC, 2007). With 20 data points, EPA characterized the vapor inhalation data by taking the 95th percentile and the 50th percentile of the combined dataset to represent the high-end and central tendency. The CEHD dataset does not describe individual worker tasks for each sample, but all samples were collected over 5 to 7 hours and are expected to represent a full 8-hour shift. With four data points available, EPA defined the high-end for the dataset as the maximum and central tendency as the median value. The samples are expected to represent worker exposures to dust, though they may also represent vapor. EPA assessed both vapor and dust datasets together, so there may be some duplication of vapor exposure, though dust is expected to be the predominant inhalation exposure type. These data sources had medium data quality ratings.

As described in Section 4.1.1.4, EPA assumed dermal exposure to BBP occurred over a standard 8-hour workday and that BBP is contacted once per day with no use of proper PPE or handwashing. EPA also assumed a high-end (2-hand surface) value of 1,070 and 890 cm² for male and female workers, respectively. For central tendency estimates, EPA used half of the two-hand surface areas (*i.e.*, 535 cm² for male workers and 445 cm² for female workers). These conservative assumptions may lead to overestimation of dermal exposure. The value of absorptive flux for solids (*i.e.*, 1.113×10⁻⁴ mg/cm²/h) was taken from Dupont *et al.* (2006a) of BBP in a film applied to *in vitro* human skin. A more detailed description of the strengths and uncertainties in the dermal exposure estimate for workers is provided in Section 4.1.1.5.1 and Table 4-5.

Due to limited inhalation data points and uncertainties present in the representativeness of the skin permeability data in the dermal exposure estimate, the central tendency values of exposure are expected to be most reflective of worker exposures within the COUs covered under the Non-PVC plastics compounding OES (*i.e.*, Processing – incorporation into formulation, mixture, or reaction product COUs: Plasticizer (custom compounding of purchased resin; rubber manufacturing); Industrial use COU: Other uses [castings]).

Non-PVC Materials Converting

For non-PVC materials converting, inhalation exposure from dust generation is expected to be the dominant route of exposure. In support of this, MOEs for high-end acute, intermediate, and chronic inhalation exposure ranged from 20 to 32 for average adult workers and women of reproductive age, while high-end dermal MOEs ranged from 1,008 to 1,601 (benchmark = 30). For central tendency, MOEs for the same population and exposure scenarios ranged from 122 to 224 for inhalation exposure and 2,015 to 3,654 for dermal exposures. Aggregation of inhalation and dermal exposures led to negligible differences in risk when compared to risk estimates from inhalation exposure alone.

The high-end and central tendency worker inhalation exposure results for this OES are based on surrogate data from two data sets; one risk evaluation conducted by the ECJRC that consists of 44 data points on vapor exposures to BBP during PVC plastics converting and four full-shift monitoring samples expected to be for sampled dust in OSHA'S CEHD database. Some of the monitoring data were for sites that did both compounding and converting, and EPA included them in this OES. The ECJRC used samples from literature to develop a task-based exposure estimate for the production of BBP. Of the 44 data points, EPA determined that 20 were full-shift worker PBZ data and based the vapor inhalation exposure assessment on those metrics (ECJRC, 2007). With 20 data points, EPA characterized the vapor inhalation data by taking the 95th percentile and the 50th percentile of the combined dataset to represent the high-end and central tendency. The CEHD dataset does not describe individual worker tasks for each sample, but all samples were collected over 5 to 7 hours and are expected to represent a full 8-hour shift. With four data points available, EPA defined the high-end for the dataset as the maximum and central tendency as the median value. The samples are expected to represent worker exposures to dust, though they may also represent vapor. EPA assessed both vapor and dust datasets together, so there may be some duplication of vapor exposure, though dust is expected to be the predominant inhalation exposure type. These data sources had medium data quality ratings.

As described in Section 4.1.1.4, EPA assumed dermal exposure to BBP occurred over a standard 8-hour workday and that BBP is contacted once per day with no use of proper PPE or handwashing. EPA also assumed a high-end (2-hand surface) value of 1,070 and 890 cm² for male and female workers, respectively. For central tendency estimates, EPA used half of the two-hand surface areas (*i.e.*, 535 cm² for male workers and 445 cm² for female workers). These conservative assumptions may lead to overestimation of dermal exposure. The value of absorptive flux for solids (*i.e.*, 1.113×10⁻⁴ mg/cm²/h)

was taken from Dupont *et al.* (2006a) of BBP in a film applied to *in vitro* human skin. A more detailed description of the strengths and uncertainties in the dermal exposure estimate for workers is provided in Section 4.1.1.5.1 and Table 4-5.

Due to limited inhalation data points and uncertainties present in the representativeness of the skin permeability data in the dermal exposure estimate, the central tendency values of exposure are expected to be most reflective of worker exposures within the COUs covered under the Non-PVC plastics converting OES (*i.e.*, Processing – incorporation into articles COUs: Plasticizer [adhesive manufacturing; fabric, textile, apparel, and leather products manufacturing; building and construction materials manufacturing; rubber product manufacturing; transportation equipment manufacturing]; Industrial use COU: Other uses [castings]).

Application of Adhesives and Sealants

For the application of adhesives and sealants containing BBP, dermal exposure to liquids is expected to be the dominant route of exposure. In support of this, MOEs for high-end acute, intermediate, and chronic inhalation exposure ranged from 17,382 to 28,032 for average adult workers and women of reproductive age, while high-end dermal MOEs ranged from 3.5 to 5.5 (benchmark = 30). For central tendency, MOEs for the same population and exposure scenarios ranged from 34,764 to 60,414 for inhalation exposure and 7.0 to 12 for dermal exposures. Aggregation of inhalation and dermal exposures led to negligible differences in risk when compared to risk estimates from dermal exposure alone.

High-end and central tendency inhalation exposures were estimated using data from the risk evaluation conducted by ECJRC for the mixing process of raw materials in a PVC float scenario as surrogate for this OES (ECJRC, 2007). The data from the ECJRC consisted of monitoring data from one site where all samples were below 0.005 mg/m³, which EPA expects is the limit of detection. Therefore, EPA could not create a full distribution of monitoring results. To estimate high-end exposures to workers exposures, EPA used the LOD of 0.005 mg/m³. To estimate central tendency worker exposure, EPA used half this value. EPA used these data as surrogate because it represents the handling of liquid BBP products in a similar manner expected for this OES (*e.g.*, no spray or other activity that may generate mists, aerosols, or particulates). Therefore, this data is expected to be representative of two-part sealants and adhesives in a paste or liquid form that is applied by hand. Literature and product data do not indicate the potential for spray coating; therefore, EPA did not assess mist exposures. This data source had a medium data quality rating.

There is uncertainty about how well these data represent the true distribution of inhalation concentrations in this scenario, in the lack of ONU exposure data, for which EPA used worker data as surrogate data, and in the fact that all data samples were below the LOD. EPA also assumed 8 exposure hours per day and 223 to 250 exposure days per year based on continuous BBP exposure each working day for a typical worker schedule; it is uncertain whether this captures actual worker schedules and exposures.

As described in Section 4.1.1.4, EPA assumed dermal exposure to BBP occurred over a standard 8-hour workday and that BBP is contacted once per day with no use of proper PPE or handwashing. EPA also assumed a high-end (2-hand surface) value of 1,070 and 890 cm² for male and female workers, respectively. For central tendency estimates, EPA used half of the two-hand surface areas (*i.e.*, 535 cm² for male workers and 445 cm² for female workers). These conservative assumptions may lead to overestimation of dermal exposure. The value of absorptive flux for liquid (*i.e.*, 3.23×10⁻² mg/cm²/h) was taken from Dupont *et al.* (2006b) of BBP applied to *in vitro* human skin. The concentration of the chemical and co-formulants may influence absorption rates, which adds additional uncertainty to these

dermal risk estimates. A more detailed description of the strengths and uncertainties in the dermal exposure estimate for workers is provided in Section 4.1.1.5.1 and Table 4-5.

Due to limited inhalation data points and uncertainties present in the representativeness of the skin permeability data in the dermal exposure estimate, the 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 OES (*i.e.*, Industrial and commercial use COUs: Construction, paint, electrical, and metal products [Adhesives and sealants]).

Application of Paints and Coatings

For the application of paints and coatings containing BBP, dermal and inhalation exposure routes are both expected to significantly contribute to exposures at both the central-tendency and high-end prediction ranges, with dermal exposures expected to be slightly dominant in its contribution. In support of this, MOEs for high-end acute, intermediate, and chronic inhalation exposure ranged from 3.9 to 6.3 for average adult workers and women of reproductive age, while high-end dermal MOEs for the same populations and exposure scenarios ranged from 3.5 to 5.5 (benchmark = 30). The central tendency MOEs for the same populations and exposure scenarios ranged from 43 to 69 for inhalation exposure and 7.0 to 11 for dermal exposure. Aggregation of inhalation and dermal exposures led to lower MOEs compared to either individual route; MOEs for high-end acute, intermediate, and chronic aggregated exposure ranged from 1.9 to 2.8 for average adult workers and women of reproductive age, while the central tendency MOEs for the same populations and exposure scenarios ranged from 6.1 to 9.4 for aggregated exposure.

To estimate inhalation exposures to vapors, EPA relied on surrogate vapor inhalation monitoring data for the application of plastisol identified during systematic review of literature sources ([ECJRC, 2007](#)). EPA determined that this data was generally relevant to the application of paint and coating products because plastisols can be manually spread on a substrate similar to a paint or coating with comparable BBP concentrations. The data from the ECJRC consisted of 13 PBZ inhalation monitoring data points from three sites. With 13 data points, EPA characterized the data by taking the 95th percentile and the 50th percentile of the combined dataset to represent the high-end and central tendency. This data source had a medium data quality rating.

EPA assessed inhalation exposure to mist using monitoring data from the ESD on Coating Application via Spray-Painting in the Automotive Refinishing Industry ([OECD, 2011a](#)). The ESD indicated a central tendency (*i.e.*, 50th percentile) of 8-hour TWA mist concentrations from automotive refinishing of 3.38 mg/m³ and a high-end concentration (*i.e.*, 95th percentile) of 22.1 mg/m³. The underlying mist concentration data considered in the ESD reflected a variety of industrial and commercial automotive refinishing scenarios (*e.g.*, different gun types and booth configurations), but all scenarios used the spray application of auto refinishing coatings. The more highly pressurized spray guns led to higher exposure levels, and less pressurized spray guns led to lower exposure levels. Therefore, the high-end inhalation exposure estimates are more representative of high-pressure spray applications (*e.g.*, conventional spray guns) whereas the central tendency estimates are more representative of low-pressure applications (*e.g.*, HVLV spray guns).

There is uncertainty about how well these data represent the true distribution of inhalation concentrations in this scenario and in the lack of ONU exposure data, for which EPA used worker data as surrogate data. EPA also assumed 8 exposure hours per day and 250 exposure days per year based on continuous BBP exposure each working day for a typical worker schedule; it is uncertain whether this captures actual worker schedules and exposures.

As described in Section 4.1.1.4, EPA assumed dermal exposure to BBP occurred over a standard 8-hour workday and that BBP is contacted once per day with no use of proper PPE or handwashing. EPA also assumed a high-end (2-hand surface) value of 1,070 and 890 cm² for male and female workers, respectively. For central tendency estimates, EPA used half of the two-hand surface areas (*i.e.*, 535 cm² for male workers and 445 cm² for female workers). These conservative assumptions may lead to overestimation of dermal exposure. The value of absorptive flux for liquid (*i.e.*, 3.23×10⁻² mg/cm²/h) was taken from Dupont *et al.* (2006b) of BBP applied to *in vitro* human skin. The concentration of the chemical and co-formulants may influence absorption rates, which adds additional uncertainty to these dermal risk estimates. A more detailed description of the strengths and uncertainties in the dermal exposure estimate for workers is provided in Section 4.1.1.5.1 and Table 4-5.

Due to limited inhalation data points and uncertainties present in the representativeness of the skin permeability data in the dermal exposure estimate, the 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 OES (*i.e.*, Industrial and commercial use COUs: Construction, paint, electrical, and metal products (paints and coatings) and Packaging, paper, plastic, hobby products (inks, toner, and colorant products)).

Use of Laboratory Chemicals

The use of laboratory chemicals was assessed for solid and liquid products containing BBP. Dermal exposure is expected to be the dominant route of exposure for solid lab chemicals, though neither the dermal nor the inhalation route shows risk. In support of this, MOEs for high-end acute, intermediate, and chronic inhalation exposure ranged from 5,901 to 9,517 for average adult workers and women of reproductive age, while high-end dermal MOEs ranged from 554 to 880 (benchmark = 30). For central tendency, MOEs for the same population and exposure scenarios ranged from 83,861 to 143,875 for inhalation exposure and 1,108 to 1,873 for dermal exposures. For dust exposure, the aggregation of inhalation and dermal exposures led to negligible differences in risk when compared to risk estimates from dermal exposure alone.

For the use of liquid lab chemical, dermal exposures to liquids are expected to be the dominant route of exposure. MOEs for high-end acute, intermediate, and chronic inhalation exposure ranged from 190 to 306 for average adult workers and women of reproductive age, while high-end dermal MOEs for the same populations and exposure scenarios ranged from 43 to 68 (benchmark = 30). The central tendency MOEs for the same populations and exposure scenarios ranged from 869 to 1,491 for inhalation exposure and 128 to 217 for dermal exposure. Aggregation of inhalation and dermal exposures led to negligible differences in risk when compared to risk estimates from dermal exposure alone.

EPA estimated worker inhalation exposures to dust from solid lab 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 NAICS 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 BBP concentration in lab chemicals (*i.e.*, 0.3%) to estimate BBP particulate concentrations in the air. 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 BBP in workplace dust is

the same as the concentration of BBP in the laboratory chemicals. However, it is likely that workplace dust contains a variety of constituents and that the concentration of BBP in workplace dust is less than the concentration of BBP in the laboratory chemicals. Due to the uncertainty of BBP concentrations in workplace dust, EPA used central tendency values of exposure to represent worker exposures within the COUs covered under the Use of lab chemicals OES (*i.e.*, Processing COU: Repackaging [*e.g.*, laboratory use]; and Commercial use COU: laboratory chemicals).

The high-end and central tendency worker inhalation exposure results for the use of liquid laboratory chemicals are based on surrogate data from one study that presented five data points for inhalation exposures to BBP during the manufacturing process. EPA used these data, which were provided in a risk evaluation conducted by the ECJRC, to estimate inhalation exposure for this OES ([ECJRC, 2007](#)). ECJRC used samples from literature to develop a task-based exposure estimate for the production of BBP, including one exposure estimate each for the filling of truck tankers, drumming, and production. Most of the data points were presented as the mean of a range or as single data points and EPA treated them in the same way that the Agency did in the Manufacturing OES. There is uncertainty about how well these data represent the true distribution of inhalation concentrations in this scenario, the lack of ONU exposure data, for which EPA used worker data as surrogate data, and that there are only five data points used for the inhalation assessment.

As described in Section 4.1.1.4, EPA assumed dermal exposure to BBP occurred over a standard 8-hour workday and that BBP is contacted once per day with no use of proper PPE or handwashing. EPA also assumed a high-end (2-hand surface) value of 1,070 cm² and 890 cm² for male and female workers, respectively. For central tendency estimates, EPA used half of the two-hand surface areas (*i.e.*, 535 cm² for male workers and 445 cm² for female workers). These conservative assumptions may lead to overestimation of dermal exposure. The value of absorptive flux for liquid (*i.e.*, 3.23×10⁻² mg/cm²/h) was taken from Dupont *et al.* ([2006b](#)) of BBP applied to *in vitro* human skin. The concentration of the chemical and co-formulants may influence absorption rates, which adds additional uncertainty to these dermal risk estimates. The value of absorptive flux for solids (*i.e.*, 1.113×10⁻⁴ mg/cm²/h) was taken from Dupont *et al.* ([2006a](#)) of BBP in a film applied to *in vitro* human skin. A more detailed description of the strengths and uncertainties in the dermal exposure estimate for workers is provided in Section 4.1.1.5.1 and Table 4-5.

Due to uncertainties about inhalation exposure and uncertainties present in the representativeness of the skin permeability data in the dermal exposure estimate, the central tendency values of exposure are expected to be most reflective of worker exposures within the COUs covered under the Use of laboratory chemicals OES (*i.e.*, Commercial use COUs: Other uses [laboratory chemicals]).

Use of Lubricants and Functional Fluids

For the use of lubricants and functional fluids containing BBP, dermal exposure from liquid contact is expected to be the dominant route of exposure. In support of this, MOEs for high-end acute, intermediate, and chronic inhalation exposure ranged from 17,382 to 1,752,000 for average adult workers and women of reproductive age, while high-end dermal MOEs for the same populations and exposure scenarios ranged from 3.5 to 345 (benchmark = 30). The central tendency MOEs for the same populations and exposure scenarios ranged from 34,764 to 7,008,000 for inhalation exposure and 7.0 to 1,381 for dermal exposure. Aggregation of inhalation and dermal exposures led to negligible differences in risk when compared to risk estimates from dermal exposure alone.

The high-end and central tendency worker inhalation exposure results for this OES are based on surrogate data from the Application of adhesives and sealants OES which were estimated using data

from the risk evaluation conducted by ECJRC for the mixing process of raw materials in a PVC float scenario as surrogate for this OES ([ECJRC, 2007](#)). The data from the ECJRC consisted of monitoring data from one site where all samples were below 0.005 mg/m³, which EPA expects is the limit of detection. Therefore, EPA could not create a full distribution of monitoring results. To estimate high-end exposures to workers exposures, the Agency used the LOD of 0.005 mg/m³. To estimate central tendency worker exposure, the Agency used half this value. EPA used these data as surrogate because it represents the handling of liquid BBP products in a similar manner expected for this OES (*e.g.*, no spray or other activity that may generate mists, aerosols, or particulates). Therefore, this data is expected to be representative of two-part sealants and adhesives in a paste or liquid form that is applied by hand. Literature and product data do not indicate the potential for spray coating and, therefore, EPA did not assess mist exposures. This data source had a medium data quality rating.

There is uncertainty about how well these data represent the true distribution of inhalation concentrations in this scenario, in the lack of ONU exposure data, for which EPA used worker data as surrogate data, and in the fact that all data samples were below the LOD. EPA also assumed 8 exposure hours per day and 223 to 250 exposure days per year based on continuous BBP exposure each working day for a typical worker schedule; it is uncertain whether this captures actual worker schedules and exposures.

As described in Section 4.1.1.4, EPA assumed dermal exposure to BBP occurred over a standard 8-hour workday and that BBP is contacted once per day with no use of proper PPE or handwashing. EPA also assumed a high-end (2-hand surface) value of 1,070 and 890 cm² for male and female workers, respectively. For central tendency estimates, EPA used half of the two-hand surface areas (*i.e.*, 535 cm² for male workers and 445 cm² for female workers). These conservative assumptions may lead to overestimation of dermal exposure. The value of absorptive flux for liquid (*i.e.*, 3.23×10⁻² mg/cm²/h) was taken from Dupont *et al.* ([2006b](#)) of BBP applied to *in vitro* human skin. The concentration of the chemical and co-formulants may influence absorption rates, which adds additional uncertainty to these dermal risk estimates. A more detailed description of the strengths and uncertainties in the dermal exposure estimate for workers is provided in Section 4.1.1.5.1 and Table 4-5.

Due to limited inhalation data points and uncertainties present in the representativeness of the skin permeability data in the dermal exposure estimate, the central tendency values of exposure are expected to be most reflective of worker exposures within the COUs covered under the Use of lubricants and functional fluids OES (*i.e.*, Industrial and Commercial use COUs: Other uses [hydraulic fluids; Automotive products, fluids]).

Fabrication and Final Use of Products or Articles

For fabrication and final use of products or articles, inhalation exposure from dust generation is expected to be the dominant route of exposure, though neither the dermal nor inhalation route shows risk. In support of this, MOEs for high-end acute, intermediate, and chronic inhalation exposure ranged from 107 to 173 for average adult workers and women of reproductive age, while high-end dermal MOEs for the same populations and exposure scenarios ranged from 1,008 to 1,601 (benchmark = 30). For central tendency, MOEs for the same population and exposure scenarios ranged from 966 to 1,557 for inhalation exposure and 2,015 to 3,201 for dermal exposures. Aggregation of inhalation and dermal exposures led to negligible differences in risk when compared to risk estimates from inhalation exposure alone.

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 337 (Furniture and Related Product Manufacturing). EPA multiplied these dust concentrations by the maximum BBP concentration in PVC (*i.e.*, 45%) to estimate BBP particulate concentrations in the air. 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 BBP in workplace dust is the same as the maximum concentration of BBP in the PVC material. However, it is likely that workplace dust contains a variety of constituents and that the concentration of BBP in workplace dust is less than the concentration of BBP in the PVC material. Due to the uncertainty of BBP 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 of final product from articles OES (*i.e.*, Industrial and commercial use COUs: Fabric, textile, and leather products not covered elsewhere, Plastic and rubber products not covered elsewhere, and Building/construction materials not covered elsewhere). In addition, the discussion under the Import and repackaging OES for limitations and strengths for dermal exposures to solids also apply to this OES.

As described in Section 4.1.1.4, EPA assumed dermal exposure to BBP occurred over a standard 8-hour workday and that BBP is contacted once per day with no use of proper PPE or handwashing. EPA also assumed a high-end (2-hand surface) value of 1,070 and 890 cm² for male and female workers, respectively. For central tendency estimates, EPA used half of the two-hand surface areas (*i.e.*, 535 cm² for male workers and 445 cm² for female workers). These conservative assumptions may lead to overestimation of dermal exposure. The value of absorptive flux for solids (*i.e.*, 1.113×10⁻⁴ mg/cm²/h) was taken from Dupont *et al.* (2006a) of BBP in a film applied to *in vitro* human skin. A more detailed description of the strengths and uncertainties in the dermal exposure estimate for workers is provided in Section 4.1.1.5.1 and Table 4-5.

Due to uncertainty in BBP concentration in workplace dust, central tendency values of exposure are expected to be most reflective of worker exposures within the COUs covered under the Fabrication and final use of products or articles OES (*i.e.*, Industrial and commercial use COUs: Other uses (automotive articles), furnishing, cleaning, treatment/care products (floor coverings; construction and building materials covering large surface areas including stone, plaster, cement, glass and ceramic articles; fabrics, textiles, and apparel; and fabric, textile, and leather products), and Packaging, paper, plastic, hobby products (packaging [excluding food packaging] and other articles with routine direct contact during normal use, rubber articles; plastic articles [hard]; plastic articles [soft]; and Toys, playground, and sporting equipment]).

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 OES, the inhalation exposure from dust generation is expected to be the dominant route of exposure. In support of this, MOEs for high-end acute, intermediate, and chronic inhalation exposure ranged from 55 to 89 for average adult workers and women of reproductive age, while high-end dermal MOEs for the same populations and exposure scenarios ranged from 1,008 to 1,601 (benchmark = 30) for both OES. The central tendency MOEs for the same populations and exposure scenarios ranged from 805 to 1,455 for inhalation exposure and 2,015 to 3,589 for dermal exposure for both OES. Aggregation of inhalation and dermal exposures led to lower MOEs compared to either individual route; MOEs for high-end acute, intermediate, and chronic aggregated exposure

ranged from 53 to 84 for average adult workers and women of reproductive age, while the central tendency MOEs for the same populations and exposure scenarios ranged from 589 to 1,010 for aggregated exposure.

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 56 (Administrative and Support and Waste Management and Remediation Services). EPA multiplied these dust concentrations by the industry provided maximum BBP concentration in PVC (*i.e.*, 45%) to estimate BBP particulate concentrations in the air. PVC concentration was used for this estimate because it is expected to be the predominant type of waste containing BBP that is recycled or disposed of. 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 BBP in workplace dust is the same as the maximum concentration of BBP in PVC plastics. However, it is likely that workplace dust contains a variety of constituents and that the concentration of BBP in workplace dust is less than the concentration of BBP in recycled or disposed products or articles.

As described in Section 4.1.1.4, EPA assumed dermal exposure to BBP occurred over a standard 8-hour workday and that BBP is contacted once per day with no use of proper PPE or handwashing. EPA also assumed a high-end (2-hand surface) value of 1,070 and 890 cm² for male and female workers, respectively. For central tendency estimates, EPA used half of the two-hand surface areas (*i.e.*, 535 cm² for male workers and 445 cm² for female workers). These conservative assumptions may lead to overestimation of dermal exposure. The value of absorptive flux for solids (*i.e.*, 1.113×10⁻⁴ mg/cm²/h) was taken from Dupont *et al.* ([2006a](#)) of BBP in a film applied to *in vitro* human skin. A more detailed description of the strengths and uncertainties in the dermal exposure estimate for workers is provided in Section 4.1.1.5.1 and Table 4-5.

Therefore, EPA used central tendency values of exposure to represent 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

Exposures from distribution in commerce were not assessed directly, but levels of exposure are expected to be similar to import/repackaging of solids. Consequently, aggregate MOEs associated with distribution in commerce are expected to be above the benchmark MOE of 30. For the crosswalk between OESs and COUs, see Table 3-1 in Section 3.1.1.1.

4.3.2.1 Overall Confidence in Worker Risks

As described in Section 4.1.1.4 and the *Draft Environmental Release and Occupational Exposure Assessment for Butyl Benzyl Phthalate (BBP)* ([U.S. EPA, 2025t](#)), EPA has moderate confidence in the assessed occupational inhalation and dermal exposures for workers, slight to moderate confidence in ONU inhalation and dermal exposures, and robust confidence in the non-cancer POD selected to characterize risk from acute, intermediate, and chronic duration exposures to BBP (see Section 4.2). Overall, EPA has moderate confidence in the risk estimates calculated for worker inhalation and dermal

exposure scenarios and slight to moderate for ONU inhalation exposure. Sources of uncertainty associated with these occupational COUs are discussed above in Section 4.3.2.

4.3.2.2 Occupational Risk Estimates and Effect of PPE

For occupational risk estimates, Females 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. Therefore, Table 4-15 below presents the acute duration risk estimates for Female Workers of Reproductive Age and the corresponding Personal Protection Equipment (PPE) that would result in a worker MOE above the benchmark MOE. Risk estimates for other populations, durations, and health effects for all the COUs/OES are included in Table 4-17 and the *Draft Occupational Risk Calculator for Butyl Benzyl Phthalate (BBP)* ([U.S. EPA, 2025y](#)). Additionally, the risk calculator contains MOE calculations and PPE information for all of the OESs.

Table 4-15 includes three main sections according to the route of exposure: inhalation, dermal, and aggregate exposure. For inhalation, typical respirator applied protection factor (APF) values of 10, 25, 50, 1000 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. For dermal exposures, typical dermal Protection Factor (PF) values of 5, 10, and 20 were compared to the calculated MOE and the benchmark MOE to determine the level of PF that could be used to bring MOEs above the benchmark MOE. For aggregate exposures, the APF and/or PF that could be used to bring MOEs above the benchmark are also shown. Descriptions of the different APFs and PFs are included in the footnote of the table. In cases, when it is not possible to raise MOE to above the benchmark with the use of respiratory and/or dermal protection, PPE with maximum APF/PF and the corresponding MOE values are shown in the table. The appropriateness of any protection factor that demonstrates exposures resulting in a worker MOE above the benchmark MOE may require additional consideration. 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. 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 PPE.

For inhalation, based on the risk characterization in Section 4.3.2, the central tendency exposures are expected to be most reflective of worker inhalation exposures for all the OES. Table 4-15 shows no COUs have MOEs below the benchmark at central tendency, and that using PPE with APF 10 for those high-end inhalation scenarios when the MOEs are below the benchmark MOE, would reduce the exposures to above benchmark MOE. For dermal, based on the risk characterization in Section 4.3.2, the central tendency exposures are expected to be most reflective of worker dermal exposures for all the OES to reasonably expected work conditions. Table 4-15 shows when dermal protection is used, the central tendency MOEs for all the OESs are increased to above benchmark for dermal exposures.

4.3.2.1 Occupational Risk Estimates for ONUs

ONUs may be exposed to dust, vapors or mists that enter their breathing zone while working in locations near where BBP 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 BBP. Dermal exposure to ONUs are represented by incidental skin contact

3553 equal to the surface area of equal to the surface area of only a single hand (or 1 side of 2 hands) and used
3554 half the mean values for two-hand surface areas (*i.e.*, 535 cm²).

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Table 4-15. Occupational Risk Estimates for Acute BBP Exposures for Females of Reproductive Age

Occupational Exposure Scenario	Exposure Level	Inhalation			Dermal			Aggregate	
		Worker MOE No PPE	Worker MOE with PPE ^a	APF ^a	Worker MOE No PPE	Worker MOE with PPE ^a	PF ^a	Worker MOE No PPE	Worker MOE with PPE ^a
Manufacturing	CT	869	Above benchmark	N/A	8	38	PF 5	7.5	36 (PF 5)
	HE	190	Above benchmark	N/A	4	38	PF 10	3.7	32 (PF 10)
Import and repackaging (solid)	CT	1,317	Above benchmark	N/A	2,193	Above benchmark	N/A	822.7	Above benchmark
	HE	58	Above benchmark	N/A	1,096	Above benchmark	N/A	55.0	Above benchmark
Import and repackaging (liquid)	CT	869	Above benchmark	N/A	8	38	PF 5	7.5	36 (PF 5)
	HE	190	Above benchmark	N/A	4	38	PF 10	3.7	32 (PF 10)
Incorporation into adhesives and sealants (solid)	CT	259	Above benchmark	N/A	2,193	Above benchmark	N/A	231.4	Above benchmark
	HE	25	248	APF 10	1,096	Above benchmark	N/A	24.3	202 (APF 10)
Incorporation into adhesives and sealants (liquid)	CT	1,738	Above benchmark	N/A	8	38	PF 5	7.5	37 (PF 5)
	HE	869	Above benchmark	N/A	4	38	PF 10	3.8	36 (PF 10)
Incorporation into paints and coatings (liquid)	CT	1,738	Above benchmark	N/A	8	38	PF 5	7.5	37 (PF 5)
	HE	869	Above benchmark	N/A	4	38	PF 10	3.8	36 (PF 10)
Incorporation into other formulations, mixtures, or reaction products (liquid)	CT	1,738	Above benchmark	N/A	8	38	PF 5	7.5	37 (PF 5)
	HE	869	Above benchmark	N/A	4	38	PF 10	3.8	36 (PF 10)
PVC plastics compounding	CT	122	Above benchmark	N/A	8	38	PF 5	7.1	47 (PF 10)
	HE	20	197	APF 10	4	38	PF 10	3.2	32 (APF 10, PF 10)
Non-PVC materials compounding	CT	122	Above benchmark	N/A	8	38	PF 5	7.1	37 (APF 10, PF 5); 47 (PF 10)
	HE	20	197	APF 10	4	38	PF 10	3.2	32 (APF 10, PF 10)
PVC plastics converting	CT	122	Above benchmark	N/A	2,193	Above benchmark	N/A	115.3	Above benchmark
	HE	20	197	APF 10	1,096	Above benchmark	N/A	19.4	167 (APF 10)
Non-PVC materials converting	CT	122	Above benchmark	N/A	2,193	Above benchmark	N/A	115.3	Above benchmark
	HE	20	197	APF 10	1,096	Above benchmark	N/A	19.4	167 (APF 10)

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Occupational Exposure Scenario	Exposure Level	Inhalation			Dermal			Aggregate	
		Worker MOE No PPE	Worker MOE with PPE ^a	APF ^a	Worker MOE No PPE	Worker MOE with PPE ^a	PF ^a	Worker MOE No PPE	Worker MOE with PPE ^a
Application of paints and coatings	CT	43	Above benchmark	N/A	8	38	PF 5	6.4	35 (APF 10, PF 5); 33 (PF 20)
	HE	4	39	APF 10	4	38	PF 10	1.9	43 (APF 25, PF 20)
Application of adhesives and sealants	CT	34,764	Above benchmark	N/A	8	38	PF 5	7.6	38 (PF 5)
	HE	17,382	Above benchmark	N/A	4	38	PF 10	3.8	38 (PF 10)
Use of lubricants and functional fluids	CT	34,764	Above benchmark	N/A	8	38	PF 5	7.6	38 (PF 5)
	HE	17,382	Above benchmark	N/A	4	38	PF 10	3.8	38 (PF 10)
Use of laboratory chemicals – solid	CT	152,474	Above benchmark	N/A	2,193	Above benchmark	N/A	2161.6	Above benchmark
	HE	10,730	Above benchmark	N/A	1,096	Above benchmark	N/A	994.7	Above benchmark
Use of laboratory chemicals – liquid	CT	869	Above benchmark	N/A	139	Above benchmark	N/A	120.2	Above benchmark
	HE	190	Above benchmark	N/A	46	Above benchmark	N/A	37.3	Above benchmark
Fabrication of final product from articles	CT	966	Above benchmark	N/A	2,193	Above benchmark	N/A	670.4	Above benchmark
	HE	107	Above benchmark	N/A	1,096	Above benchmark	N/A	97.7	Above benchmark
Recycling	CT	805	Above benchmark	N/A	2,193	Above benchmark	N/A	588.7	Above benchmark
	HE	55	Above benchmark	N/A	1,096	Above benchmark	N/A	52.5	Above benchmark
Waste handling, treatment and disposal	CT	805	Above benchmark	N/A	2,193	Above benchmark	N/A	588.7	Above benchmark
	HE	55	Above benchmark	N/A	1,096	Above benchmark	N/A	52.5	Above benchmark
Benchmark MOE = 30 APF = assigned protection factor; PF = protection factor; PPE = personal protective equipment; ^a PPE with the least amount of APF/PF that could be used to bring MOE values above the benchmark MOE (30) are shown in the table with corresponding MOE values. In cases, when it is not possible to raise MOE to above benchmark with PPE, PPE with maximum APF/PF and the corresponding MOE values are shown in the table. The <i>Draft Risk Calculator for Occupational Exposures for Butyl Benzyl Phthalate (BBP)</i> (U.S. EPA, 2025y) contains MOE calculations and PPE information for all the OES for all durations (acute, intermediate, and chronic). APFs for respirators are available in Table 4-16.									

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Table 4-16. Assigned Protection Factors for Respirators

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 (<i>e.g.</i> , open/closed circuit)	—	—	10,000	10,000	—
Source: 29 CFR 1910.134(d)(3)(i)(A)					

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Table 4-17. Occupational Risk Estimation for BBP

Life Cycle Stage – Category	Subcategory	OES	Worker Population	Exposure Level	Inhalation Risk Estimates (Benchmark MOE = 30)			Dermal Risk Estimates (Benchmark MOE = 30)			Aggregate Risk Estimates (Benchmark MOE = 30)		
					Acute	Inter.	Chronic	Acute	Inter.	Chronic	Acute	Inter.	Chronic
Manufacturing – Domestic manufacturing	Domestic Manufacturing	Manufacturing	Average Adult Worker	CT	960	1,309	1,402	7	9	10	6.9	9.4	10.1
				HE	210	286	306	3	5	5	3.4	4.7	5.0
			Female of Reproductive Age	CT	869	1,185	1,269	8	10	11	7.5	10.2	11.0
				HE	190	259	277	4	5	6	3.7	5.1	5.4
			ONU	CT	960	1,309	1,402	NA	NA	NA	960.0	1,309.1	1,401.6
Manufacturing – Importing	Importing	Import and repackaging (solid)	Average Adult Worker	CT	1,455	1,983	2,552	2,015	2,748	3,536	844.8	1,152.0	1,482.5
				HE	64	87	93	1,008	1,374	1,471	60.2	82.1	87.9
Female of Reproductive Age	CT		1,317	1,796	2,311	2,193	2,990	3,848	822.7	1,121.9	1,443.7		
	HE		58	79	85	1,096	1,495	1,601	55.0	75.0	80.3		
Processing – Repackaging	Repackaging		ONU	CT	1,455	1,983	2,552	2,015	2,748	3,536	844.8	1,152.0	1,482.5
Manufacturing – Importing	Importing	Import and repackaging (liquid)	Average Adult Worker	CT	960	1,309	1,685	7	9	12	6.9	9.4	12.1
				HE	210	286	306	3	5	5	3.4	4.7	5.0
Female of Reproductive Age	CT		869	1,185	1,525	8	10	13	7.5	10.2	13.2		
	HE		190	259	277	4	5	6	3.7	5.1	5.4		
Processing – Repackaging	Repackaging		ONU	CT	960	1,309	1,685	NA	NA	NA	960.0	1,309.1	1,684.6
Processing – Incorporation into formulation, mixture, or reaction product	Plasticizer in: – adhesive manufacturing	Incorporation into adhesives and sealants (solid)	Average Adult Worker	CT	286	390	417	2,015	2,748	2,942	250.2	341.2	365.3
				HE	27	37	40	1,008	1,374	1,471	26.7	36.4	39.0
			Female of Reproductive Age	CT	259	353	378	2,193	2,990	3,201	231.4	315.5	337.8
				HE	25	34	36	1,096	1,495	1,601	24.3	33.1	35.5
			ONU	CT	286	390	417	2,015	2,748	2,942	250.2	341.2	365.3
Processing – Incorporation into formulation, mixture, or reaction product	Plasticizer in: – adhesive manufacturing	Incorporation into adhesives and sealants (liquid)	Average Adult Worker	CT	1,920	2,618	2,803	7	9	10	6.9	9.4	10.1
				HE	960	1,309	1,402	3	5	5	3.5	4.7	5.1
			Female of Reproductive Age	CT	1,738	2,370	2,538	8	10	11	7.5	10.3	11.0
				HE	869	1,185	1,269	4	5	6	3.8	5.1	5.5
			ONU	CT	1,920	2,618	2,803	NA	NA	NA	1,920.0	2,618.2	2,803.2
Processing – Incorporation into formulation, mixture, or reaction product	Plasticizer in: – paint and coating manufacturing	Incorporation into paints and coatings (liquid)	Average Adult Worker	CT	1,920	2,618	2,803	7	9	10	6.9	9.4	10.1
				HE	960	1,309	1,402	3	5	5	3.5	4.7	5.1
			Female of Reproductive Age	CT	1,738	2,370	2,538	8	10	11	7.5	10.3	11.0
				HE	869	1,185	1,269	4	5	6	3.8	5.1	5.5
			ONU	CT	1,920	2,618	2,803	NA	NA	NA	1,920.0	2,618.2	2,803.2

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Life Cycle Stage – Category	Subcategory	OES	Worker Population	Exposure Level	Inhalation Risk Estimates (Benchmark MOE = 30)			Dermal Risk Estimates (Benchmark MOE = 30)			Aggregate Risk Estimates (Benchmark MOE = 30)		
					Acute	Inter.	Chronic	Acute	Inter.	Chronic	Acute	Inter.	Chronic
Processing – Incorporation into formulation, mixture, or reaction product	Plasticizer in: – ink, toner, and colorant manufacturing	Incorporation into other formulations, mixtures, or reaction products (liquid)	Average Adult Worker	CT	1,920	2,618	2,803	7	9	10	6.9	9.4	10.1
				HE	960	1,309	1,402	3	5	5	3.5	4.7	5.1
	Female of Reproductive Age		CT	1,738	2,370	2,538	8	10	11	7.5	10.3	11.0	
			HE	869	1,185	1,269	4	5	6	3.8	5.1	5.5	
	Laboratory chemical manufacturing		ONU	CT	1,920	2,618	2,803	NA	NA	NA	1,920.0	2,618.2	2,803.2
Processing – Incorporation into formulation, mixture, or reaction product	Plasticizers (custom compounding of purchased resin; plastic material and resin manufacturing)	PVC plastics compounding	Average Adult Worker	CT	134	183	220	7	9	11	6.6	9.0	10.8
				HE	22	30	32	3	5	5	3.0	4.1	4.4
			Female of Reproductive Age	CT	122	166	199	8	10	12	7.1	9.7	11.6
				HE	20	27	29	4	5	6	3.2	4.3	4.6
			ONU	CT	134	183	220	2,015	2,748	3,299	126.0	171.9	206.3
Processing – Incorporation into formulation, mixture, or reaction product	Plasticizers (custom compounding of purchased resin; resin manufacturing; rubber manufacturing)	Non-PVC plastics compounding	Average Adult Worker	CT	134	183	210	7	9	11	6.6	9.0	10.3
				HE	22	30	32	3	5	5	3.0	4.1	4.4
Industrial Use – Other uses	Castings		Female of Reproductive Age	CT	122	166	190	8	10	12	7.1	9.7	11.1
				HE	20	27	29	4	5	6	3.2	4.3	4.6
Commercial Use – Other uses	Castings		ONU	CT	134	183	210	2,015	2,748	3,143	126.0	171.9	196.6
Processing – Incorporation into articles	Plasticizers (adhesive manufacturing; fabric, textile, apparel, and leather products manufacturing; building and construction materials manufacturing; plastics product manufacturing; rubber product manufacturing; transportation equipment manufacturing)	PVC plastics converting	Average Adult Worker	CT	134	183	224	2,015	2,748	3,359	126.0	171.9	210.1
				HE	22	30	32	1,008	1,374	1,471	21.3	29.1	31.1
			Female of Reproductive Age	CT	122	166	203	2,193	2,990	3,654	115.3	157.3	192.2
				HE	20	27	29	1,096	1,495	1,601	19.4	26.4	28.3
			ONU	CT	134	183	224	2,015	2,748	3,359	126.0	171.9	210.1

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Life Cycle Stage – Category	Subcategory	OES	Worker Population	Exposure Level	Inhalation Risk Estimates (Benchmark MOE = 30)			Dermal Risk Estimates (Benchmark MOE = 30)			Aggregate Risk Estimates (Benchmark MOE = 30)		
					Acute	Inter.	Chronic	Acute	Inter.	Chronic	Acute	Inter.	Chronic
Incorporation into formulation, mixture, or reaction product	Plasticizers (custom compounding of purchased resin; resin manufacturing; rubber manufacturing)	Non-PVC materials converting	Average Adult Worker	CT	134	183	224	2,015	2,748	3,359	126.0	171.9	210.1
				HE	22	30	32	1,008	1,374	1,471	21.3	29.1	31.1
Industrial Use – Other uses	Castings		Female of Reproductive Age	CT	122	166	203	2,193	2,990	3,654	115.3	157.3	192.2
				HE	20	27	29	1,096	1,495	1,601	19.4	26.4	28.3
Commercial Use – other uses	Castings		ONU	CT	134	183	224	2,015	2,748	3,359	126.0	171.9	210.1
Industrial Use – Construction, paint, electrical, and metal products	Adhesives and sealants	Application of Adhesives and Sealants	Average Adult Worker	CT	38,400	52,364	60,414	7	9	11	7.0	9.5	10.9
				HE	19,200	26,182	28,032	3	5	5	3.5	4.7	5.1
Commercial Use – Construction, paint, electrical, and metal products	Adhesives and sealants		Female of Reproductive Age	CT	34,764	47,405	54,693	8	10	12	7.6	10.3	11.9
				HE	17,382	23,703	25,378	4	5	6	3.8	5.2	5.5
			ONU	CT	38,400	52,364	60,414	NA	NA	NA	38,400	52,363	60,413
Industrial Use – Construction, paint, electrical, and metal products	Paints and coatings	Application of paints and coatings	Average Adult Worker	CT	47	64	69	7	9	10	6.1	8.3	8.8
				HE	4	6	6	3	5	5	1.9	2.6	2.8
Industrial Use – Packaging, paper, plastic, hobby products	Ink, toner and colorant products		Female of Reproductive Age	CT	43	58	62	8	10	11	6.4	8.8	9.4
				HE	4	5	6	4	5	6	1.9	2.6	2.8
Commercial Use – Construction, paint, electrical, and metal products	Paints and coatings		ONU	CT	47	64	69	7	9	10	6.1	8.3	8.8

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Life Cycle Stage – Category	Subcategory	OES	Worker Population	Exposure Level	Inhalation Risk Estimates (Benchmark MOE = 30)			Dermal Risk Estimates (Benchmark MOE = 30)			Aggregate Risk Estimates (Benchmark MOE = 30)		
					Acute	Inter.	Chronic	Acute	Inter.	Chronic	Acute	Inter.	Chronic
Industrial Use – Other uses	Hydraulic fluids	Use of lubricants and functional fluids	Average Adult Worker	CT	38,400	576,000	7,008,000	7	104	1,269	7.0	104.3	1269.1
	HE			19,200	144,000	1,752,000	3	26	317	3.5	26.1	317.3	
	Automotive products, fluids		Female of Reproductive Age	CT	34,764	521,460	6,344,430	8	114	1,381	7.6	113.5	1380.7
				HE	17,382	130,365	1,586,108	4	28	345	3.8	28.4	345.2
Commercial Use – Other uses	Automotive products, fluids		ONU	CT	38,400	576,000	7,008,000	NA	NA	NA	38400.0	576,000	7,008,000
Commercial Use – Other uses	Laboratory chemicals	Use of laboratory chemicals – solid	Average Adult Worker	CT	168,421	229,665	261,590	2,015	2,748	3,130	1991.4	2715.6	3093.1
				HE	11,852	16,162	17,304	1,008	1,374	1,471	928.7	1266.4	1355.9
			Female of Reproductive Age	CT	152,474	207,919	236,821	2,193	2,990	3,406	2161.6	2947.6	3357.4
				HE	10,730	14,631	15,665	1,096	1,495	1,601	994.7	1356.4	1452.3
			ONU	CT	168,421	229,665	261,590	2,015	2,748	3,130	1991.4	2715.6	3093.1
Commercial Use – Other uses	Laboratory chemicals	Use of laboratory chemicals – liquid	Average Adult Worker	CT	960	1,309	1,491	128	175	199	113.1	154.2	175.6
				HE	210	286	306	43	58	62	35.5	48.4	51.8
			Female of Reproductive Age	CT	869	1,185	1,350	139	190	217	120.2	163.9	186.6
				HE	190	259	277	46	63	68	37.3	50.9	54.5
			ONU	CT	960	1,309	1,491	NA	NA	NA	960.0	1309.1	1491.1

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Life Cycle Stage – Category	Subcategory	OES	Worker Population	Exposure Level	Inhalation Risk Estimates (Benchmark MOE = 30)			Dermal Risk Estimates (Benchmark MOE = 30)			Aggregate Risk Estimates (Benchmark MOE = 30)		
					Acute	Inter.	Chronic	Acute	Inter.	Chronic	Acute	Inter.	Chronic
Industrial Use – Other uses	Automotive articles	Fabrication of final product from articles	Average Adult Worker	CT	1,067	1,455	1,557	2,015	2,748	2,942	697.5	951.1	1018.3
Commercial Use – Furnishing, cleaning, treatment/care products	Floor coverings; Construction and building materials covering large surface areas including stone, plaster, cement, glass and ceramic articles; fabrics, textiles, and apparel			HE	119	162	173	1,008	1,374	1,471	106.0	144.6	154.8
	Fabric, textile, and leather products												
Commercial Use – Packaging, paper, plastic, hobby products	Packaging (excluding food packaging) and other articles with routine direct contact during normal use, rubber articles; plastic articles (hard); plastic articles (soft)		Female of Reproductive Age	CT	966	1,317	1,410	2,193	2,990	3,201	670.4	914.2	978.8
	Toys, playground, and sporting equipment												
Commercial Use – Other uses	Automotive articles			HE	107	146	157	1,096	1,495	1,601	97.7	133.3	142.7
			ONU	CT	1,067	1,455	1,557	2,015	2,748	2,942	697.5	951.1	1018.3
Processing – Recycling	Recycling	Recycling	Average Adult Worker	CT	889	1,212	1,298	2,015	2,748	2,942	616.8	841.1	900.6
				HE	61	83	89	1,008	1,374	1,471	57.5	78.4	83.9
			Female of Reproductive Age	CT	805	1,097	1,175	2,193	2,990	3,201	588.7	802.7	859.5
				HE	55	75	81	1,096	1,495	1,601	52.5	71.6	76.7
			ONU	CT	889	1,212	1,298	2,015	2,748	2,942	616.8	841.1	900.6
Disposal	Disposal	Waste handling, treatment and disposal	Average Adult Worker	CT	889	1,212	1,298	2,015	2,748	2,942	616.8	841.1	900.6
				HE	61	83	89	1,008	1,374	1,471	57.5	78.4	83.9
			Female of Reproductive Age	CT	805	1,097	1,175	2,193	2,990	3,201	588.7	802.7	859.5
				HE	55	75	81	1,096	1,495	1,601	52.5	71.6	76.7
			ONU	CT ^a	889	1,212	1,298	2,015	2,748	2,942	616.8	841.1	900.6

^a In absence of ONU inhalation exposure data, EPA used worker central tendency exposure estimates as surrogate data for ONU inhalation exposure. Dermal exposures to ONUs are represented by incidental skin contact equal to the surface area of 1 palm.

4.3.3 Risk Estimates for Consumers

Table 4-18 summarizes the dermal, inhalation, ingestion, and aggregate MOEs used to characterize non-cancer risk for acute, intermediate, and chronic exposure to BBP and presents these values for all lifestages for each COU. A screening level assessment for consumers considers high-intensity exposure scenarios risk estimates and relies on conservative assumptions to assess exposures that would be expected to be on the high-end of the expected exposure distribution. For instance, EPA used the stay-at-home CEM setting, which assumes 20 hours of inhalation and dust ingestion estimates as the likelier higher potential indoor exposure. MOEs for high intensity exposure scenarios are shown for all consumer COUs, whereas MOEs for medium-intensity exposure scenarios are shown only for COUs associated with high-intensity MOEs at or under the benchmark of 30 (see COUs listed below).

Further, Table 4-18 provides MOEs for the modeling indoor exposure assessment. The main objective in reconstructing the indoor environment using consumer products and articles commonly present in indoor spaces is to calculate exposure and risk estimates by COU, and by product and article from indoor dust ingestion and inhalation. EPA identified article-specific information by COU to construct relevant and representative exposure scenarios. Exposure to BBP via ingestion of dust was assessed for all articles expected to contribute significantly to dust concentrations due to high surface area ($>1 \text{ m}^2$) for either a single article or collection of like articles as appropriate. See Section 4 in U.S. EPA (2025d) for a brief discussion of the assumptions associated with BBP migration from articles indoor dust. Articles included in the indoor environment assessment included children's toys (new and legacy), synthetic leather furniture, car mats, and vinyl flooring. COUs associated with articles included in the indoor environment assessment are indicated with note "b" in Table 4-18.

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 described in the *Draft Consumer Risk Calculator for Butyl Benzyl Phthalate (BBP)* (U.S. EPA, 2025f).

COUs with MOEs for High-Intensity Exposure Scenarios Above Benchmark

The screening level assessment for consumers considers high-intensity exposure scenario risk estimates, MOEs, and relies on conservative assumptions to assess exposures that would be expected to be on the high-end of the expected exposure distribution. If MOEs are above the benchmark of 30 for the high intensity use scenario then any exposures with lower intensity use inputs would result in larger MOEs. Consumer COUs that resulted in MOEs for high-intensity exposure scenarios above the benchmark of 30 for acute, chronic and intermediate exposures are summarized in Table 4-18 and in the following list:

- Construction, paint, electrical, and metal products: paints and coatings;
- Furnishing, cleaning, treatment/care products: fabrics, textiles, and leather products;
- Furnishing, cleaning, treatment/care products: floor coverings; construction and building materials covering large surface areas including stone, plaster, cement, glass and ceramic articles fabrics, textiles, and apparel;
- Other uses: automotive products, fluids;
- Other uses: automotive products, other than fluids;
- Other uses: novelty articles;
- Packaging, paper, plastic, hobby products: ink, toner, and colorant products;
- Packaging, paper, plastic, hobby products: toys, playgrounds, and sporting equipment;
- Packaging, paper, plastic, hobby products: arts, crafts, and hobby materials; and

- Packaging, paper, plastic, hobby products: packaging (excluding food packaging) and other articles with routine direct contact during normal use, including rubber articles; plastic articles (hard); plastic articles (soft).

Variability in MOEs for these high-intensity exposure scenarios results from use of different exposure factors for each COU and product/article examples that led to different estimates of exposure to BBP. As described in the *Draft Consumer and Indoor Exposure Assessment for Butyl Benzyl Phthalate (BBP)* ([U.S. EPA, 2025d](#)) and the *Draft Non-Cancer Human Health Hazard Assessment for Butyl Benzyl Phthalate (BBP)* ([U.S. EPA, 2025v](#)), 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. EPA is confident that the high-intensity use scenarios used in the screening approach represent an upper bound estimate and provide a health protective estimate for consumer exposures.

COUs with MOEs for High-Intensity Exposure Scenarios Equal or Below Benchmark

The screening level assessment for consumers considered high-intensity exposure scenario risk estimates (MOEs) and relied on conservative assumptions to assess exposures that would be expected to be on the high-end of the expected exposure distribution. If MOEs are equal to or below the benchmark of 30 for the high intensity use scenario, EPA reevaluates the approaches and inputs used and determines if refinement of those is needed. See Section 2 in *Draft Consumer and Indoor Exposure Assessment for Butyl Benzyl Phthalate (BBP)* ([U.S. EPA, 2025d](#)) for details about the consumer modeling approaches, sources of data, model parameterization, and assumptions. Out of 11 COUs the only consumer COU that resulted in MOEs for high-intensity exposure scenarios equal to or below the benchmark of 30 is summarized in Table 4-18 and is discussed in detail below.

Construction, Paint, Electrical, and Metal Products: Adhesives and Sealants

This section summarizes the MOEs that fall below the benchmark of 30 for the construction, paint, electrical, and metal products; adhesives and sealants COU individual BBP (Table 4-18) risk assessment. Products with similar BBP content and expected use patterns were grouped together for modeling as described below. Some products were not assessed for inhalation exposure due to (1) the small volume of the product that is expected to be used; (2) short durations of use and thus a shorter duration for emissions to air to occur (*e.g.*, adhesives with short working times [less than a few minutes] until solidification and liquids poured directly into a reservoir that is capped after product addition); and/or (3) products used in outdoor conditions where air exchange rates are high and product application is not expected to generate aerosols. Three different scenarios were assessed under this COU for products with differing use patterns: adhesives for small projects (2 product examples), caulking products (5 product examples), and patching and repair products for exterior use (5 product examples).

- Adhesives for small projects: two adhesives were identified with BBP content, including a model and hobby cement with reported BBP content of 3.85 percent ([Elmers, 2009](#)) and a structural adhesive with reported BBP content of 10 to 20 percent ([Royal Adhesives & Sealants, 2017](#)). Use of these products is not expected to result in significant inhalation exposure as very small quantities are used and working times are very short (<5 minutes). However, they were assessed for dermal exposure under the assumption that consumers may not immediately wash the product off after contact, resulting in dermal exposure durations longer than product working times.
- Caulking products: five products were identified for various indoor or outdoor repair and sealing applications, including for perimeter caulking (doors, windows), expansion and control joints, kitchen and bath. The reported BBP content in these products ranged from 10 to 30 percent ([Protecto Wrap, 2020](#)), 15 to 40 percent ([Tremco Canadian Sealants, 2015](#)), 5 to 10 percent ([Momentive, 2017](#)), 5 to 10 percent ([HCC Holdings Inc., 2015](#)), and 7 to 13 percent ([Wilsonart, 2013](#)). Based on these data, the weight fractions of BBP used in low-, medium-, and high-

inhalation exposure scenarios were the minimum, average of all reported values and maximum values of 0.05, 0.145, and 0.4 wet weight (w/w), respectively. These products were assessed for both inhalation and dermal exposure.

- Patching and repair products for exterior use: five products were identified for various outdoor repair and sealing applications, including for concrete, mortar, blacktop, stucco, and roofing. The reported BBP content ranged from 4 to 10 percent in the blacktop sealant ([DeLima Associates, 2018b](#)), 1 to 2 percent in the concrete, mortar, and stucco sealants ([DeLima Associates, 2018a](#); [Quikrete, 2015a, b](#)), and 10 to 30 percent in the roofing sealant ([DAP Products, 2024](#)). Because the anticipated use for these products is outdoors, the products are not applied in a manner likely to generate aerosols and large areas, and inhalation exposure is expected to be negligible, the products were modeled for dermal exposure only.

Of the three product scenarios assessed for this COU, only the patching and repair products for exterior use resulted in an MOE equal to 30 (benchmark) for the dermal acute high intensity use exposure route. The remaining two product scenarios in this COU MOEs were above the benchmark of 30 (Table 4-18). The MOEs for patching and repair products for exterior repairs was 30 for adults in the high-intensity exposure scenarios. For the medium-intensity exposure route the MOE was 120 for adults. For the patching and repair products for exterior use, the duration of skin contact used in the high-, medium-, and low-intensity use scenarios were 120, 60, and 30 minutes respectively. The contact area for the high-intensity use scenario corresponded to the inside of two hands including palms and fingers, for the medium-intensity scenario contact area was the inside of one hand, and for the low-intensity scenario used 10 percent of hands.

For caulking projects, the products may be used several times over a long and short durations depending on the project. Since a caulking project can include a wide range of durations, EPA considered repair products requiring caulk in multiple locations or applications. The consideration of repetitive small projects high, medium, and low contact durations of 60, 30, and 15 minutes were chosen. In each case, while direct contact with the product (actual use duration) is expected to be very short, reasonably foreseeable circumstances exist (multiple application locations) under which the user may not wash the products off their hands immediately, resulting in a longer exposure time. The contact area for the high-intensity use scenario corresponded to the inside of two hands including palms and fingers, for the medium-intensity scenario contact area was the inside of one hand, and for the low-intensity scenario used 10 percent of hands.

Confidence in Consumer Dermal Approaches and Exposures

All MOEs below the benchmark of 30 for the individual BBP and cumulative risk assessments are from dermal exposures. This section discusses confidence in the consumer dermal approaches and exposures that apply to all of the COU dermal exposure scenario discussions in previous sections.

EPA selected Dupont ([2006b](#)) and Dupont ([2006a](#)) among the available BBP skin absorption studies for this assessment because they use human skin for the experimental study. Both studies also considered formulations and an experimental setup, which included detailed temperature and humidity controls rather than a neat chemical study, but which may have overestimated results. A source of uncertainty regarding the dermal absorption of BBP from products or formulations stems from the varying concentrations and co-formulants that exist in products or formulations containing BBP. For purposes of this draft risk evaluation, EPA assumes that the absorptive flux of BBP formulations measured from *in vitro* human experiments serves as an upper bound of potential absorptive flux of chemical into and through the skin for dermal contact with all liquid products or formulations. Dermal contact with products or formulations that have lower concentrations of BBP can exhibit lower rates of flux since

there is less material available for absorption. Conversely, there is evidence co-formulants or materials within the products or formulations can lead to enhanced dermal absorption, even at lower concentrations, as described in *Draft Consumer and Indoor Exposure Assessment for Butyl Benzyl Phthalate (BBP)* ([U.S. EPA, 2025d](#)). Therefore, it is uncertain whether the products or formulations containing BBP would result in decreased or increased dermal absorption. Based on the available dermal absorption data for BBP, EPA has made assumptions ranging from conservative to representative of expected uses that result in exposure assessments that are the most human health protective in nature. The confidence in the dermal exposure MOEs from liquid products used in this assessment is moderate.

Indoor Dust

Exposure to BBP via ingestion of dust was assessed for all articles expected to contribute significantly to dust concentrations due to high surface area (exceeding $\sim 1 \text{ m}^2$). Either a single article or collection of like articles was considered as appropriate—including indoor synthetic leather furniture, vinyl flooring, carpet tiles, car mats, and children's toys (legacy and new). In a screening assessment for indoor dust ingestion, EPA considered the aggregation of chronic dust ingestion doses (see Section 4.1.2.3). However, the indoor assessment was further refined to only consider articles assumed to be present in residential indoor environments such as indoor synthetic leather furniture, vinyl flooring, carpet tiles, and children's toys new and legacy. Car mats are in other indoor environments such as vehicles, but not in residential indoor environments. The highest aggregated dose from indoor scenario chronic ingestion of settled dust was for preschoolers, aged 3 to 5 years, and resulted in an MOE of 3,000. See *Draft Consumer Risk Calculator for Butyl Benzyl Phthalate (BBP)* ([U.S. EPA, 2025f](#)). All other doses were lower and would have resulted in larger MOEs.

4.3.3.1 Overall Confidence in Consumer Risks

As described in Section 4.1.2, and in more detail in the *Draft Consumer and Indoor Exposure Assessment for Butyl Benzyl Phthalate (BBP)* ([U.S. EPA, 2025d](#)), EPA has moderate and robust confidence in the assessed inhalation, ingestion, and dermal consumer exposure scenarios. Furthermore, the Agency has robust confidence in the non-cancer POD selected to characterize risk from acute, intermediate, and chronic duration exposures to BBP (see Section 4.2 and ([U.S. EPA, 2025v](#))). The exposure doses used to estimate risk relied on conservative inputs and parameters that are considered representative of a wide selection of use patterns. Overall, EPA has moderate to robust confidence in the risk estimates calculated for consumers inhalation, ingestion, and dermal exposure scenarios. The overall confidence considers confidence in the approach and the inputs used in the calculations. Sources of uncertainty associated with the risk estimates for 11 consumer COUs (Table 4-18) are discussed above in Section 4.1.2.4.

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Table 4-18. Consumer Risk Summary Table

Life Cycle Stage: COU: Subcategory	Product or Article	Duration	Exposure Route	Exposure Scenario (H, M, L) ^a	Lifestage (years) MOE (Benchmark MOE = 30)						
					Infants (<1 year)	Toddlers (1–2 years)	Preschoolers (3–5 years)	Middle Childhood (6–10 years)	Young Teens (11–15 years)	Teenagers (16–20 years)	Adults (21+ years)
Consumer Uses: Construction, paint, electrical, and metal products: Adhesives and sealants	Adhesives for small projects	Acute	Dermal	H	–	–	–	–	290	320	300
			Ingestion	–	–	–	–	–	–	–	–
			Inhalation	–	–	–	–	–	–	–	–
		Intermed.	–	–	–	–	–	–	–	–	–
		Chronic	Dermal	H	–	–	–	–	2,100	2,200	2,100
			Ingestion	–	–	–	–	–	–	–	–
			Inhalation	–	–	–	–	–	–	–	–
	Caulking products	Acute	Dermal	H	–	–	–	–	59	64	60
			Ingestion	–	–	–	–	–	–	–	–
			Inhalation	H	980 ^b	1,000 ^b	1,300 ^b	1,800 ^b	2,400	2,800	3,500
			Aggregate	H	–	–	–	–	57	63	59
		Intermed.	Dermal	H	–	–	–	–	1,800	1,900	1,800
			Ingestion	–	–	–	–	–	–	–	–
			Inhalation	H	3.0E4 ^b	3.1E4 ^b	3.9E4 ^b	5.5E4 ^b	7.1E4	8.4E4	1.0E5
			Aggregate	H	–	–	–	–	1,700	1,900	1,800
	Patching and repair products for exterior surfaces	Acute	Dermal	H	–	–	–	–	–	32	30
				M	–	–	–	–	–	130	120
			Ingestion	–	–	–	–	–	–	–	–
		Intermed.	Inhalation	–	–	–	–	–	–	–	–
			Dermal	H	–	–	–	–	–	960	900
			Ingestion	–	–	–	–	–	–	–	–
			Inhalation	–	–	–	–	–	–	–	–

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Life Cycle Stage: COU: Subcategory	Product or Article	Duration	Exposure Route	Exposure Scenario (H, M, L) ^a	Lifestage (years) MOE (Benchmark MOE = 30)						
					Infants (<1 year)	Toddlers (1–2 years)	Preschoolers (3–5 years)	Middle Childhood (6–10 years)	Young Teens (11–15 years)	Teenagers (16–20 years)	Adults (21+ years)
Consumer Uses: Construction, paint, electrical, and metal products: Paints and coatings	Sealing and refinishing sprays (indoor use)	Acute	Dermal	H	–	–	–	–	–	40	37
				M	–	–	–	–	–	80	75
			Ingestion	–	–	–	–	–	–	–	–
			Inhalation	H	390 ^b	410 ^b	510 ^b	630 ^b	810 ^b	1,000	1,200
				M	390 ^b	410 ^b	510 ^b	680 ^b	930 ^b	1,100	1,400
			Aggregate	H	–	–	–	–	–	39	36
				M	–	–	–	–	–	75	71
		Intermed.	Dermal	H	–	–	–	–	–	1,200	1,100
			Ingestion	–	–	–	–	–	–	–	–
			Inhalation	H	1.2E4 ^b	1.2E4 ^b	1.5E4 ^b	1.9E4 ^b	2.4E4 ^b	3.1E4	3.6E4
			Aggregate	H	–	–	–	–	–	1,200	1,100
	Sealing and refinishing sprays (outdoor use)	Acute	Dermal	H	–	–	–	–	–	40	37
				M	–	–	–	–	–	80	75
			Ingestion	–	–	–	–	–	–	–	–
			Inhalation	H	2,300 ^b	2,400 ^b	3,000 ^b	4,300 ^b	2,000 ^b	2,600	3,000
				M	2,300 ^b	2,400 ^b	3,000 ^b	4,300 ^b	3,400 ^b	4,300	5,000
			Aggregate	H	–	–	–	–	–	39	37
				M	–	–	–	–	–	79	74
		Intermed.	Dermal	H	–	–	–	–	–	1,200	1,100
			Ingestion	–	–	–	–	–	–	–	–
			Inhalation	H	6.9E4 ^b	7.3E4 ^b	9.0E4 ^b	1.3E5 ^b	6.1E4 ^b	7.9E4	9.0E4
			Aggregate	H	–	–	–	–	–	1,200	1,100

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Life Cycle Stage: COU: Subcategory	Product or Article	Duration	Exposure Route	Exposure Scenario (H, M, L) ^a	Lifestage (years) MOE (Benchmark MOE = 30)						
					Infants (<1 year)	Toddlers (1–2 years)	Preschoolers (3–5 years)	Middle Childhood (6–10 years)	Young Teens (11–15 years)	Teenagers (16–20 years)	Adults (21+ years)
Consumer Uses: Furnishing, cleaning, treatment care products: Fabric, textile, and leather products	Clothing (synthetic leather)	Acute	Dermal	H	–	–	–	–	–	– ^c	– ^c
				M	–	–	–	–	–	1,800	1,700
			Ingestion	–	–	–	–	–	–	–	–
			Inhalation	–	–	–	–	–	–	–	–
		Intermed.	–	–	–	–	–	–	–	–	–
		Chronic	Dermal	H	–	–	–	–	–	– ^c	– ^c
				M	–	–	–	–	–	1.3E4	1.2E4
			Ingestion	–	–	–	–	–	–	–	–
			Inhalation	–	–	–	–	–	–	–	–
	Furniture (synthetic leather)	Acute	Dermal	H ^c	–	– ^c	– ^c	– ^c	– ^c	– ^c	– ^c
				M	–	–	980	1,300	1,600	1,800	1,700
				L	–	4,700	5,400	6,700	8,500	9,300	8,700
			Ingestion	H	5.9E4	7.9E4	9.5E4	5.0E5	8.9E5	1.1E6	2.5E6
			Inhalation	H	7,700	8,200	1.0E4	1.4E4	2.1E4	2.4E4	3.0E4
			Aggregate	H	6,800	7,400	9,100	1.4E4	2.0E4	2.4E4	3.0E4
				M	1.7E4	1.8E4	940	1,200	1,600	1,800	1,700
				L	8.5E4	4,400	5,200	6,500	8,200	9,000	8,500
		Intermed.	–	–	–	–	–	–	–	–	–
		Chronic	Dermal	H ^c	–	– ^c	– ^c	– ^c	– ^c	– ^c	– ^c
				M	–	–	980	1,300	1,600	1,800	1,700
				L	–	4,700	5,400	6,700	8,500	9,300	8,700
			Ingestion	H	6.7E4	9.9E4	1.3E5	9.8E5	1.8E6	2.2E6	4.9E6
			Inhalation	H	1.9E4	2.1E4	2.5E4	3.7E4	5.2E4	6.0E4	7.5E4
			Aggregate	H	1.5E4	1.7E4	2.1E4	3.5E4	5.0E4	5.9E4	7.4E4
				M	4.1E4	4.4E4	970	1,300	1,600	1,800	1,700
				L	2.1E5	4,600	5,300	6,600	8,400	9,200	8,600

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Life Cycle Stage: COU: Subcategory	Product or Article	Duration	Exposure Route	Exposure Scenario (H, M, L) ^a	Lifestage (years) MOE (Benchmark MOE = 30)						
					Infants (<1 year)	Toddlers (1–2 years)	Preschoolers (3–5 years)	Middle Childhood (6–10 years)	Young Teens (11–15 years)	Teenagers (16–20 years)	Adults (21+ years)
Consumer Uses: Furnishing, cleaning, treatment care products: Floor coverings; construction and building materials covering large surface areas including stone, plaster, cement, glass and ceramic articles; fabrics, textiles, and apparel	Vinyl flooring	Acute	Dermal	H	2,000	2,300	2,700	3,400	4,300	4,700	4,400
			Ingestion	H	2,200	1,800	1,600	4,600	8,100	1.0E4	2.3E4
			Inhalation	H	130	140	170	250	350	410	510
			Aggregate	H	120	120	150	220	310	360	450
		Intermed.	–	–	–	–	–	–	–	–	–
		Chronic	Dermal	H	2,000	2,300	2,700	3,400	4,300	4,700	4,400
			Ingestion	H	4,400	3,500	3,100	9,000	1.6E4	2.0E4	4.5E4
			Inhalation	H	330	350	430	620	880	1,000	1,300
			Aggregate	H	270	280	330	500	700	810	970
Consumer Uses: Packaging, paper, plastic, hobby products: Arts, crafts, and hobby materials	Crafting resin (liquid)	Acute	Dermal	H	–	–	560	690	880	960	900
			Ingestion	–	–	–	–	–	–	–	–
			Inhalation	H	470 ^b	490 ^b	670	1,000	1,500	1,800	2,200
			Aggregate	H	–	–	310	410	550	630	640
		Intermed.	–	–	–	–	–	–	–	–	–
		Chronic	Dermal	H	–	–	3,900	4,900	6,200	6,700	6,300
			Ingestion	–	–	–	–	–	–	–	–
			Inhalation	H	35 ^b	37 ^b	50	76	110	130	160
			Aggregate	H	–	–	50	75	110	130	160
	Crafting resin (cured)	Acute	Dermal	H	–	–	5,400	6,700	8,500	9,300	8,700
			Ingestion	–	–	–	–	–	–	–	–
			Inhalation	H	470 ^b	490 ^b	670	1,000	1,500	1,800	2,200
			Aggregate	H	–	–	600	890	1,300	1,500	1,700
		Intermed.	–	–	–	–	–	–	–	–	–
		Chronic	Dermal	H	–	–	3.8E4	4.7E4	6.0E4	6.5E4	6.1E4
			Ingestion	–	–	–	–	–	–	–	–
			Inhalation	H	35 ^b	37 ^b	50	76	110	130	160
			Aggregate	H	-	-	50	76	110	130	160

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Life Cycle Stage: COU: Subcategory	Product or Article	Duration	Exposure Route	Exposure Scenario (H, M, L) ^a	Lifestage (years) MOE (Benchmark MOE = 30)						
					Infants (<1 year)	Toddlers (1–2 years)	Preschoolers (3–5 years)	Middle Childhood (6–10 years)	Young Teens (11–15 years)	Teenagers (16–20 years)	Adults (21+ years)
Consumer Uses: Packaging, paper, plastic, hobby products: Arts, crafts, and hobby materials	Small articles with the potential for semi-routine contact, modeling clay, jewelry making crafts	Acute	Dermal	H	2,000	2,300	2,700	3,400	4,300	4,700	4,400
			Ingestion	–	–	–	–	–	–	–	–
			Inhalation	–	–	–	–	–	–	–	–
		Intermed.	–	–	–	–	–	–	–	–	–
		Chronic	Dermal	H	2,000	2,300	2,700	3,400	4,300	4,700	4,400
			Ingestion	–	–	–	–	–	–	–	–
			Inhalation	–	–	–	–	–	–	–	–
		Chronic	Dermal	H	–	–	–	–	230	260	240
			Ingestion	–	–	–	–	–	–	–	–
			Inhalation	–	–	–	–	–	–	–	–
Consumer Uses: Packaging, paper, plastic, hobby products: Ink, toner, and colorant products	Inks and dyes	Acute	Dermal	H	–	–	–	–	–	–	–
			Ingestion	–	–	–	–	–	–	–	–
			Inhalation	–	–	–	–	–	–	–	–
		Intermed.	–	–	–	–	–	–	–	–	–
		Chronic	Dermal	H	–	–	–	–	1,600	1,800	1,700
			Ingestion	–	–	–	–	–	–	–	–
			Inhalation	–	–	–	–	–	–	–	–
		Chronic	Dermal	H	2,000	2,300	2,700	3,400	4,300	4,700	4,400
			Ingestion	–	–	–	–	–	–	–	–
			Inhalation	–	–	–	–	–	–	–	–
Consumer Uses: Packaging, paper, plastic, hobby products: packaging (excluding food packaging) and other articles with routine direct contact during normal use, including rubber articles; plastic articles (hard); plastic articles (soft)	Small articles with the potential for semi-routine contact, packaging, including plastic bags and pouches; vinyl shelf liner, bottom surface of shoe, small exterior clothing components, disposable gloves	Acute	Dermal	H	2,000	2,300	2,700	3,400	4,300	4,700	4,400
			Ingestion	–	–	–	–	–	–	–	–
			Inhalation	–	–	–	–	–	–	–	–
		Intermed.	–	–	–	–	–	–	–	–	–
		Chronic	Dermal	H	2,000	2,300	2,700	3,400	4,300	4,700	4,400
			Ingestion	–	–	–	–	–	–	–	–
			Inhalation	–	–	–	–	–	–	–	–
		Chronic	Dermal	H	2,000	2,300	2,700	3,400	4,300	4,700	4,400
			Ingestion	–	–	–	–	–	–	–	–
			Inhalation	–	–	–	–	–	–	–	–

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Life Cycle Stage: COU: Subcategory	Product or Article	Duration	Exposure Route	Exposure Scenario (H, M, L) ^a	Lifestage (years) MOE (Benchmark MOE = 30)						
					Infants (<1 year)	Toddlers (1–2 years)	Preschoolers (3–5 years)	Middle Childhood (6–10 years)	Young Teens (11–15 years)	Teenagers (16–20 years)	Adults (21+ years)
Consumer Uses: Packaging, paper, plastic, hobby products: toys, playgrounds, and sporting equipment	Children's toys (legacy)	Acute	Dermal	H	3,500	4,100	4,700	5,900	7,500	8,100	–
			Ingestion	H	2.6E4	3.7E4	3.7E4	1.2E5	2.1E5	2.6E5	5.9E5
			Inhalation	H	1,600	1,700	2,200	3,100	4,400	5,100	6,400
			Aggregate	H	1,100	1,200	1,400	2,000	2,700	3,100	6,300
		Intermed.	–	–	–	–	–	–	–	–	–
		Chronic	Dermal	H	3,500	4,100	4,700	5,900	7,500	8,100	–
			Ingestion	H	3.4E4	6.1E4	6.6E4	2.3E5	4.1E5	5.2E5	1.2E6
			Inhalation	H	4,100	4,400	5,400	7,800	1.1E4	1.3E4	1.6E4
			Aggregate	H	1,800	2,100	2,400	3,300	4,400	4,900	1.6E4
	Children's toys (new)	Acute	Dermal	H	3,500	4,100	4,700	5,900	7,500	8,100	–
			Ingestion	H	4.2E4	1.0E5	1.3E5	5.9E5	1.1E6	1.3E6	3.0E6
			Inhalation	H	8,200	8,700	1.1E4	1.5E4	2.2E4	2.6E4	3.2E4
			Aggregate	H	2,300	2,700	3,200	4,200	5,500	6,100	3.2E4
		Intermed.	–	–	–	–	–	–	–	–	–
		Chronic	Dermal	H	3,500	4,100	4,700	5,900	7,500	8,100	–
			Ingestion	H	4.5E4	1.3E5	1.9E5	1.2E6	2.1E6	2.6E6	5.8E6
			Inhalation	H	2.1E4	2.2E4	2.7E4	3.9E4	5.5E4	6.4E4	8.0E4
			Aggregate	H	2,800	3,400	4,000	5,100	6,500	7,200	7.9E4
	Tire crumb	Acute	Dermal	H	–	–	7,000	7,400	9,500	1.1E4	1.1E4
			Ingestion	H	–	–	2.1E6	4.7E6	8.4E6	2.1E7	2.4E7
			Inhalation	H	–	–	1.9E6	2.9E6	1.5E6	2.8E6	3.0E6
			Aggregate	H	–	–	7,000	7,400	9,500	1.1E4	1.0E4
		Intermed.	–	–	–	–	–	–	–	–	–
		Chronic	Dermal	H	–	–	3.3E4	3.5E4	2.5E4	2.9E4	4.9E4
			Ingestion	H	–	–	9.7E6	2.2E7	2.2E7	5.6E7	1.1E8
			Inhalation	H	–	–	9.0E6	1.3E7	3.9E6	7.4E6	1.4E7
			Aggregate	H	–	–	3.3E4	3.5E4	2.5E4	2.8E4	4.9E4

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Life Cycle Stage: COU: Subcategory	Product or Article	Duration	Exposure Route	Exposure Scenario (H, M, L) ^a	Lifestage (years) MOE (Benchmark MOE = 30)						
					Infants (<1 year)	Toddlers (1–2 years)	Preschoolers (3–5 years)	Middle Childhood (6–10 years)	Young Teens (11–15 years)	Teenagers (16–20 years)	Adults (21+ years)
Consumer Uses: Other uses: Automotive articles	Car mat	Acute	Dermal	H	–	–	–	–	8.5E4	9.3E4	8.7E4
			Ingestion	H	7.6E7	6.3E7	5.7E7	1.5E8	2.7E8	3.4E8	7.0E8
			Inhalation	H	2.0E6	2.2E6	2.7E6	3.8E6	5.4E6	6.3E6	7.8E6
			Aggregate	H	2.0E6	2.1E6	2.5E6	3.7E6	8.4E4	9.2E4	8.6E4
		Intermed.	–	–	–	–	–	–	–	–	–
		Chronic	Dermal	H	–	–	–	–	6.0E5	6.5E5	6.1E5
			Ingestion	H	1.5E8	1.2E8	1.1E8	3.1E8	5.4E8	6.7E8	1.4E9
			Inhalation	H	5.3E6	5.6E6	6.9E6	9.9E6	1.4E7	1.6E7	2.0E7
			Aggregate	H	5.1E6	5.4E6	6.5E6	9.6E6	5.7E5	6.3E5	5.9E5
Consumer Uses: Other uses: Automotive products, fluids	Automotive lubricants	Acute	Dermal	H	–	–	–	–	–	160	150
			Ingestion	–	–	–	–	–	–	–	–
			Inhalation	–	–	–	–	–	–	–	–
		Intermed.	–	–	–	–	–	–	–	–	–
		Chronic.	–	–	–	–	–	–	–	–	–
	Interior car care	Acute	Dermal	H	–	–	–	–	–	85	80
			Ingestion	–	–	–	–	–	–	–	–
			Inhalation	H	1.2E5 ^b	1.3E5 ^b	1.6E5 ^b	2.3E5 ^b	1.2E5 ^b	1.5E5	1.7E5
			Aggregate	H	–	–	–	–	–	85	80
		Intermed.	–	–	–	–	–	–	–	–	–
		Chronic	Dermal	H	–	–	–	–	–	600	560
			Ingestion	–	–	–	–	–	–	–	–
			Inhalation	H	3.9E5 ^b	4.2E5 ^b	5.1E5 ^b	7.4E5 ^b	4.3E5 ^b	5.4E5	6.4E5
			Aggregate	H	–	–	–	–	–	600	560

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					Infants (<1 year)	Toddlers (1–2 years)	Preschoolers (3–5 years)	Middle Childhood (6–10 years)	Young Teens (11–15 years)	Teenagers (16–20 years)	Adults (21+ years)
Consumer Uses: Other uses: Novelty articles	Adult toys	Acute	Dermal	H	–	–	–	–	–	1.9E4	1.7E4
			Ingestion	H	–	–	–	–	–	2.9E4	3.2E4
			Inhalation	–	–	–	–	–	–	–	–
			Aggregate	H	–	–	–	–	–	1.1E4	1.1E4
		Intermed.	–	–	–	–	–	–	–	–	
		Chronic	Dermal	H	–	–	–	–	–	1.9E4	1.7E4
			Ingestion	H	–	–	–	–	–	2.9E4	3.2E4
			Inhalation	–	–	–	–	–	–	–	–
			Aggregate	H	–	–	–	–	–	1.1E4	1.1E4

^a Exposure scenario intensities include high (H), medium (M), and low (L).
^b MOE for bystander scenario.
^c Scenario was removed due to high uncertainties, see *Draft Consumer and Indoor Exposure Assessment for Butyl Benzyl Phthalate (BBP)* ([U.S. EPA, 2025d](#)).

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4.3.4 Risk Estimates for General Population

EPA utilized previously peer-reviewed methodologies to conduct screening level analyses of general population exposures to BBP associated with TSCA COUs via the ambient air, ambient water, ambient land, and fish ingestion pathways/routes as described in the *Draft Environmental Media, General Population, and Environmental Exposure Butyl Benzyl Phthalate (BBP)* ([U.S. EPA, 2025r](#)) and Section 4.1.3,. This assessment focuses on subsets of the general population in proximity to releasing facilities, including fenceline communities.

EPA evaluated surface water, drinking water, fish ingestion, ambient air, and soil via deposition from ambient air pathways quantitatively. Land pathways (*i.e.*, landfills and application of biosolids) were assessed qualitatively for releases from facilities and down-the-drain disposal of consumer products and landfill disposal of consumer articles (see Section 3.1.4 for details on the qualitative assessment of consumer disposal of BBP-containing products and articles). For pathways assessed quantitatively, EPA used high-end inputs to provide high-end estimates of BBP concentration in the various environmental media for screening level purposes. EPA used a MOE approach using high-end exposure estimates with the human health POD to determine whether an exposure pathway had potential non-cancer risks. High-end exposure estimates were defined as those associated with the manufacturing, 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 for a COU and given exposure pathway, then EPA determined that the pathway was not a pathway of concern and it was not further evaluated. If any pathways were identified as pathways of concern for the general population, further exposure assessments for that pathway would be conducted to include higher tiers of modeling, if available, and 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. Therefore, using a screening level approach described in Section 4.1.3, exposure to BBP 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 Risk

As described in Sections 3.3.1.1 and 4.1.3.3 and in more technical detail in the *Draft Environmental Media, General Population, and Environmental Exposure Butyl Benzyl Phthalate (BBP)* ([U.S. EPA, 2025r](#)), EPA has robust confidence that modeled releases used for the screening level analysis are appropriately conservative for a screening level analysis. Therefore, EPA has robust confidence that no general population exposure scenarios via the air, land, or surface water pathways will lead to greater exposures than presented in this evaluation. Despite slight to moderate confidence in the estimated values themselves, confidence in upper bound exposure estimates capturing high-end exposure scenarios was robust given the conservative assumptions used for the estimates. Along with EPA's robust confidence in the non-cancer POD selected to characterize risk from acute, intermediate, and chronic duration exposures to BBP (see Section 4.2 and ([U.S. EPA, 2025v](#))), EPA has robust confidence that the risk estimates calculated for the general population were conservative and appropriate for a screening level analysis.

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 draft BBP risk evaluation.

Some population group lifestages may be more susceptible to the health effects of BBP exposure. As discussed in Section 4.2 and in EPA's *Draft Non-Cancer Human Health Hazard Assessment for Butyl Benzyl Phthalate* ([U.S. EPA, 2025v](#)) and draft revised TSD for CRA ([U.S. EPA, 2025ad](#)), exposure to BBP causes adverse effects on the developing male reproductive system consistent with a disruption of androgen action and phthalate syndrome in experimental animal models. Therefore, women of reproductive age, pregnant women, male infants, male children, and male adolescents are considered to be susceptible subpopulations. These susceptible lifestages were considered throughout the draft risk evaluation. For example, women of reproductive age were evaluated for occupational exposures to BBP for each COU (Table 4-15). 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 BBP through consumer products and articles (Section 0). 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, 2002c](#)).

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

- EPA evaluated a range of OESs for workers and ONUs, including high-end exposure scenarios for women 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 BBP through fish ingestion for subsistence fishers and tribal populations.
- EPA aggregated occupational inhalation and dermal exposures for each COU for women 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 DEHP, DBP, BBP, DIBP, and DINP for the U.S. civilian population using NHANES urinary biomonitoring data and reverse dosimetry for women of reproductive age (16–49 years) and male children (3–5, 6–11, and 12–15 years of age) (discussed in Section 4.4).
- For women of reproductive age, black non-Hispanic women had slightly higher 95th percentile cumulative exposures to DEHP, DBP, BBP, DIBP, and DINP compared to women of other races (*e.g.*, white non-Hispanic, Mexican American). 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 (discussed in Section 4.4).

4.4 Cumulative Risk Considerations

EPA developed the draft revised TSD for CRA ([U.S. EPA, 2025ad](#)) for six toxicologically similar phthalates being evaluated under section 6 of TSCA: DEHP, BBP, DBP, DCHP, DIBP, and DINP. In 2023, EPA issued a draft CRA TSD (draft 2023 approach) that outlined an approach for this assessment ([U.S. EPA, 2023d](#)) and that was peer reviewed by the SACC in May 2023 ([U.S. EPA, 2023g](#)). In the 2023 draft approach, EPA identified a cumulative chemical group and PESS [15 U.S.C. § 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). The CRA approach emphasizes a uniform measure of hazard for sensitive subpopulations—namely women 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, 2024e](#)), DBP ([U.S. EPA, 2024c](#)), DIBP ([U.S. EPA, 2025w](#)), BBP ([U.S. EPA, 2025v](#)), DCHP ([U.S. EPA, 2024d](#)), and DINP ([U.S. EPA, 2024h](#)), including, but not limited to, hepatic, kidney, and other developmental and reproductive toxicity.

EPA's 2025 revised approach for assessing cumulative risk is described in detail in the 2025 draft revised TSD for CRA ([U.S. EPA, 2025ad](#)) and incorporates feedback from the SACC ([U.S. EPA, 2023g](#)) on EPA's 2023 draft proposal ([U.S. EPA, 2023d](#)). The Agency is focusing its CRA on acute duration exposures of women of reproductive age, male infants, and male children to six toxicologically similar phthalates (DEHP, DBP, BBP, DIBP, DCHP, and DINP) that induce effects on the developing male reproductive system consistent with a disruption of androgen action and phthalate syndrome. EPA 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 the draft revised TSD for CRA ([U.S. EPA, 2025ad](#)) for further details). To evaluate cumulative risk, EPA is using a relative potency factor (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 CDC's NHANES biomonitoring 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 draft risk evaluation 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 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.

Additionally, EPA's 2025 revised draft approach for assessing cumulative risk ([U.S. EPA, 2025ad](#)) is subject to public comment and SACC peer-review. EPA's cumulative risk approach may differ in the final BBP risk evaluation after considering input from the public and peer reviewers. The remainder of this human health CRA section is organized as follows:

- Section 4.4.1 – Describes the approach used by EPA to derive draft RPFs for DEHP, DBP, BBP, DIBP, DCHP, and DINP based on reduced fetal testicular testosterone. These are used by the

Agency as part of the current CRA and to assess exposures to individual phthalates by scaling to an index chemical (i.e., the RPF analysis). Section 2 of EPA's revised draft revised TSD for CRA ([U.S. EPA, 2025ad](#)) 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 draft revised TSD for CRA ([U.S. EPA, 2025ad](#)) provides additional details.
- Section 4.4.3 – Describes how EPA combined exposures to BBP from individual consumer and occupational COUs/OES with cumulative non-attributable phthalate exposures from NHANES to estimate cumulative risk. An empirical example is also provided. Section 5 of EPA's draft revised TSD for CRA ([U.S. EPA, 2025ad](#)) provides additional details.
- Sections 4.4.4 through 4.4.6 – Summarizes risk estimates for workers, consumers, and the general population based on relative potency assumptions.

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

- *Revised Draft 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, 2025ad](#));
- *Draft 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, 2024b](#));
- *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, 2023d](#));
- *Draft Proposed Principles of Cumulative Risk Assessment under the Toxic Substances Control Act* ([U.S. EPA, 2023e](#)); and
- *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, 2023g](#)).

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 provides a brief overview of the draft RPFs derived by EPA for DEHP, DBP, BBP, DIBP, DCHP, and DINP based on decreased fetal testicular testosterone. Further details regarding the draft relative potency analysis conducted by EPA are provided in the following TSDs:

- *Revised Draft 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, 2025ad](#))
- *Draft 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, 2024b](#)).

4.4.1.1 Relative Potency Factor Approach Overview

For the RPF approach, chemicals being evaluated require: (1) 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 (2) have dose-response data for the effect of concern over similar exposure ranges ([U.S. EPA, 2023b](#), [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 the response at a fixed dose or the dose at a fixed response (Equation 4-3).

Equation 4-3. Calculating RPFs

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

Where:

<i>BMD</i>	=	Benchmark dose (mg/kg/day)
<i>R</i>	=	Magnitude of response (<i>i.e.</i> , benchmark response)
<i>i</i>	=	ith chemical
<i>IC</i>	=	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:

<i>Index chemical equivalents</i>	=	Dose of the mixture in index chemical equivalents (mg/kg/day)
<i>d_i</i>	=	Dose of the ith chemical in the mixture (mg/kg/day)
<i>RPF_i</i>	=	Relative potency factor of the ith chemical in the mixture (unitless)

Non-cancer risk associated with exposure to an individual chemical or 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 BMD level or 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 Draft 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 *Draft Meta-Analysis and Benchmark Dose Modeling of Fetal Testicular Testosterone for DEHP, DBP, BBP, DIBP, and DCHP* ([U.S. EPA, 2024b](#)), the Agency evaluated benchmark responses (BMRs) of 5, 10, and 40 percent. EPA estimated RPFs at the 5, 10, and

40 percent response levels. 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. Therefore, for input into the CRA of phthalates, EPA has selected draft RPFs using BMD₄₀ estimates, as this was the only response level in which a full set of RPFs could be derived for all phthalates being evaluated (Table 4-19). There is some uncertainty in the applicability of the selected RPFs for DIBP and BBP at the low response levels (*i.e.*, 5% to 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. For further details regarding RPFs derivation, see Section 2 of EPA’s draft revised TSD for CRA ([U.S. EPA, 2025ad](#)). The draft RPFs will be peer reviewed by the SACC in 2025 and EPA will take into consideration SACC’s recommendations for the final risk evaluation.

Selection of the Index Chemical

As described further in Section 2 of EPA’s draft revised TSD for CRA ([U.S. EPA, 2025ad](#)), EPA has *preliminarily selected DBP as the index chemical*. 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 BMD₅ and BMDL₅ are derived. This provides a robust and scientifically sound foundation for BMD and BMDL estimates on which the RPF approach is based. EPA’s preliminary decision to select DBP as the index chemical will be peer reviewed by the SACC in 2025 and EPA will take into consideration SACC’s recommendations for the final risk evaluation.

Table 4-19. Draft Relative Potency Factors Based on Decreased Fetal Testicular Testosterone

Phthalate	BMD ₄₀ (mg/kg-day)	RPF Based on BMD ₄₀
DBP (index chemical)	149	1.0
DEHP	178	0.84
DIBP	279	0.53
BBP	284	0.52
DCHP	90	1.66
DINP	699	0.21

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, 2024e](#)), DBP ([U.S. EPA, 2024c](#)), BBP ([U.S. EPA, 2025v](#)), DIBP ([U.S. EPA, 2025w](#)), DCHP ([U.S. EPA, 2024d](#)), and DINP ([U.S. EPA, 2024h](#)) (see also the appendix titled “Considerations for Benchmark Response (BMR) Selection for Reduced Fetal Testicular Testosterone” in each hazard assessment), EPA has reached the conclusion that a BMR of 5 percent is the most appropriate and health protective response level for evaluating decreased fetal testicular testosterone as the basis of the POD (as noted above, RPFs are based on a 40% response

level). For the index chemical, DBP, the BMDL₅ for the best fitting linear-quadratic model is 9 mg/kg-day for reduced fetal testicular testosterone. Using allometric body weight scaling to the $\frac{3}{4}$ -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, 2022d, 2002c](#)), 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 $\frac{3}{4}$ -power to derive an HED of 2.1 mg/kg-day DBP, which accounts for species differences in toxicokinetics. Consistent with published EPA guidance ([U.S. EPA, 2011c](#)), the interspecies uncertainty factor (UF_A), was reduced from 10 to 3 to account for remaining uncertainty associated with interspecies differences in toxicodynamics. Overall, a total uncertainty factor of 30× was selected for use as the benchmark margin of exposure for the CRA (based on an interspecies uncertainty factor [UF_A] of 3 and an intraspecies uncertainty factor [UF_H] of 10).

Weight of Scientific Evidence

EPA has preliminary selected an HED of 2.1 mg/kg-day (BMDL₅ 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. The Agency has also derived draft RPFs of 1, 0.84, 0.53, 0.52, 1.66, and 0.21 for DBP (index chemical), DEHP, DIBP, BBP, DCHP, and DINP (Table 4-19), respectively, based on a common toxicological outcome (*i.e.*, reduced fetal testicular testosterone). EPA has robust overall confidence in the proposed POD for the index chemical DBP and the derived draft RPFs.

Application of RPFs provides a robust basis for assessing the dose-response to the common hazard endpoint across all assessed phthalates. For BBP 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 EPA's draft revised TSD for CRA ([U.S. EPA, 2025ad](#)) for a discussion of the weight of scientific evidence supporting EPA's preliminary conclusions.

4.4.2 Cumulative Phthalate Exposure: Non-Attributable Cumulative Exposure to DEHP, DBP, BBP, DIBP, and DINP Using NHANES Biomonitoring Data

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 draft revised TSD for CRA ([U.S. EPA, 2025ad](#)) for additional details.

NHANES is an ongoing exposure assessment of the U.S. population's exposure to environmental chemicals using biomonitoring. The NHANES biomonitoring dataset is a national, statistical representation of the general, non-institutionalized, civilian U.S. population. CDC's NHANES dataset provides an estimate of average aggregate exposure to individual phthalates for the national 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 also 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, 2023g](#)). These estimates of total non-attributable exposure can supplement assessments of scenario-specific acute risk in individual risk evaluations.

Monoester metabolites of BBP, DBP, DEHP, DIBP, and DINP in human urine are regularly measured as part of the NHANES biomonitoring program and are generally detectable in human urine at a high frequency, including during the most recent NHANES survey period (*i.e.*, 2017–2018). One urinary metabolite (*i.e.*, monocyclohexyl phthalate [MCHP]) of DCHP was included in NHANES from 1999 through 2010, but was excluded from NHANES after 2010 due to low detection levels and a low frequency of detection in human urine (detected in <10% of samples in 2009–2010 NHANES survey) ([CDC, 2013](#)). Therefore, EPA did not use NHANES urinary biomonitoring data to estimate a daily aggregate intake value for DCHP through reverse dosimetry.

The Agency used urinary phthalate metabolite concentrations for DEHP, DBP, BBP, DIBP, and DINP measured in the 2017 to 2018 NHANES survey period to estimate the average daily aggregate intake of each phthalate through reverse dosimetry for the following groups:

- women of reproductive age (16–49 years);
- male children (4 to <6 years, used as a proxy for male infants and toddlers);
- male children (6–11 years); and
- male children (12 to <16 years).

Because NHANES does not include urinary biomonitoring for infants or toddlers, and other national datasets are not available, EPA used biomonitoring data from male children 3 to less than 6 years of age as a proxy for both male infants (<1 year) and male toddlers (1–2 years). See Section 4 of the draft revised TSD for CRA ([U.S. EPA, 2025ad](#)) for further details regarding the reverse dosimetry approach. Aggregate daily intake estimates for these populations are presented in Table 4-20.⁵ Aggregate daily intake values were also calculated for women of reproductive age stratified by race and socioeconomic status (Table 4-21). A similar analysis by race was not done for male children because the NHANES sample size is smaller for this population.

Aggregate daily intake values for each phthalate were then scaled by relative potency using the RPFs listed in Table 4-19, 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 women 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 women of reproductive age were selected for use in the CRA of BBP (Table 4-21).

The 95th percentile of national cumulative exposure serves as the estimate of non-attributable phthalate exposure for its CRA of BBP, as summarized below:

- Women 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 women 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

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 702.33](#)).

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. EPA 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 EPA has been used extensively in the literature and has been used 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 might provide an underestimate of acute phthalate exposure.

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Table 4-20. Cumulative Phthalate Daily Intake (µg/kg-day) Estimates for Women 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; n = 1,620)	50	DBP	0.21	1	0.210	22.1	0.950	2,211	1.4%
		DEHP	0.53	0.84	0.445	46.9			
		BBP	0.08	0.52	0.042	4.38			
		DIBP	0.2	0.53	0.106	11.2			
		DINP	0.7	0.21	0.147	15.5			
	95	DBP	0.61	1	0.610	17.2	3.55	592	5.1%
		DEHP	1.48	0.84	1.24	35.0			
		BBP	0.42	0.52	0.218	6.15			
		DIBP	0.57	0.53	0.302	8.51			
		DINP	5.6	0.21	1.18	33.1			
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			

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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.

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Table 4-21. Cumulative Phthalate Daily Intake (µg/kg-day) Estimates for Women of Reproductive Age (16–49 years old) by Race and Socioeconomic Status from the 2017–2018 NHANES Cycle

Race/ Socioeconomic Status (SES)	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
Race: white non- Hispanic (n = 494)	50	DBP	0.22	1	0.22	21.6	1.02	2,058	1.5%
		DEHP	0.59	0.84	0.50	48.6			
		BBP	0.10	0.52	0.05	5.1			
		DIBP	0.20	0.53	0.11	10.4			
		DINP	0.70	0.21	0.15	14.4			
	95	DBP	0.58	1	0.58	17.6	3.30	636	4.7%
		DEHP	1.44	0.84	1.21	36.6			
		BBP	0.29	0.52	0.15	4.6			
		DIBP	0.55	0.53	0.29	8.8			
		DINP	5.10	0.21	1.07	32.4			
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			

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Race/ Socioeconomic Status (SES)	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
Race: Mexican American (n = 259)	50	DBP	0.19	1	0.19	22.4	0.849	2,474	1.2%
		DEHP	0.49	0.84	0.41	48.5			
		BBP	0.06	0.52	0.03	3.7			
		DIBP	0.17	0.53	0.09	10.6			
		DINP	0.60	0.21	0.13	14.8			
	95	DBP	0.42	1	0.42	11.6	3.61	582	5.2%
		DEHP	1.24	0.84	1.04	28.9			
		BBP	0.39	0.52	0.20	5.6			
		DIBP	0.46	0.53	0.24	6.8			
		DINP	8.10	0.21	1.70	47.1			
Race: Other (n = 496)	50	DBP	0.26	1	0.26	25.3	1.03	2041	1.5%
		DEHP	0.64	0.84	0.54	52.2			
		BBP	0.07	0.52	0.04	3.5			
		DIBP	0.15	0.46	0.07	6.7			
		DINP	0.60	0.21	0.13	12.2			
	95	DBP	0.84	1	0.84	20.7	4.06	517	5.8%
		DEHP	1.37	0.84	1.15	28.3			
		BBP	0.41	0.52	0.21	5.2			
		DIBP	0.46	0.53	0.24	6.0			
		DINP	7.70	0.21	1.62	39.8			

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Race/ Socioeconomic Status (SES)	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
SES: Below poverty level (n = 1,056)	50	DBP	0.21	1	0.21	22.0	0.955	2,199	1.4%
		DEHP	0.53	0.84	0.45	46.6			
		BBP	0.09	0.52	0.05	4.9			
		DIBP	0.20	0.53	0.11	11.1			
		DINP	0.70	0.21	0.15	15.4			
	95	DBP	0.82	1	0.82	18.2	4.50	467	6.4%
		DEHP	1.75	0.84	1.47	32.7			
		BBP	0.34	0.52	0.18	3.9			
		DIBP	0.51	0.53	0.27	6.0			
		DINP	8.40	0.21	1.76	39.2			
SES: At or above poverty level (n = 354)	50	DBP	0.20	1.00	0.20	27.9	0.718	2,924	1.0%
		DEHP	0.31	0.84	0.26	36.3			
		BBP	0.06	0.52	0.03	4.3			
		DIBP	0.15	0.53	0.08	11.1			
		DINP	0.70	0.21	0.15	20.5			
	95	DBP	0.48	1.00	0.48	16.3	2.94	713	4.2%
		DEHP	1.07	0.84	0.90	30.5			
		BBP	0.45	0.52	0.23	7.9			
		DIBP	0.65	0.53	0.34	11.7			
		DINP	4.70	0.21	0.99	33.5			

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Race/ Socioeconomic Status (SES)	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
SES: Unknown (n = 210)	50	DBP	0.26	1.00	0.26	23.2	1.12	1,870	1.6%
		DEHP	0.67	0.84	0.56	50.1			
		BBP	0.06	0.52	0.03	2.8			
		DIBP	0.23	0.53	0.12	10.9			
		DINP	0.70	0.21	0.15	13.1			
	95	DBP	0.60	1.00	0.60	25.5	2.35	893	3.4%
		DEHP	0.86	0.84	0.72	30.7			
		BBP	0.21	0.52	0.11	4.6			
		DIBP	0.35	0.53	0.19	7.9			
		DINP	3.50	0.21	0.74	31.2			

^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.

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4.4.3 Estimation of Risk Based on Relative Potency

As described in the draft revised TSD for CRA ([U.S. EPA, 2025ad](#)), EPA is focusing its exposure assessment for the CRA for BBP on evaluation of exposures through individual consumer and occupational BBP COUs as well as non-attributable cumulative exposure to DEHP, DBP, BBP, DIBP, and DINP using NHANES urinary biomonitoring data and reverse dosimetry. As described in the draft revised TSD for CRA, the Agency is considering two options for characterizing cumulative risk.

Herein, EPA uses the first option to estimate cumulative risk in which all phthalate exposures are scaled by relative potency using the RPFs presented in Table 4-19 to express phthalate exposure in terms of index chemical (DBP) equivalents. Exposures from individual BBP consumer or worker COUs/OES were then combined to estimate cumulative risk. Cumulative risk was estimated using the four-step process outlined below, along with one empirical example of how EPA calculated cumulative risk for one occupational OES for BBP (*i.e.*, PVC plastics converting). In the second option, which is not presented in this document but is presented in Section 5.2 of the draft revised TSD for CRA ([U.S. EPA, 2025ad](#)), individual phthalate exposures for consumer and occupational COUs are not scaled by RPFs but instead use individual phthalate hazard values combined with non-attributable cumulative exposures for each phthalate estimated using NHANES.

Both options are compared in Section 5.4 of U.S. EPA ([2025ad](#)). Both options for calculating cumulative risk, along with draft RPFs and selection of DBP as the index chemical, will be peer reviewed by the SACC in 2025. Following peer review and public comment, EPA will select one option for characterizing cumulative risk in the final BBP risk evaluation.

Step 1: Convert BBP Exposure Estimates from Each Individual Consumer and Occupational COU to Index Chemical Equivalents (*i.e.*, Occupational and Consumer Exposure from Sections 4.1.1 and 4.1.2, Respectively)

In this step, BBP acute duration exposure estimates from a single consumer or occupational COU/OES is scaled by relative potency and expressed in terms of index chemical (DBP) equivalents using Equation 4-5. This step is repeated for all individual exposure estimates for each route of exposure being assessed for each COU (*i.e.*, inhalation and dermal exposures for occupational COUs; inhalation, ingestion, and dermal exposure for consumer COUs). This step calculates the route-specific estimates for a single BBP COU.

Equation 4-5. Scaling BBP Exposures by Relative Potency

$$BBP \text{ Exposure (in DBP equivalents)} = AD_{Route\ 1} \times RPF_{BBP}$$

Where:

<i>BBP exposure</i>	=	Acute exposure for a given route of exposure from a single occupational or consumer COU expressed in terms of µg/kg index chemical (DBP) equivalents
<i>AD_{Route 1}</i>	=	Acute dose in µg/kg from a given route of exposure from a single occupational or consumer COU/OES
<i>RPF_{BBP}</i>	=	The relative potency factor (unitless) for BBP, which is 0.52 (Table 4-19).

Example: 50th percentile inhalation and dermal BBP exposures for female workers of reproductive age are 98.6 and 5.47 µg/kg for the PVC plastics converting OES ([U.S. EPA, 2025y](#)). Using Equation 4-5,

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inhalation, dermal, and aggregate BBP exposures for this OES can be scaled by relative potency to 51.3, 2.85, and 54.1 µg/kg DBP equivalents, respectively.

$$BBP_{Inhalation-COU} = 51.3 \text{ µg/kg DBP equivalents} = 98.6 \text{ µg/kg BBP} \times 0.52$$

$$BBP_{Dermal-COU} = 2.85 \text{ µg/kg DBP equivalents} = 5.47 \text{ µg/kg BBP} \times 0.52$$

$$BBP_{Aggregate-COU} = 54.1 \text{ µg/kg DBP equivalents} = (98.6 \text{ µg/kg BBP} + 5.47 \text{ µg/kg BBP}) \times 0.52$$

Step 2: Estimate Non-Attributable Cumulative Exposure to DEHP, DBP, BBP, DIBP, and DINP Using NHANES Urinary Biomonitoring Data and Reverse Dosimetry (see Section 4.4.2 for Further Details)

Non-attributable exposure for a national population to DEHP, DBP, BBP, DIBP, and DINP was also estimated using Equation 4-6. For this option, individual phthalate daily intake values were estimated from NHANES biomonitoring data using reverse dosimetry and were scaled by relative potency, expressed in terms of index chemical (DBP) equivalents, and summed to estimate non-attributable cumulative exposure (as DBP equivalents). EPA used Equation 4-6 to calculate the cumulative exposure estimates provided in Table 4-20 and Table 4-21.

Equation 4-6. Estimating Non-Attributable Cumulative Exposure to DEHP, DBP, BBP, DIBP, and DINP

$$\begin{aligned} \text{Cumulative Exposure (Non - attributable)} \\ = (DI_{DEHP} \times RPF_{DEHP}) + (DI_{DBP} \times RPF_{DBP}) + (DI_{BBP} \times RPF_{BBP}) \\ + (DI_{DIBP} \times RPF_{DIBP}) + (DI_{DINP} \times RPF_{DINP}) \end{aligned}$$

Where:

Cumulative exposure (non-attributable)	=	Expressed in index chemical (DBP) equivalents (µg/kg-day)
DI	=	Daily intake values (µg/kg-day) for each phthalate were calculated using NHANES urinary biomonitoring data; DI values for each phthalate and assessed population are provided in Table 4-20 and Table 4-21
RPF	=	All relative potency factors (unitless) are listed in Table 4-19.

Example: The 95th percentile cumulative exposure estimate of 5.16 µg/kg-day DBP equivalents for black, non-Hispanic women of reproductive age (Table 4-21) is calculated using Equation 4-6 as follows:

$$\begin{aligned} 5.16 \text{ µg/kg DBP equivalents} \\ = (4.28 \text{ µg/kg DEHP} \times 0.84) + (0.48 \text{ µg/kg DBP} \times 1) + (0.30 \text{ µg/kg BBP} \times 0.52) \\ + (0.40 \text{ µg/kg DIBP} \times 0.53) + (3.40 \text{ µg/kg DINP} \times 0.21) \end{aligned}$$

Step 3: Calculate MOEs for BBP Exposures and for Each Phthalate Exposure Included in the Cumulative Scenario

Next, MOEs are calculated for each exposure of interest that is included in the cumulative scenario using Equation 4-7. For example, this step involves calculating MOEs for inhalation and dermal BBP

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exposures expressed in index chemical equivalents for each individual COU/OES in Step 1 as well as an MOE for non-attributable cumulative phthalate exposure from Step 2 above.

Equation 4-7. Calculating MOEs for Exposures of Interest for Use in the RPF and Cumulative Approaches

$$MOE_x = \frac{\text{Index Chemical (DBP) POD}}{\text{Exposure}_x \text{ in DBP Equivalents}}$$

Where:

MOE_x (unitless)	=	The MOE calculated for each exposure of interest included in the cumulative scenario
<i>Index chemical (DBP) POD</i>	=	The POD selected for the index chemical DBP; the index chemical POD is 2,100 µg/kg (Section 4.4.1)
$Exposure_x$	=	The exposure estimate in DBP equivalents for the pathway of interest derived from Step 1 or 2 above

Example: Using Equation 4-7, EPA calculated the MOEs for inhalation and dermal BBP exposure estimates for the PVC plastics converting OES in DBP equivalents from Step 1 and the MOE for the non-attributable cumulative exposure estimate in DBP equivalents from Step 2:

$$MOE_{Cumulative\ Non-attributable} = 407 = \frac{2,100\ \mu g/kg}{5.16\ \mu g/kg}$$

$$MOE_{COU-Inhalation} = 41 = \frac{2,100\ \mu g/kg}{351.3\ \mu g/kg}$$

$$MOE_{COU-Dermal} = 738 = \frac{2,100\ \mu g/kg}{2.85\ \mu g/kg}$$

Step 4: Calculate the Cumulative MOE

For the cumulative MOE approach, MOEs for each exposure of interest in the cumulative scenario are first calculated using Step 3. The cumulative MOE for the cumulative scenario can then be calculated using Equation 4-8, which shows the addition of MOEs for the inhalation and dermal exposures routes from an individual BBP COU as well as the MOE for non-attributable cumulative exposure to phthalates from NHANES urinary biomonitoring data. Additional MOEs can be added to the equation as necessary (e.g., for the ingestion route for consumer scenarios).

Equation 4-8. Cumulative Margin of Exposure Calculation

$$Cumulative\ MOE = \frac{1}{\frac{1}{MOE_{COU-Inhalation}} + \frac{1}{MOE_{COU-Dermal}} + \frac{1}{MOE_{Cumulative-Non-attributable}} \dots}$$

Example: The cumulative MOE for the PVC plastics converting OES is 35 and is calculated by summing the MOEs for each exposure of interest from Step 3 as follows:

$$Cumulative\ MOE = 35 = \frac{1}{\frac{1}{41} + \frac{1}{738} + \frac{1}{407}}$$

4.4.4 Risk Estimates for Workers Based on Relative Potency

This section summarizes RPF analysis risk estimates for female workers of reproductive age from acute duration exposures to BBP. In the RPF analysis, EPA focused its occupational risk assessment on this population and exposure duration because as described in Section 4.4 and the draft revised TSD for CRA ([U.S. EPA, 2025ad](#)), this population and exposure duration is considered most directly applicable to the common hazard outcome that serves as the basis for the RPF analysis (*i.e.*, reduced fetal testicular testosterone).

To evaluate cumulative risk to female workers of reproductive age, EPA combined inhalation and dermal exposures to BBP from each individual occupational COU/OES with non-attributable cumulative exposure to DEHP, DBP, BBP, DIBP, and DINP (estimated from NHANES biomonitoring data). As described in Section 4.4.3, for each individual phthalate exposures were scaled by relative potency per chemical, expressed in terms of index chemical (DBP) equivalents, and summed to estimate cumulative exposure and cumulative risk for each COU. MOEs in Table 4-22 are shown both with (cumulative MOE) and without (MOEs for individual BBP COU derived using the RPF analysis) the addition of non-attributable cumulative exposure (estimated from NHANES using reverse dosimetry) to allow comparisons of MOEs scaled by relative potency.

Table 4-22 summarizes the acute duration central tendency and high-end MOEs for female workers of reproductive age used to characterize cumulative risk from exposure to DCHP, DEHP, DBP, BBP, DIBP, and DINP, as well as BBP MOEs scaled by relative potency without non-attributable cumulative exposure (*i.e.*, from NHANES) included. MOE calculations are also provided in the *Draft Occupational and Consumer Cumulative Risk Calculator for Butyl Benzyl Phthalate (BBP)* ([U.S. EPA, 2025x](#)). As discussed in Section 4.3.2, of the 19 OESs evaluated for BBP, 10 had high-end and central tendency acute MOEs for women of reproductive age ranging from 0.6 to 7.6 (benchmark = 30) in both the individual BBP assessment (Table 4-15) and the cumulative assessment (Table 4-22) (listed below). For these 10 OESs, addition of non-attributable cumulative national exposure (from NHANES) would have no influence on risk conclusions, because MOEs were already below the benchmark in the individual BBP assessment and these 10 OESs are not further discussed. The 10 OESs are as follows:

- Manufacturing;
- Import and repackaging (liquid);
- Incorporation into adhesives and sealants (liquid);
- Incorporation into paints and coatings (liquid);
- Incorporation into other formulations, mixtures, or reaction products (liquid);
- PVC plastics compounding;
- Non-PVC materials compounding;
- Application of paints and coatings;
- Application of adhesives and sealants; and
- Use of lubricants and functional fluids.

For 3 of the 19 OESs evaluated for BBP, high-end acute MOEs for women of reproductive age ranged from 6.4 to 25 (benchmark = 30) in the individual BBP assessment (Table 4-15) and the cumulative assessment (Table 4-22) (listed below), while central tendency acute cumulative MOEs for these 3 OESs ranged from 35 to 65. For these three OESs, addition of non-attributable cumulative national exposure (from NHANES) has no influence on risk conclusions, because MOEs were already below the benchmark in the individual BBP assessment; therefore, these OESs are not further discussed.

- Incorporation into adhesives and sealants (solid);
- PVC plastics converting; and

- Non-PVC materials converting.

For 2 of the 19 OESs evaluated for BBP, high-end acute cumulative acute MOEs ranged from 30 to 184 (benchmark = 30) for women of reproductive age (Table 4-22) (listed below). For these two OESs, addition of non-attributable cumulative national exposure (from NHANES) has no influence on risk conclusions; therefore, both OESs are not further discussed.

- Use of laboratory chemicals (solid) (high-end and central tendency cumulative MOEs = 184 and 261, respectively); and
- Fabrication or use of final products and articles (high-end and central tendency cumulative MOEs = 30 and 145, respectively).

For 4 of the 19 OESs evaluated for BBP, high-end aggregate acute MOEs for women of reproductive age ranged from 37 to 55 (benchmark = 30) in the individual BBP assessment (Table 4-15), while high-end cumulative acute MOEs for these same 4 OESs for women of reproductive age ranged from 12 to 18 (benchmark = 30) in the cumulative assessment (Table 4-22) (discussed below). Central tendency cumulative acute MOEs for these four OESs ranged from 37 to 165 in the cumulative assessment.

- Import and repackaging (solid) (high-end and central tendency cumulative acute MOE = 18 and 165);
- Use of laboratory chemicals (liquid) (high-end and central tendency cumulative acute MOE = 12 and 37);
- Recycling (high-end and central tendency cumulative acute MOE = 17 and 133); and
- Waste handling, treatment, and disposal (high-end and central tendency cumulative acute MOE = 17 and 133).

For all of the evaluated OESs, including the four preceding OESs, three factors contribute to the lower cumulative MOEs compared to the acute aggregate MOEs for female workers of reproductive age:

- *Scaling by Relative Potency*: BBP inhalation and dermal exposures for the OESs were scaled by relative potency to the index chemical DBP. The RPF for BBP is 0.52 (see Table 4-19), which means BBP exposures when multiplied by the RPF and expressed in terms of DBP equivalents, decreased by 48 percent. RPFs used to scale for relative potency were calculated based on a common hazard endpoint—reduced fetal testicular testosterone—from data from multiple studies evaluating effects of phthalates on fetal testicular testosterone using a meta-analysis and BMD modeling approach for each of the six phthalates included in the CRA (see ([U.S. EPA, 2025ad](#)) and ([U.S. EPA, 2025ad](#)) for further details). Although this analysis provides a robust basis for assessing the dose-response for reduced fetal testicular testosterone across the six phthalates and overall, EPA has robust confidence in the draft RPFs used in this CRA (Section 4.4.1), there is some uncertainty associated with the applicability of the BBP RPF at low response levels (*i.e.*, 5% and 10% decreases in fetal testicular testosterone). This is because RPFs could not be estimated for BBP at the 5 or 10 percent response levels due to lack of data at the low-end range of the dose-response curve. However, as discussed previously in Section 4.4.1.2, 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. The draft RPFs are included in the August 2025 SACC peer review of phthalates and EPA will take into consideration SACC’s recommendations in the final risk evaluation.
- *Index Chemical POD*: Cumulative MOEs are calculated by dividing the cumulative exposure estimate expressed in terms of DBP equivalents by the index chemical (DBP) POD. The POD for

DBP used to calculate cumulative risk is 2.1 mg/kg (based on a BMDL₅ for reduced fetal testicular testosterone). Comparatively, the BBP POD used to calculate MOEs for individual BBP COUs in Section 4.3.2 is 12 mg/kg (based on a NOAEL for phthalate syndrome-related effects). *The index chemical (DBP) POD is approximately 5.7-fold lower (i.e., more sensitive) than the individual BBP POD, which is the primary factor leading to lower cumulative MOEs.* Overall, EPA has robust confidence in the index chemical POD used in this CRA because it is based on fetal testicular testosterone data from eight publications that were integrated via meta-analysis and BMD modeling. Notably, several of the available studies evaluated effects on fetal testicular testosterone at dose levels in the low-end range of the dose response curve (i.e., 1, 10, 33, and 50 mg/kg-day) where the BMD₅ (14 mg/kg-day) and BMDL₅ (9 mg/kg-day) were derived (see ([U.S. EPA, 2025ad](#)) for further details). The draft BBP POD and index chemical PODs are included in the SACC August 2025 peer review and EPA will take into consideration SACC's recommendations for the final risk evaluation.

- *Addition of Non-Attributable Cumulative Exposure:* As part of its CRA, EPA calculated non-attributable cumulative exposure to DEHP, DBP, BBP, DIBP, and DINP using NHANES urinary biomonitoring data from 2017 to 2018 survey and reverse dosimetry, representing exposure to a national population. DCHP was not included because it has not been included in NHANES analyses since 2011 due to both 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 DBP equivalents. Non-attributable cumulative exposure was then combined with acute inhalation and dermal BBP exposures for each individual OES scaled by relative potency. 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 women of reproductive age (16–49 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 since it was calculated from CDC's NHANES biomonitoring dataset.

4.4.4.1 Overall Confidence in Cumulative Worker Risk Estimates

As described in Section 4.1.1.5 and the *Draft Environmental Release and Occupational Exposure Assessment for Butyl Benzyl Phthalate* ([U.S. EPA, 2025t](#)), EPA has moderate to robust confidence in the assessed inhalation and dermal OESs. The Agency has robust confidence in the RPFs and index chemical POD used to calculate the RPF analysis and cumulative MOEs (see Section 4.4.1.2). To derive RPFs and the index chemical POD, EPA integrated data from multiple studies evaluating fetal testicular testosterone using meta-analysis and BMD modeling. Because this represents a refinement of the NOAEL/LOAEL approach used in the individual BBP assessment, it increases EPA's confidence in risk estimates. The draft RPFs, index chemical POD, and BBP POD will be peer reviewed by the SACC in 2025 and EPA will take into consideration the SACC's recommendations in the final risk evaluation. Finally, the Agency has robust confidence in the non-attributable cumulative exposure estimates for DEHP, DBP, BBP, DIBP, and DINP derived from NHANES urinary biomonitoring data using reverse dosimetry (Section 4.4.2.1). Overall, EPA has moderate to robust confidence in the cumulative risk estimates calculated for worker exposure scenarios (Table 4-22).

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Life Cycle Stage – Category	Subcategory	OES	Exposure Level	Acute MOEs for Female Workers of Reproductive Age (Benchmark = 30)			
				Inhalation MOE (BBP COU; Exposure in DBP Equiv.)	Dermal MOE (BBP COU; Exposure in DBP Equiv.)	Aggregate MOE (BBP COU; Exposure in DBP Equiv.)	Cumulative MOE (Aggregate BBP MOE + Cumulative Non-Attributable) ^a
Manufacturing – Domestic manufacturing	Domestic manufacturing	Manufacturing	CT	292	2.5	2.5	2.5
			HE	64	1.3	1.2	1.2
Manufacturing – Importing	Importing	Import and repackaging (solid)	CT	443	738	277	165
Processing – Repackaging	Repackaging		HE	19	369	19	18
Manufacturing – Importing	Importing	Import and repackaging (liquid)	CT	292	2.5	2.5	2.5
Processing – Repackaging	Repackaging		HE	64	1.3	1.2	1.2
Processing – Incorporation into formulation, mixture, or reaction product	Plasticizer in: – Adhesive manufacturing	Incorporation into adhesives and sealants (solid)	CT	87	738	78	65
			HE	8.4	369	8.2	8.0
		Incorporation into adhesives and sealants (liquid)	CT	585	2.5	2.5	2.5
			HE	292	1.3	1.3	1.3
	Plasticizer in: – Paint and coating manufacturing – Ink, toner, and colorant manufacturing	Incorporation into paints and coatings (liquid)	CT	585	2.5	2.5	2.5
			HE	292	1.3	1.3	1.3
	Plasticizer in: – All other basic inorganic chemical manufacturing	Incorporation into other formulations, mixtures, or reaction products (liquid)	CT	585	2.5	2.5	2.5
	Laboratory chemical manufacturing		HE	292	1.3	1.3	1.3
	Plasticizers (custom compounding of purchased resin; plastic material and resin manufacturing; rubber manufacturing	PVC plastics compounding	CT	41	2.5	2.4	2.4
			HE	6.6	1.3	1.1	1.1
		Non-PVC plastics compounding	CT	41	2.5	2.4	2.4
Industrial Use – Other uses	Castings		HE	6.6	1.3	1.1	1.1
Commercial Use – Other uses	Castings						

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Life Cycle Stage – Category	Subcategory	OES	Exposure Level	Acute MOEs for Female Workers of Reproductive Age (Benchmark = 30)			
				Inhalation MOE (BBP COU; Exposure in DBP Equiv.)	Dermal MOE (BBP COU; Exposure in DBP Equiv.)	Aggregate MOE (BBP COU; Exposure in DBP Equiv.)	Cumulative MOE (Aggregate BBP MOE + Cumulative Non-Attributable) ^a
Processing – Incorporation into articles	Plasticizers (adhesive manufacturing; fabric, textile, apparel, and leather products manufacturing; building and construction materials manufacturing; plastics product manufacturing; rubber product manufacturing; transportation equipment manufacturing)	PVC plastics converting	CT	41	738	39	35
			HE	6.6	369	6.5	6.4
	Non-PVC materials converting		CT	41	738	39	35
			HE	7	369	6.5	6.4
Industrial Use – Other uses	Castings						
Commercial Use – Other uses	Castings						
Industrial Use – Construction, paint, electrical, and metal products	Paints and coatings	Application of paints and coatings	CT	14	2.5	2.2	2.2
Industrial Use – Packaging, paper, plastic, hobby products	Ink, toner and colorant products		HE	1.3	1.3	0.6	0.6
Commercial Use – Construction, paint, electrical, and metal products	Paints and coatings						
Commercial Use – Packaging, paper, plastic, hobby products	Ink, toner and colorant products						
Industrial Use – Construction, paint, electrical, and metal products	Adhesives and sealants	Application of adhesives and sealants	CT	11,699	2.5	2.5	2.5
Commercial Use – Construction, paint, electrical, and metal products	Adhesives and sealants		HE	5,850	1.3	1.3	1.3

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Life Cycle Stage – Category	Subcategory	OES	Exposure Level	Acute MOEs for Female Workers of Reproductive Age (Benchmark = 30)			
				Inhalation MOE (BBP COU; Exposure in DBP Equiv.)	Dermal MOE (BBP COU; Exposure in DBP Equiv.)	Aggregate MOE (BBP COU; Exposure in DBP Equiv.)	Cumulative MOE (Aggregate BBP MOE + Cumulative Non-Attributable) ^a
Industrial Use – Other uses	Hydraulic fluids	Use of lubricants and functional fluids	CT	11,699	2.5	2.5	2.5
	Automotive products, fluids		HE	5,850	1.3	1.3	1.3
Commercial Use – Other uses	Automotive products, fluids						
Commercial use – Other uses	Laboratory Chemical	Use of laboratory chemicals (solid)	CT	51,313	738	727	261
			HE	3,611	369	335	184
		Use of laboratory chemicals (liquid)	CT	292	47	40	37
			HE	64	16	13	12
Industrial Use – Other uses	Automotive articles	Fabrication or use of final products and articles	CT	325	738	226	145
Commercial Use – Furnishing, cleaning, treatment/care products	Floor coverings; Construction and building materials covering large surface areas including stone, plaster, cement, glass and ceramic articles; fabrics, textiles, and apparel		HE	36	369	33	30
	Fabric, textile, and leather products						
Commercial Use – Packaging, paper, plastic, hobby products	Packaging (excluding food packaging) and other articles with routine direct contact during normal use, rubber articles; plastic articles (hard); plastic articles (soft)						
	Toys, playground, and sporting equipment						
Commercial Use – Other uses	Automotive articles						
Processing – Recycling	Recycling	Recycling	CT	271	738	198	133
			HE	19	369	18	17
Disposal – Disposal	Disposal	Waste handling, treatment, and disposal	CT	271	738	198	133
			HE	19	369	18	17

^a The acute cumulative MOE is derived by summing inhalation exposure from each individual BBP COU with dermal exposure from the same BBP COU and the cumulative non-attributable exposure to phthalates DEHP, DBP, BBP, DIBP, and DINP. Non-attributable cumulative exposure was estimated from NHANES urinary biomonitoring data using reverse dosimetry. All exposure estimates were (1) scaled by relative potency, (2) expressed in index chemical (*i.e.*, DBP) equivalents, (3) summed to calculate cumulative exposure in index chemical equivalents, and then (4) compared to the index chemical POD (*i.e.*, HED of 2.1 mg/kg-day) to calculate the cumulative MOE.

4.4.5 Risk Estimates for Consumers Based on Relative Potency

This section summarizes cumulative risk estimates for consumers from acute duration exposures to BBP. EPA focused its consumer CRA on women of reproductive age and male infants and children for acute exposure duration because they are considered most directly applicable to the common hazard outcome that serves as the basis for the CRA (*i.e.*, reduced fetal testicular testosterone). For consumers, EPA did not specifically evaluate women 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 women 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 BBP from each individual consumer COU and product/article exposure scenario with non-attributable cumulative exposure to DEHP, DBP, BBP, DIBP, and DINP (estimated from NHANES urinary biomonitoring data). As described in Section 4.4.3, for each individual phthalate exposures were scaled by relative potency per chemical, expressed in terms of chemical (DBP) equivalents, and summed to estimate cumulative exposure and cumulative risk for each COU.

As described in Section 4.3.3, EPA evaluated 20 product or article example exposure scenarios associated with 11 consumer COUs. Of the 20 product or article examples, 15 have high-intensity cumulative MOEs ranging from 30 to 474 (benchmark = 30) across evaluated age groups (listed below) (Table 4-23). Scaling by relative potency and adding non-attributable cumulative national exposure (from NHANES) did not influence the risk conclusions therefore the following 15 product or article examples are not further discussed:

- Construction, paint, electrical, and metal products: Adhesives and sealants, including fillers and putties: Adhesives for small projects;
- Furnishing, cleaning, treatment/care products: Fabric, textile, and leather products: Clothing (synthetic leather);
- Furnishing, cleaning, treatment/care products: Fabric, textile, and leather products: Furniture (synthetic leather);
- Furnishing, cleaning, treatment/care products: Floor coverings; construction and building materials covering large surface areas including stone, plaster, cement, glass and ceramic articles; fabrics, textiles, and apparel: Vinyl Flooring;
- Packaging, paper, plastic, hobby products: Arts, crafts, and hobby materials: Crafting resin (liquid);
- Packaging, paper, plastic, hobby products: Arts, crafts, and hobby materials: Crafting resin (cured);
- Packaging, paper, plastic, hobby products: Arts, crafts, and hobby materials: Small articles with the potential for semi-routine contact, modeling clay, jewelry making crafts;
- Packaging, paper, plastic, hobby products: Ink, toner, and colorant products: Inks and dyes
- Packaging, paper, plastic, hobby products: Packaging (excluding food packaging) and other articles with routine direct contact during normal use, including rubber articles; plastic articles (hard); plastic articles (soft): Small articles with the potential for semi-routine contact, packaging, including plastic bags and pouches; vinyl shelf liner, bottom surface of shoe, small exterior clothing components, disposable gloves;
- Packaging, paper, plastic, hobby products: Toys, playgrounds, and sporting equipment: children's toys (legacy);

- Packaging, paper, plastic, hobby products: Toys, playgrounds, and sporting equipment: Children's toys (new);
- Packaging, paper, plastic, hobby products: Toys, playgrounds, and sporting equipment: Tire crumbs;
- Other uses: Automotive articles: Car mat;
- Other uses: Automotive products, fluids: Automotive lubricants; and
- Other uses: Novelty articles: Adult toys (cumulative MOE: 368).

Product or Article Examples with Acute Cumulative MOEs Ranging from 10–29

As can be seen in Table 4-23, cumulative acute MOEs for high- or medium-intensity scenarios ranged from 10 to 29 for 5 out of 20 product or article examples for at least 1 of the evaluated consumer age groups (listed below). Of these 5 product or article examples, only one had an acute high-intensity MOE below the benchmark of 30 in the individual BBP assessment (*i.e.*, Construction, paint, electrical, and metal products: Adhesives and sealants: Patching and repair products for exterior surfaces) (Table 4-18). For all five of the product or article examples discussed further below, scaling by relative potency to express exposures in DBP equivalents and using the DBP POD resulted in MOEs below 30, prior to the addition of non-attributable cumulative national exposure (from NHANES).

Construction, Paint, Electrical, and Metal Products: Adhesives and Sealants, Including Fillers and Putties: Caulking Products

Acute, high-intensity cumulative MOEs ranged from 19 to 20 for young teenagers (11–15 years), teenagers (16–20 years), and adults (21+ years), whereas medium-intensity cumulative MOEs ranged from 67 to 70 across these age groups (Table 4-23). Comparatively, acute high-intensity aggregate MOEs ranged from 57 to 63 for these age groups in the individual BBP assessment (Table 4-18). The caulking products exposure scenario from the individual BBP assessment was characterized in detail previously in Section 4.3.3.

Construction, Paint, Electrical, and Metal Products: Adhesives and Sealants, Including Fillers and Putties: Patching and Repair Products for Exterior Surfaces

Acute, high-intensity cumulative MOEs ranged from 10 to 11 for teenagers (16–20 years) and adults (21+ years), while medium-intensity cumulative MOEs ranged from 37 to 39 for these age groups (Table 4-23). Comparatively, acute, high-intensity dermal (*i.e.*, the only exposure route evaluated for this scenario) MOEs ranged from 30 to 32 for these age groups in the individual BBP assessment (Table 4-18). The patching and repair products for exterior surfaces exposure scenario from the individual BBP assessment was characterized in detail previously in Section 4.3.3.

Construction, Paint, Electrical, and Metal Products: Paints and Coatings: Sealing and Refinishing Sprays (Indoor Use and Outdoor Use)

For the *indoor use scenario*, acute, high-intensity cumulative MOEs ranged from 12 to 13 for teenagers (16–20 years) and adults (21+ years), while medium- and low-intensity cumulative MOEs ranged from 23 to 24 and 45 to 47, respectively, for these age groups (Table 4-23). Comparatively, acute high-intensity aggregate MOEs ranged from 36 to 39 for these age groups in the individual BBP assessment (Table 4-18). For the *outdoor use scenario*, acute high-intensity cumulative MOEs ranged from 12 to 13 for teenagers (16–20 years) and adults (21+ years), while medium- and low-intensity cumulative MOEs ranged from 23 to 25 and 42 to 44, respectively, for these age groups (Table 4-23). Comparatively, acute, high-intensity aggregate MOEs ranged from 37 to 39 for these age groups in the individual BBP assessment (Table 4-18). The indoor and outdoor use exposure scenarios from the individual BBP assessment are characterized further below.

Among the quantitatively assessed paint and coating products, all were assessed for exposure by both inhalation and dermal exposure routes. Two of the products were modeled for indoor use. These products are a spray paint product with reported BBP content of 0.1 to 1 percent used for repairing or renewing surfaces such as bathtubs, sinks and vanities ([Multi-Tech Products Corp, 2015](#)) and a concrete sealant with reported BBP content of 0.1 to 1 percent. Consumer reviews on online retail sites report use of the concrete sealant for a variety of projects, including sealing and refinishing of fireplace stone, concrete countertops, and floors. Weight fractions of 0.001, 0.0055, and 0.01 w/w were used in low, medium, and high exposure scenarios for these products. The third quantitatively assessed product is an ultraviolet (UV) and waterproof coating applied to exterior building surfaces; manufacturer suggested uses with potential relevance for home DIY repairs include application under roofing materials and structural facades. The BBP content reported for this product is 1 to 5 percent ([Henry Company, 2015](#)); BBP weight fractions used in low, medium, and high exposure scenarios for this product were 0.01, 0.025, and 0.05 w/w.

For indoor and outdoor use of sealing and refinishing sprays dermal exposure assessment, EPA used professional judgement for the duration of use input. Professional judgement entailed incorporating information from product labels and technical specifications as well as information obtained from an informal survey of customer reviews on e-commerce sites. The duration of skin contact used in the high, medium-, and low-intensity use scenarios were 480, 240, and 120 minutes respectively. The selected exposure durations reflect on the available product volumes to consumers. For example, the 5-gallon container was used for larger (high intensity use) outside and inside projects and as such 8-hour (480 minutes) application duration was selected. The contact area for high, medium, and low intensity use exposure scenarios was 10 percent of hands. The contact area selected reflects the use of clothing that covers legs, arms, and face, while partially covering hands. A larger contact area would result in larger exposures and lower MOEs. As discussed previously in Section 4.3.3, EPA has moderate confidence in its consumer dermal exposure assessment.

Other Uses: Automotive Products, Fluids: Interior Car Care

Acute, high-intensity cumulative MOEs ranged from 25 to 27 for teenagers (16–20 years) and adults (21+ years), while medium-intensity cumulative MOEs ranged from 67 to 71 for these age groups (Table 4-23). Comparatively, acute high-intensity aggregate MOEs ranged from 80 to 85 for these age groups in the individual BBP assessment (Table 4-18). The interior car care exposure scenario from the individual BBP assessment is characterized further below.

Two different scenarios were quantitatively assessed under this COU for two product types with differing use patterns: Automotive lubricants and interior car care products. Of these two consumer exposure scenarios only the interior car care products scenario resulted in cumulative MOEs below the benchmark of 30. One spray interior car cleaner product was identified with BBP content from a 2012 study on U.S. consumer products ([Dodson et al., 2012](#)). The measured BBP content was 0.0001 w/w, and this weight fraction was used in low-, medium-, and high-exposure scenarios for this product. Inhalation and dermal exposures were assessed.

The interior car care product identified with BBP was not represented in CEM default scenario and there was no data available for specific or similar products in the Exposure Factors handbook. As such, CEM default values for mass of product from the CEM Exterior Car Wax and Polish Scenario were applied; mass of product used in low-, medium-, and high-exposure scenarios was modeled as 100, 150, and 200 g. It was assumed that while product formulations differ (wipe-on vs. spray-on), use patterns would be similar and thus these values would be reasonable. The application duration and therefore, dermal contact duration was also taken from the CEM Exterior Car Wax and Polish Scenario, 45, 30, and 15

minutes for high-, medium-, and low-intensity use exposure scenarios respectively. As discussed previously in Section 4.3.3, EPA has moderate confidence in its consumer dermal exposure assessment.

Factors Contributing to Lower Cumulative MOEs Compared to MOEs in the Individual DIBP Assessment

Three factors contribute to the lower cumulative MOEs compared to the MOEs in the individual BBP consumer risk assessment:

- ***Scaling by Relative Potency:*** BBP inhalation, dermal, and ingestion exposures for each product or article example were scaled by relative potency to the index chemical (DBP). The RPF for BBP is 0.52 (Table 4-19), which means BBP exposures when multiplied by the RPF and expressed in terms of index DBP equivalents, decreased by 48 percent. EPA has robust confidence in the draft RPFs used in this CRA. RPFs used to scale for relative potency were calculated based on a common hazard endpoint—reduced fetal testicular testosterone—from data from multiple studies evaluating effects of phthalates on fetal testicular testosterone using a meta-analysis and BMD modeling approach for each of the six phthalates included in the CRA (see [\(U.S. EPA, 2025ad\)](#) for further details). Although this analysis provides a robust basis for assessing the dose-response for reduced fetal testicular testosterone across the six phthalates and overall, EPA has robust confidence in the draft RPFs used in this CRA (Section 4.4.1), there is some uncertainty associated with the applicability of the BBP RPF at low response levels (*i.e.*, 5% and 10% decreases in fetal testicular testosterone). This is because RPFs could not be estimated for BBP at the 5 or 10 percent response levels due to lack of data at the low-end range of the dose-response curve. However, as discussed previously in Section 4.4.1.2, 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. The draft RPFs will be peer reviewed by the SACC in 2025 and EPA will take into consideration SACC’s recommendations in the final risk evaluation.
- ***Index Chemical (DBP) POD:*** As described previously, cumulative MOEs are calculated by dividing the cumulative exposure estimate expressed in terms of DBP equivalents by the POD for DBP (2.1 mg/kg based on a BMDL₅ for reduced fetal testicular testosterone). Comparatively, the BBP POD used to calculate MOEs for individual BBP COUs in Section 4.3.3 is 12 mg/kg (based on a NOAEL for phthalate syndrome-related effects). The index chemical (DBP) POD is approximately 5.7-fold lower (*i.e.*, more sensitive) than the individual BBP POD, which is the primary factor leading to lower cumulative MOEs. Overall, EPA has robust confidence in the index chemical (DBP) POD used in this CRA. The draft BBP POD and index chemical PODs are be part of the SACC August 2025 peer review and EPA will take into consideration SACC’s recommendations for the final risk evaluation.
- ***Addition of Non-Attributable Cumulative Exposure:*** As part of its CRA, EPA calculated non-attributable cumulative exposure to DEHP, DBP, BBP, DIBP, and DINP using NHANES urinary biomonitoring data and reverse dosimetry (see Section 4.4.2), representing exposure to a national population. Non-attributable cumulative exposure estimates were scaled by relative potency and expressed in DBP equivalents. Non-attributable cumulative exposure was then combined with acute inhalation, dermal, and ingestion BBP exposures for each individual product or article example exposure scenario scaled by relative potency. For infants (<1 year), toddlers (1–2 years), and preschoolers (3–5 years) EPA added a non-attributable cumulative exposure of 10.8 µg/kg index chemical (DBP) equivalents to calculate the cumulative MOE, which contributes 15.5 percent to the risk cup with a benchmark MOE of 30. For children aged 6–10 years, EPA added a non-attributable cumulative exposure of 7.35 µg/kg DBP equivalents to calculate the

cumulative MOE, which contributes 10.5 percent to the risk cup with a benchmark MOE of 30. For young teens (11–15 years), EPA added a non-attributable cumulative exposure of 4.36 µg/kg DBP equivalents to calculate the cumulative MOE, which contributes 6.2 percent to the risk cup with a benchmark MOE of 30. For teenagers (16–20 years) and adults (21+ years), EPA added a non-attributable cumulative exposure of 5.15 µg/kg DBP equivalents to calculate the cumulative MOE, which contributes 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.

4.4.5.1 Overall Confidence in Cumulative Consumer Risks

As described in Section 4.1.2.4 and in more detail in the *Draft Consumer and Indoor Exposure Assessment for Butyl Benzyl Phthalate (BBP)* ([U.S. EPA, 2025d](#)), EPA has moderate to robust confidence in the assessed inhalation, ingestion, and dermal consumer exposure scenarios. The Agency has robust confidence in the RPFs and index chemical (DBP) POD used to calculate the cumulative MOEs (Section 4.4.1.2). To derive RPFs and the index chemical POD, EPA integrated data from multiple studies evaluating fetal testicular testosterone using meta-analysis and BMD modeling. The draft RPFs, index chemical POD, and BBP POD are part of the SACC August 2025 peer review and EPA will take into consideration the SACC's recommendations in the final risk evaluation. Finally, EPA has robust confidence in the non-attributable cumulative exposure estimates for DEHP, DBP, BBP, DIBP, and DINP derived from NHANES urinary biomonitoring data using reverse dosimetry (Section 4.4.2.1). Overall, EPA has moderate to robust confidence in the cumulative risk estimates calculated for consumer exposure scenarios (Table 4-23).

4606 **Table 4-23. Consumer Cumulative Risk Summary Table**

Life Cycle Stage: COU: Subcategory	Product or Article	Exposure Scenario (H, M, L) ^a	Exposure Scenario	Lifestage (Years) MOE (Based on All Exposures in Index Chemical Equivalents – RPF Analysis) (Benchmark MOE = 30)						
				Infant (<1 year)	Toddler (1–2 years)	Preschoolers (3–5 years)	Middle Childhood (6–10 years)	Young Teens (11–15 years)	Teenagers (16–20 years)	Adults (21+ years)
Consumer Uses: Construction, paint, electrical, and metal products: Adhesives and sealants, including fillers and putties	Adhesives for small projects	H	Cumulative (Aggregate BBP COU + Cumulative Non-Attributable)	–	–	–	–	82	85	81
	Caulking products	H	Dermal (COU Alone)	–	–	–	–	20 ^c	22 ^c	20 ^c
			Inhalation (COU Alone)	331 ^b	352 ^b	433 ^b	621 ^b	799	946	1,164
			Aggregate (COU Alone)	–	–	–	–	19	21	20
			Cumulative (NHANES)	194	194	194	286	482	407	407
			Cumulative (Aggregate BBP COU + Cumulative Non-Attributable)	123 ^b	125 ^b	134 ^b	196 ^b	19 ^c	20 ^c	19 ^c
		M	Dermal (COU Alone)	–	–	–	–	79	86	81
			Inhalation (COU Alone)	1,690 ^b	1,794 ^b	2,207 ^b	3,169 ^b	3,973	4,661	5,782
			Aggregate (COU Alone)	–	–	–	–	77	85	80
			Cumulative (NHANES)	194	194	194	286	482	407	407
			Cumulative (Aggregate BBP COU + Cumulative Non-Attributable)	174 ^b	175 ^b	179 ^b	262 ^b	67	70	67
	Patching and repair products for exterior surfaces	H	Dermal (COU Alone)	–	–	–	–	–	11 ^c	10 ^d
			Cumulative (NHANES)	–	–	–	–	–	407	407
			Cumulative (Aggregate BBP COU + Cumulative Non-Attributable)	–	–	–	–	–	11 ^c	10 ^c
		M	Dermal (COU Alone)	–	–	–	–	–	43	40
			Cumulative (NHANES)	–	–	–	–	–	407	407
			Cumulative (Aggregate BBP COU + Cumulative Non-Attributable)	–	–	–	–	–	39	37

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Life Cycle Stage: COU: Subcategory	Product or Article	Exposure Scenario (H, M, L) ^a	Exposure Scenario	Lifestage (Years) MOE (Based on All Exposures in Index Chemical Equivalents – RPF Analysis) (Benchmark MOE = 30)						
				Infant (<1 year)	Toddler (1–2 years)	Preschoolers (3–5 years)	Middle Childhood (6–10 years)	Young Teens (11–15 years)	Teenagers (16–20 years)	Adults (21+ years)
Consumer Uses: Construction, paint, electrical, and metal products: Paints and coatings	Sealing and refinishing sprays (indoor use)	H	Dermal (COU Alone)	–	–	–	–	–	13 ^c	13 ^c
			Inhalation (COU Alone)	130 ^b	138 ^b	170 ^b	211 ^b	273 ^b	350	403
			Aggregate (COU Alone)	–	–	–	–	–	13 ^c	12 ^c
			Cumulative (NHANES)	194	194	194	286	482	407	407
			Cumulative (Aggregate BBP COU + Cumulative Non-Attributable)	78 ^b	81 ^b	91 ^b	121 ^b	174 ^b	13 ^c	12 ^c
		M	Dermal (COU Alone)	–	–	–	–	–	27 ^c	25 ^c
			Inhalation (COU Alone)	130 ^b	138 ^b	170 ^b	227 ^b	315 ^b	384	460
			Aggregate (COU Alone)	–	–	–	–	–	25 ^c	24 ^c
			Cumulative (NHANES)	194	194	194	286	482	407	407
			Cumulative (Aggregate BBP COU + Cumulative Non-Attributable)	78 ^b	81 ^b	91 ^b	127 ^b	190 ^b	24 ^c	23 ^c
		L	Dermal (COU Alone)	–	–	–	–	–	54	50
			Inhalation (COU Alone)	2,000 ^b	2,100 ^b	2,600 ^b	3,400 ^b	4,400 ^b	5,400	6,400
			Aggregate (COU Alone)	–	–	–	–	–	53	50
			Cumulative (NHANES)	194	194	194	286	482	407	407
			Cumulative (Aggregate BBP COU + Cumulative Non-Attributable)	177 ^b	178 ^b	181 ^b	264 ^b	434 ^b	47	45
Consumer Uses: Construction, paint, electrical, and metal products: Paints and coatings	Sealing and refinishing sprays (outdoor use)	H	Dermal (COU Alone)	–	–	–	–	–	13 ^c	13 ^c
			Inhalation (COU Alone)	770 ^b	820 ^b	1,000 ^b	1,400 ^b	680 ^b	880	1,000
			Aggregate (COU Alone)	–	–	–	–	–	13 ^c	12 ^c
			Cumulative (NHANES)	194	194	194	286	482	407	407
			Cumulative (Aggregate BBP COU + Cumulative Non-Attributable)	155 ^b	157 ^b	163 ^b	238 ^b	282 ^b	13 ^c	12 ^c
		M	Dermal (COU Alone)	–	–	–	–	–	27 ^c	25 ^c
			Inhalation (COU Alone)	780 ^b	820 ^b	1,000 ^b	1,500 ^b	1,200 ^b	1,400	1,700
			Aggregate (COU Alone)	–	–	–	–	–	26 ^c	25 ^c
			Cumulative (NHANES)	194	194	194	286	482	407	407
			Cumulative (Aggregate BBP COU + Cumulative Non-Attributable)	156 ^b	157 ^b	163 ^b	239 ^b	339 ^b	25 ^c	23 ^c
		L	Dermal (COU Alone)	–	–	–	–	–	54	50
			Inhalation (COU Alone)	770 ^b	820 ^b	1,000 ^b	1,200 ^b	410 ^b	550	610
			Aggregate (COU Alone)	–	–	–	–	–	49	47
			Cumulative (NHANES)	194	194	194	286	482	407	407
			Cumulative (Aggregate BBP COU + Cumulative Non-Attributable)	155 ^b	157 ^b	163 ^b	232 ^b	222 ^b	44	42

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Life Cycle Stage: COU: Subcategory	Product or Article	Exposure Scenario (H, M, L) ^a	Exposure Scenario	Lifestage (Years) MOE (Based on All Exposures in Index Chemical Equivalents – RPF Analysis) (Benchmark MOE = 30)						
				Infant (<1 year)	Toddler (1–2 years)	Preschoolers (3–5 years)	Middle Childhood (6–10 years)	Young Teens (11–15 years)	Teenagers (16–20 years)	Adults (21+ years)
Consumer Uses: Furnishing, cleaning, treatment/care products: Fabric, textile, and leather products	Clothing (synthetic leather)	M	Cumulative (Aggregate BBP COU + Cumulative Non-Attributable)	–	–	–	–	–	244	238
	Furniture (synthetic leather)	H	Cumulative (Aggregate BBP COU + Cumulative Non-Attributable)	179 ^e	180 ^e	183 ^e	269 ^e	450 ^e	387 ^e	391 ^e
		M	Cumulative (Aggregate BBP COU + Cumulative Non-Attributable)	188 ^e	188 ^e	121 ^e	169 ^e	254 ^e	241 ^e	236 ^e
Consumer Uses: Furnishing, cleaning, treatment/care products: Floor coverings; construction and building materials covering large surface areas including stone, plaster, cement, glass and ceramic articles; fabrics, textiles, and apparel	Vinyl flooring	H	Cumulative (Aggregate BBP COU + Cumulative Non-Attributable)	33	34	40	59	86	94	110
		M	Cumulative (Aggregate BBP COU + Cumulative Non-Attributable)	82	85	93	138	213	212	234
Consumer Uses: Packaging, paper, plastic, hobby products: arts, crafts, and hobby materials	Crafting resin (liquid)	H	Cumulative (Aggregate BBP COU + Cumulative Non-Attributable)	87 ^b	89 ^b	67	94	134	139	140
	Crafting resin (cured)	H	Cumulative (Aggregate BBP COU + Cumulative Non-Attributable)	87 ^b	89 ^b	99	146	226	227	240
	Small articles with the potential for semi-routine contact, Modeling clay, jewelry making crafts	H	Cumulative (Aggregate BBP COU + Cumulative Non-Attributable)	151	156	160	228	360	323	318
Consumer Uses: Packaging, paper, plastic, hobby products: ink, toner, and colorant products	Inks and dyes	H	Cumulative (Aggregate BBP COU + Cumulative Non-Attributable)	–	–	–	–	68	71	67
Consumer Uses: Packaging, paper, plastic, hobby products: packaging (excluding food packaging) and other articles with routine direct contact during normal use, including rubber articles; plastic articles (hard); plastic articles (soft)	Small articles with the potential for semi-routine contact, packaging, including plastic bags and pouches; vinyl shelf liner, bottom surface of shoe, small exterior clothing components, disposable gloves	H	Cumulative (Aggregate BBP COU + Cumulative Non-Attributable)	151	156	160	228	360	323	318
Consumer Uses: Packaging, Paper, plastic, hobby products:	Children’s toys (legacy)	H	Cumulative (Aggregate BBP COU + Cumulative Non-Attributable)	126	131	138	200	316	293	341

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Life Cycle Stage: COU: Subcategory	Product or Article	Exposure Scenario (H, M, L) ^a	Exposure Scenario	Lifestage (Years) MOE (Based on All Exposures in Index Chemical Equivalents – RPF Analysis) (Benchmark MOE = 30)						
				Infant (<1 year)	Toddler (1–2 years)	Preschoolers (3–5 years)	Middle Childhood (6–10 years)	Young Teens (11–15 years)	Teenagers (16–20 years)	Adults (21+ years)
toys, playgrounds, and sporting equipment	Children’s toys (new)	H	Cumulative (Aggregate BBP COU + Cumulative Non-Attributable)	156	160	165	238	383	340	392
	Tire crumbs	H	Cumulative (Aggregate BBP COU + Cumulative Non-Attributable)	–	–	180	256	418	366	365
Consumer Uses: Other uses: Automotive articles	Car mat	H	Cumulative (Aggregate BBP COU + Cumulative Non-Attributable)	–	–	–	–	474	402	401
Consumer Uses: Other uses: Automotive products, fluids	Automotive lubricants	H	Cumulative (Aggregate BBP COU + Cumulative Non-Attributable)	–	–	–	–	–	48	45
Consumer uses: Other uses: Automotive products, fluids	Interior car care	H	Dermal (COU Alone)	–	–	–	–	–	29 ^c	27 ^c
			Inhalation (COU Alone)	42,000 ^b	44,000 ^b	54,000 ^b	78,000 ^b	40,000 ^b	50,000	58,000
			Aggregate (COU Alone)	–	–	–	–	–	29 ^c	27 ^c
			Cumulative (NHANES)	194	194	194	286	482	407	407
			Cumulative (Aggregate BBP COU + Cumulative Non-Attributable)	194 ^b	194 ^b	194 ^b	285 ^b	476 ^b	27 ^c	25 ^c
		M	Dermal (COU Alone)	–	–	–	–	–	86	81
			Inhalation (COU Alone)	57,000	61,000	75,000	108,000	51,000	62,000	74,000
			Aggregate (COU Alone)	–	–	–	–	–	86	81
			Cumulative (NHANES)	194	194	194	286	482	407	407
			Cumulative (Aggregate BBP COU + Cumulative Non-Attributable)	194	194	194	285	477	71	67
Consumer Uses: Other uses: Novelty articles	Adult toys	H	Cumulative (Aggregate BBP COU + Cumulative Non-Attributable)	–	–	–	–	–	368	368

^a Exposure scenario intensities include high (H), medium (M), and low (L).
^b Bystander scenarios
^c MOEs for this age group are less than 30 in the cumulative assessment, but not the individual BBP risk assessment.
^d MOEs for this age group are less than 30 in both the cumulative and individual BBP risk assessment.
^e High-intensity aggregate scenario includes ingestion and inhalation exposure routes, while the medium-intensity scenario includes ingestion, inhalation, and dermal exposures routes. The high-intensity dermal scenario was deemed to be unlikely due to high uncertainties, see also *Draft Consumer and Indoor Exposure Assessment for Butyl Benzyl Phthalate (BBP)* ([U.S. EPA, 2025d](#)).

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4.4.6 Cumulative Risk Estimates for the General Population

For BBP, 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 BBP 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. However, as discussed in Section 4.4.2, EPA did evaluate cumulative exposure and risk from exposure to several toxicologically similar phthalates—DEHP, DBP, BBP, DIBP, and DINP—using NHANES. 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 4-20, and as discussed in more detail in the draft revised TSD for CRA ([U.S. EPA, 2025ad](#)), 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 DEHP, DBP, DIBP, BBP, 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 this draft risk evaluation, EPA has relied substantially on existing CRA-related publications by the Agency’s Risk Assessment Forum (RAF), Office of Pesticide Programs (OPP), Organisation for Economic Co-operation and Development (OECD), European Commission, World Health Organization (WHO), and International Programme on Chemical Safety (IPCS), including

- *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, 2007](#))
- *Pesticide Cumulative Risk Assessment: Framework for Screening Analysis Purpose* ([U.S. EPA, 2016b](#))
- *Advances in Dose Addition for Chemical Mixtures: A White Paper* ([U.S. EPA, 2023b](#))
- *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](#))
- *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 0), and the general population (Section 4.3.4) from exposure to BBP. The Agency has also assessed 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 DEHP, DBP, BBP, DIBP, and DINP from NHANES biomonitoring and reverse dosimetry.

There are several notable differences between the individual BBP assessment (Section 4.3) and the CRA (Section 4.4). As part of the individual BBP assessment (Section 4.3), EPA considered all human health hazards of BBP and selected a POD based on a NOAEL for phthalate syndrome-related effects to characterize risk from exposure to BBP. As part of its exposure assessment in the individual BBP 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 lifestages (*e.g.*, infants, toddlers, children, adults). Furthermore, in the individual BBP assessment, EPA evaluated inhalation and dermal exposures to workers as well as consumer exposure to BBP via the inhalation, dermal, and ingestion exposure routes. In contrast, the CRA is more focused in scope (Section 4.4). First, the CRA is based on a uniform measure of hazard (*i.e.*, reduced fetal testicular testosterone) that serves as the basis for deriving RPFs and the index chemical (DBP) POD, which were derived via meta-analysis and BMD modeling (Section 4.4.1). Second, the CRA is focused on acute duration exposures and the most sensitive populations (*i.e.*, women of reproductive age, male infants, male children). Finally, for the CRA, BBP exposures from individual consumer and worker COUs were (1) scaled by relative potency; (2) expressed in index chemical (DBP) equivalents; and (3) combined with non-attributable cumulative exposure to DEHP, DBP, BBP, DIBP, and DINP using NHANES.

For workers, cumulative acute high-end MOEs were less than 30 for four OESs that did not already have an MOE less than 30 in the individual BBP assessment (*i.e.*, high-end cumulative MOE = 25 for Rubber converting OES) (Section 4.4.4). Similarly, for consumers, high-intensity acute cumulative MOEs were less than 30 for 6 out of 20 product or article examples evaluated (Section 4.4.5), while only 1 out of 20 product or article examples evaluated in the individual BBP assessment had a high-intensity MOE below the benchmark (Section 0). Overall, there are three factors that influenced differences in risk estimates between the individual BBP assessment (Section 4.3) and the RPF analysis (Section 4.4), which are described below:

- **Scaling by Relative Potency.** BBP inhalation, dermal, and ingestion exposures from individual COUs were scaled by relative potency to the index chemical. The RPF for BBP is 0.52, which means BBP exposures when multiplied by the RPF and expressed in terms of index chemical (DBP) equivalents, decreased by 48 percent.
- **Index Chemical POD.** Cumulative MOEs are calculated by dividing the index chemical (DBP) POD by a cumulative exposure estimate expressed in terms of index chemical equivalents. The POD for DBP used to calculate cumulative risk is 2.1 mg/kg (based on a BMDL₅ for reduced fetal testicular testosterone). Comparatively, the BBP POD used to calculate MOEs for individual BBP COUs is 12 mg/kg (based on a NOAEL for phthalate syndrome-related effects). The index chemical (DBP) POD is approximately 5.7-fold lower (*i.e.*, more sensitive) than the individual BBP POD, which is the primary factor contributing to the lower cumulative MOEs.
- **Addition of Non-Attributable Cumulative Exposure.** As part of the CRA, EPA calculated non-attributable cumulative exposure to DEHP, DBP, BBP, DIBP, and DINP using NHANES urinary biomonitoring and reverse dosimetry from 2017 to 2018 (Section 4.4.2) to represent exposure to a national population. *Overall, this non-attributable cumulative exposure contributes approximately 6.2 to 15.5 percent to the risk cup, depending on the population and age group.*

Ultimately, the impact of scaling by relative potency and using the index chemical (DBP) POD to calculate the cumulative MOE has a significant impact on the risk estimates for exposure to BBP alone. There is little additional cumulative risk by adding the simultaneous exposure of other phthalates to the single chemical risk estimates for BBP (*i.e.*, non-attributable cumulative exposure from NAHNES adds 6.2–15.5% to the risk cup).

4700 EPA has robust confidence in its CRA and moderate to robust confidence in its individual assessment of
4701 BBP for workers (Section 4.3.2), consumers (Section 0), and the general population (Section 4.1.3).
4702 RPFs used to scale for relative potency were calculated based on a common hazard endpoint (*i.e.*,
4703 reduced fetal testicular testosterone) from data from multiple studies evaluating effects of phthalates on
4704 fetal testicular testosterone using a meta-analysis and BMD modeling approach for each of the six
4705 phthalates included in the cumulative chemical group ([U.S. EPA, 2025ad](#)). This analysis provides a
4706 robust basis for assessing the dose-response for reduced fetal testicular testosterone across the six
4707 toxicologically similar phthalates included in the CRA.

4708 **5 ENVIRONMENTAL RISK ASSESSMENT**

**BBP – Environmental Risk Assessment (Section 5):
Key Points**

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

- Aquatic species
 - Risk quotient (RQ) values were determined for surface water exposure to aquatic organisms for five OES scenarios using DMR data. The RQ exceeded the benchmark of 1 for the Waste handling, treatment, and disposal OES. An RQ of 5.26 for chronic (21-day) vertebrate exposure was determined. EPA has robust confidence in risk estimates to aquatic species from these OES scenarios.
 - RQ values were determined for surface water exposure to aquatic organisms for six OES generic scenarios of water releases. A first-tier assessment resulted in RQ values exceeding the benchmark of 1 under the most conservative scenario of high-end release, low flow, and no wastewater treatment removal. Thus, a second-tier assessment was conducted with refined scenarios of central tendency (median) release volumes, 62 percent wastewater removal, and medium stream flow rates. These scenarios resulted in water exposures less than the BBP limit of solubility and within the range of water concentrations measured in U.S. surface waters.
 - The refined assessment resulted in RQs exceeding 1 for chronic (21-day) BBP exposures to vertebrates in surface waters due to modeled water releases from two COUs/OESs that release into water: Processing/PVC compounding, and Processing/PVC converting. An RQ of 31.79 was determined for chronic vertebrate exposure in Processing/PVC compounding release scenarios. An RQ of 1.92 was determined for chronic vertebrate exposure in Processing/PVC converting release scenarios.
 - The refined assessment resulted in an RQ of 2.88 for 4-day BBP exposures to algae in the Processing/PVC compounding COU/OES.
 - The refined assessment resulted in no RQs exceeding 1 for acute (2- to 4-day) BBP exposures to aquatic animals and chronic (21-day) BBP exposures to invertebrates in surface water.
 - EPA has moderate confidence in risk estimates to aquatic species from these refined scenarios.
 - RQ values were determined for the Manufacturing OES by assuming 10 percent of the multimedia (water, incineration, or landfill) release is to water and median release, 62 percent wastewater removal, and medium flow rates. An RQ of 24.2 was determined for chronic vertebrate exposure and 2.2 for 4-day exposure to algae. EPA has moderate confidence in risk estimates to aquatic species from these refined scenarios.
- Terrestrial species
 - Exposure concentrations did not exceed hazard thresholds for exposures to terrestrial mammals from BBP releases to soil (*i.e.*, biosolids, landfill, air to soil deposition) or from trophic transfer through aquatic or terrestrial food webs.
 - No hazard threshold for BBP exposure to soil invertebrates was derived because one medium-quality study did not find mortality at any experimental BBP concentration.
 - No hazard threshold for BBP exposure to terrestrial plants was derived because four high- or medium-quality studies did not find BBP effects on plant growth releases to soil.
 - EPA has robust confidence in no risk estimates being identified for exposures to terrestrial species.

4709 **5.1 Summary of Environmental Exposures**

EPA evaluated reasonably available information for various environmental media concentrations and estimated exposure using the most conservative exposure scenario as a screening level approach. The environmental exposures are described in the *Draft Physical Chemistry and Fate and Transport Assessment for Butyl Benzyl Phthalate (BBP)* ([U.S. EPA, 2025z](#)) and the *Draft Environmental Media and General Population and Environment Exposure for Butyl Benzyl Phthalate (BBP)* ([U.S. EPA, 2025r](#)). Environmental BBP concentrations were quantified in ambient air, soil from ambient air deposition, sediment, and surface water. Given the physical chemical properties and fate parameters of BBP (Section 2), concentrations of BBP in soil and groundwater from releases to biosolids and landfills were not quantified. Instead, BBP in soil and groundwater are discussed qualitatively. The most conservative exposure was estimated from the highest BBP releases of the TSCA COU for each exposure pathway. The key points are summarized below.

For the land pathway, there are uncertainties in the relevance of limited monitoring data for biosolids and landfill leachate to the COUs. However, high-quality physical and chemical property data suggest that BBP 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 are discussed qualitatively.

For the water pathway, BBP in water releases is expected to predominantly partition into sediment. The high-end modeled total water column concentration of 3,440 BBP µg/L was used for a screening level analysis for the aquatic organism exposure scenarios. This value was greater than the BBP limit of water solubility (2,690 µg/L) and orders of magnitude above any monitored BBP value. A refined and second tier analysis of surface water BBP concentrations included central tendency release volumes, wastewater treatment removal, and multiple surface water flow rates. The resulting concentrations were within the bounds of BBP solubility and within the range of measured BBP concentrations in surface waters in the U.S. and across the globe. EPA is confident that the use of the refined modeled concentrations to estimate risk reflect realistic scenarios of release, wastewater treatment, flow rate, and subsequent BBP concentrations in water.

For the ambient air pathway, modeled BBP concentrations are higher than measured concentrations by several orders of magnitude. This is an expected outcome because EPA's modeling uses high-end releases and conservative meteorological data. Further refinement of the modeled value was not conducted for inhalation or air to soil deposition because it was not identified as a pathway of concern. Screening level risk estimates using high-end air concentrations were above the benchmark for inhalation of ambient air. Therefore, no further refinement was necessary.

BBP is not readily found (or if found, is in relatively low concentrations) in organism tissues and has low bioaccumulation and biomagnification potential in aquatic and terrestrial organisms. Therefore, BBP has a low potential for trophic transfer through food webs.

5.2 Summary of Environmental Hazards

EPA considered the quality, consistency, strength and precision, biological gradient/dose response, and relevance of the reasonably available data to weigh the scientific evidence in determining the environmental hazards of BBP. The Agency determined that BBP poses acute and chronic exposure hazards to aquatic vertebrates, acute and chronic exposure hazards to aquatic invertebrates, 4-day exposure hazards to algae, and chronic dietary exposure hazards to terrestrial mammals. These hazards occurred at BBP concentrations below the BBP limit of solubility and within the range of measured concentrations in U.S. surface waters. A summary of the overall confidence and hazard values for each taxonomic group and duration is provided in this section. For more information on the weight of

scientific evidence, including the strengths and limitations of the data that led to this overall confidence conclusions, see the *Draft Environmental Hazard Assessment for Butyl Benzyl Phthalate (BBP)* ([U.S. EPA, 2025p](#)).

Concentrations of concern (COCs) were derived for acute and chronic exposures to aquatic organisms. Concentrations of BBP that are lethal to 50 percent of test organisms (*i.e.*, LC50) from 11 acute duration exposures of BBP to aquatic fish and invertebrates were used to develop a species sensitivity distribution (SSD). This SSD suggests that BBP poses acute hazard effects to vertebrate and invertebrate animals at 197 µg/L BBP. EPA has robust confidence in the quality, consistency, strength and precision, and relevance of the studies used in determining this acute aquatic COC (197 µg/L BBP).

The most sensitive aquatic vertebrate for which a clear population-level fitness endpoint of chronic water exposure was for the zebrafish (*Danio rerio*) ([Battelle, 2018](#)). This 21-day reproduction test of zebrafish exposed to measured concentrations of BBP found 17 percent lower fecundity and 2 percent lower fertilization success in females in treatments with 33 µg/L BBP (lowest-observed-effect concentration or LOEC). No effects were observed at 11 µg/L BBP (no-observed-effect concentration or NOEC). These BBP effects on female zebrafish occurred in a monotonic dose-response manner with greater effects at higher BBP concentrations. Male zebrafish had higher gonad weight, gonadal-somatic index values, and body weight in treatments with 3.6 µg/L BBP (LOEC). These BBP effects did not increase at higher BBP concentrations but were consistently higher than in fish from control treatments. This combination of reproductive effects on multiple female and male zebrafish endpoints over chronic BBP exposures signifies potential adverse outcomes to fish populations. Based on the presence of a clear dose-response relationship and a greater than 10 percent reduction in a population-level fitness endpoint in female zebrafish (17% lower fecundity), the 21-day chronic value (ChV) for reduction in fecundity was selected to derive the chronic COC for aquatic vertebrates. The ChV was calculated as the geometric mean of the NOEC (11 µg/L BBP) and LOEC (33 µg/L BBP) and equal to 19.1 µg/L BBP. EPA applied an assessment factor of 10 to the ChV, resulting in a COC of 1.9 µg/L BBP. The Agency has robust confidence in the quality, consistency, strength and precision, and relevance of the studies that were reviewed and used in determining the chronic aquatic COC for vertebrates (1.9 µg/L BBP).

Chronic effects of BBP on aquatic invertebrates ranged from reduced opossum shrimp (*Americamysis bahia*) reproduction after 28-days at 170 µg/L BBP ([Springborn Bionomics, 1986](#)) to growth reduction in midges (*Chironomus tentans*) after 10-days at 1,420 µg/L BBP ([Call et al., 2001](#)). A 21-day study of *Daphnia magna* found 80 percent mortality and 70 percent fewer offspring per female due to BBP chronic exposure ([Rhodes et al., 1995](#)). This study found the most consistent dose-response effects at the most protective BBP concentration among the highly rated studies available for review and was selected to derive the COC. Thus, EPA has robust confidence in the quality, consistency, strength and precision, and relevance of the studies used in determining the chronic aquatic COC for invertebrates (62.6 µg/L BBP).

EPA also reviewed studies for toxicity in aquatic plants and algae. Population level hazard effects (96-hour EC50) in these studies ranged from 210 µg/L (green algae *Raphidocelis subcapitata*) to 600 µg/L (diatoms *Navicula pelliculosa* and *Skeletonema costatum*) ([Adams et al., 1995](#); [EG&G Bionomics, 1978](#)). The Agency derived a COC for chronic algal BBP exposure from the nominal concentration that reduced the population growth of *Raphidocelis subcapitata* by 50 percent (EC50) ([Adams et al., 1995](#)). This study found effects at the lowest BBP concentration among the eight high- or medium-rated studies of green algae and diatoms available for review. EPA has robust confidence in the quality, consistency, strength and precision, and relevance of the studies used in determining the chronic aquatic COC for algae (21 µg/L BBP).

No studies on terrestrial wildlife involving mammals were identified. In lieu of terrestrial wildlife studies, nine references for rat studies as human health model organisms were used to determine a lowest and most conservative BBP concentration that affected an apical endpoint (survival, reproduction, or growth) in rodents and that could serve as an indication of hazard effects in wild mammal populations. Evidence suggests that BBP poses chronic dietary exposure hazard effects to terrestrial mammals at 311 mg/kg bw-day BBP ([TNO CIVO, 1993](#)). EPA has robust confidence in the quality, consistency, and strength and precision of the studies used in determining the hazard threshold for terrestrial mammals (311 mg/kg bw-day BBP), but moderate confidence in their relevance to wild mammal populations.

No evidence of BBP toxicity to terrestrial invertebrates was reasonably available to consider for a hazard threshold. Thus, EPA did not derive a terrestrial invertebrate hazard threshold.

No evidence of BBP toxicity to terrestrial plants in soil was reasonably available to consider for a hazard threshold. Thus, EPA did not derive a terrestrial plant hazard threshold.

5.3 Environmental Risk Characterization

5.3.1 Risk Assessment Approach

The environmental risk characterization of BBP was conducted to evaluate whether the potential releases and resultant exposures of BBP in water, air, or soil will exceed the BBP concentrations that result in hazardous effects to aquatic or terrestrial organisms. In evaluating the BBP exposure concentrations, modeled BBP concentrations in surface water were assessed quantitatively. Environmental risk of BBP in soil (biosolids, landfills, air deposition) and air were assessed qualitatively because (1) exposure or hazard effects estimates were not reasonably available; or (2) evidence indicates that BBP is unlikely to be bioavailable in air, landfill, biosolid, and trophic transfer exposure scenarios. In evaluating the environmental hazard of BBP, a weight of scientific evidence approach was used to select hazard threshold concentrations for the derivation of risk quotients for aquatic organisms and 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

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

Environmental exposure concentrations (*i.e.*, surface water, pore water, sediment, and soil) were based on concentrations of BBP measured (*i.e.*, monitored data and/or available literature) and/or modeled (*i.e.*, EPA's Exposure and Fate Assessment Screening Tool [E-FAST], VVWM-PSC Tool and I, American Meteorological Society (AMS)/EPA Regulatory Model [AERMOD], Integrated Indoor-Outdoor Air Calculator Model [IIOAC]) (Section 3.3). The COCs used to calculate RQs for aquatic organisms were derived from hazard values resulting from acute BBP exposures to animals, chronic BBP exposures to animals, and 4-day BBP exposures to algae. 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.

RQ values were determined for surface water exposure to aquatic organisms for the six OES scenarios of potential water releases. An initial first-tier assessment resulted in RQ values greater than benchmark of 1 under the most conservative scenarios with high-end release, low flow, and no wastewater treatment removal, which is presented in *Draft Environmental Media, General Population, and Environmental Exposure Assessment for Butyl Benzyl Phthalate (BBP)* ([U.S. EPA, 2025r](#)). Therefore, EPA used a second-tier and refined assessment and aquatic organism risk characterization by using additional lines of evidence presented in this draft risk evaluation. These lines of evidence used modeled distributions at both high-end (95th percentile) and central tendency (50th percentile) BBP releases into streams as presented in U.S. EPA ([2025t](#)), three different flow rates (7Q10 P50, 7Q10P 75, and 7Q10 P90 ([U.S. EPA, 2025r](#))), and wastewater treatment removal (62% BBP removal ([U.S. EPA, 2025r](#))) (Section 6.3). The refined assessment represented typical (median) modeled releases, conservative wastewater treatment removal, and a flow rate that matches facility size with stream size, resulting in surface water concentrations within an order of magnitude of measured BBP concentrations in the United States (as described in Section 5.3.3).

EPA reviewed and screened environmental monitoring and biomonitoring data to assess wildlife exposure to BBP ([U.S. EPA, 2025s](#)). EPA then conducted a qualitative trophic transfer assessment by evaluating the chemical and physical properties, fate, and exposure of BBP and determined that BBP does not bioaccumulate. Due to its physical and chemical properties, environmental fate, and exposure parameters, BBP is not expected to persist in surface water, groundwater, or air. Additionally, because BBP has low bioaccumulation and biomagnification potential in aquatic and terrestrial organisms, it is expected to go through trophic dilution as it passes through the food web.

5.3.2 Relevant Exposure Pathways of BBP into the Environment

EPA evaluated environmental releases of BBP to water, air, and land from the OESs associated with the COUs assessed in this draft risk evaluation ([U.S. EPA, 2025t](#)). Environmentally relevant exposure pathways that potentially affect organisms from these releases were based on BBP's physical and chemical properties and fate, release volumes, and exposure estimates (Table 5-1). EPA quantitatively characterized the environmental risk through the surface water pathway because wastewater releases are expected to result in water concentrations that affect aquatic organism survival or reproduction indicated by acute and chronic COCs. EPA qualitatively assessed environmental risk through sediment, air, soil, and trophic transfer pathways because either (1) the available evidence indicates that the bioavailability of BBP in these pathways is expected to be low, or (2) no evidence of hazard to organisms through these pathways is available for a quantitative assessment.

Table 5-1. Relevant Exposure Pathway to Organisms and Corresponding Risk Assessment for the BBP Environmental Risk Characterization

Exposure Pathway	Duration and Organism Hazard	Risk Assessment ^a
Surface water and sediment pore water	Acute exposure resulting in aquatic vertebrate and invertebrate species mortality	RQ < 1
	Chronic exposure to aquatic vertebrate species (reduced fish [<i>Danio rerio</i>] reproduction over 21 days)	RQ > 1
	Chronic exposure to aquatic invertebrate species (reduced waterflea [<i>Daphnia magna</i>] reproduction over 21 days)	RQ < 1
	Reduced algae (<i>Raphidocelis subcapitata</i>) population growth over 4 days	RQ > 1
Sediment	Acute exposure resulting in mortality to sediment dwelling invertebrate species (reduced larval midge [<i>Chironomus tentans</i>] survival over 48 hours)	RQ < 1

Exposure Pathway	Duration and Organism Hazard	Risk Assessment ^a
Air deposition to soil	Chronic dietary exposure to terrestrial mammals (reduced reproduction over 136 days)	Qualitative; no RQs calculated
Biosolids	Chronic dietary exposure to terrestrial mammals (reduced reproduction over 136 days)	Qualitative; no RQs calculated
Landfills	Chronic dietary exposure to terrestrial mammals (reduced reproduction over 136 days)	Qualitative; no RQs calculated
Trophic transfer from water or soil	Chronic dietary exposure to terrestrial mammals (reduced reproduction over 136 days)	Qualitative; no RQs calculated
RQ = risk quotient ^a Represents results of second tier and refined assessment using GS of central tendency (median) release volumes, 62% wastewater treatment removal, and 7Q10 P75 (medium) modeled flow rates of 250,573 m ³ /day.		

DMR-reported BBP releases to water were identified for five OESs listed in Table 3-7 and Table 5-2 and include release data for “Application of Paints, Coatings, Adhesives, and Sealants” as a single OES. This assessment uses these data to assess environmental risk for the separately listed OESs Application of paints and coatings as well as Application of adhesives and sealants. Generic scenarios of releases to wastewater with subsequent exposure in surface water and sediments were identified for six additional OESs (Table 3-7 and Table 5-2). A screening assessment of multimedia release that did not distinguish among wastewater, incineration, or landfill from the Use of laboratory chemicals OES was conducted by assuming a 100 percent water release. Multimedia release to water from the Manufacturing OES was assessed using an additional line of evidence from the draft DEHP risk evaluation ([U.S. EPA, 2025aa](#)). BBP exposures in sediment after surface water releases were characterized in a screening assessment with the most conservative scenario. COU/OESs with releases of BBP to air with subsequent deposition to soil, biosolids, landfills, and trophic transfer through water or soil were assessed qualitatively.

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Table 5-2. Environmental Risk Summary and Basis for BBP Risk Characterization

COUs			OES(s)	Release Media ^a	Risk Characterization ^{b c}
Manufacturing	Domestic manufacturing	Domestic manufacturing	Manufacturing	Multimedia (10% water release assumption)	Quantitative assessment RQ = 24.20 for chronic hazard to fish RQ = 2.88 for hazard to algae
	Importing	Importing	Import and repackaging	Water (DMR data)	Quantitative assessment RQs < 1
Processing	Repackaging	Repackaging	Import and repackaging	Water (DMR data)	Quantitative assessment RQs < 1
	Incorporation into formulation, mixture, or reaction product	Plasticizers (custom compounding of purchased resin; plastic material and resin manufacturing; rubber manufacturing; adhesive manufacturing; paints and coatings manufacturing; ink, toner, and colorant manufacturing)	PVC plastics compounding ^d	Water (Generic Scenario)	Quantitative assessment RQ = 31.79 for chronic hazard to fish RQ = 2.20 for hazard to algae
		Laboratory chemical manufacturing	Incorporation into other formulations, mixtures, or reaction products	Water (DMR data)	Quantitative Assessment RQs < 1
	Incorporation into articles	Plasticizers (adhesive manufacturing; fabric, textile, apparel, and leather products manufacturing; building and construction materials manufacturing; plastics product manufacturing; rubber product manufacturing; transportation equipment manufacturing)	PVC plastics converting	Water (Generic Scenario)	Quantitative Assessment RQ = 1.92 for chronic hazard to fish
			Non-PVC material converting	Water (Generic Scenario)	Quantitative Assessment RQs < 1
	Recycling	Recycling	Recycling	Water (Generic Scenario)	Quantitative Assessment RQs < 1
Distribution	Distribution in commerce	Distribution in commerce	Distribution in commerce	Water	Qualitative Assessment: Water exposures expected to be negligible
Industrial Use	Construction, paint, electrical, and metal products	Paints and coatings	Application of paints and coatings	Water (DMR data)	Quantitative Assessment RQs < 1
		Adhesives and sealants	Application of adhesives and sealants		
	Packaging, paper, plastic, hobby products	Ink, toner and colorant products	Application of paints and coatings		
	Other uses	Hydraulic fluids	Use of lubricants and functional fluids	Water (Generic Scenario)	Quantitative Assessment RQs < 1
		Castings	Non-PVC material compounding	Water (Generic Scenario)	Quantitative Assessment RQs < 1

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COUs			OES(s)	Release Media ^a	Risk Characterization ^{b c}
			Non-PVC material converting	Water (Generic Scenario)	Quantitative Assessment RQs < 1
		Automotive products, fluids	Use of lubricants and functional fluids	Water (Generic Scenario)	Quantitative Assessment RQs < 1
		Automotive articles	Fabrication of final product from articles	No release data	Water exposures expected to be negligible
Commercial Use	Construction, paint, electrical, and metal products	Paints and coatings	Application of paints and coatings	Water (DMR data)	Quantitative Assessment RQs < 1
		Adhesives and sealants	Application of adhesives and sealants	Water (DMR data)	Quantitative Assessment RQs < 1
	Furnishing, cleaning, treatment/care products	Floor coverings; Construction and building materials covering large surface areas including stone, plaster, cement, glass and ceramic articles; fabrics, textiles, and apparel	Fabrication of final product from articles	No release data	Water exposures expected to be negligible
		Fabric, textile, and leather products			
	Packaging, paper, plastic, hobby products	Packaging (excluding food packaging) and other articles with routine direct contact during normal use, rubber articles; plastic articles (hard); plastic articles (soft)			
		Inks, toner and colorant products	Application of paints and coatings	Water (DMR data)	Quantitative Assessment RQs < 1
		Toys, playground, and sporting equipment	Fabrication of final product from articles	No release data	Water exposures expected to be negligible
	Other uses	Laboratory chemical	Use of laboratory chemicals	Multimedia	Quantitative Assessment RQs < 1
		Castings	Non-PVC material compounding	Water (Generic Scenario)	Quantitative Assessment RQs < 1
			Non-PVC material converting	Water (Generic Scenario)	Quantitative Assessment RQs < 1
		Automotive products, fluids	Use of lubricants and functional fluids	Water (Generic Scenario)	Quantitative Assessment RQs < 1
		Automotive articles	Fabrication of final product from articles	No release data	Water exposures expected to be negligible
Disposal	Disposal	Disposal	Waste handling, treatment, and disposal	Water (DMR data)	Quantitative Assessment RQ=5.26 for chronic hazard to fish

^a Air release media and air to soil deposition qualitative screening assessments resulted in preliminary indication of no risk across all air releasing OESs (see Section 5.3.4).

^b Quantitative assessments of water exposures reported from second-tier assessment using predicted exposure concentrations from generic scenarios of surface water concentrations using median release volumes, 62% wastewater removal, and 7Q10 P75 (250,573 m³/day) stream flows and chronic fish (vertebrate) hazard COC = 1.9 µg/L BBP.

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COUs	OES(s)	Release Media ^a	Risk Characterization ^{b c}
^c Environmental release data did not distinguish between release to wastewater, landfill, or incineration, which was further refined when applicable. ^d The OES with the highest RQ is listed for this COU. Other OESs applicable to this COU were Formulation into adhesives and sealants; Formulation into paints and coatings; Incorporation into other formulation, mixture or reaction products; and Non-PVC material compounding.			

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5.3.3 Risk Characterization for Aquatic Organisms

Risk to aquatic organisms was characterized by comparing hazard thresholds (COCs) for aquatic organisms to modeled surface water exposures due to (1) DMR data for OESs with facility-specific data; (2) modeled data from generic scenarios of water releases for OES with water releases, but no facility-specific data; and (3) modeled data from generic scenarios of water releases from OESs with multimedia releases that did not distinguish among wastewater, incineration, or landfill. No evidence of hazard effects of BBP in the sediment was available to derive sediment exposure or sediment pore water COCs. However, equilibrium partitioning theory was used to calculate a sediment-dwelling animal hazard threshold based on the 48-hour water column exposure LC50 for the midge *Chironomus tentans* ([U.S. EPA, 2025p](#)). EPA conducted a screening assessment for sediment exposures by comparing this calculated sediment hazard threshold to the highest sediment value from high-end releases, no wastewater treatment, and slowest stream flow modeled estimates. Sediment porewater exposure estimates are entirely dependent on the three compartment VVMW-PSC modeling estimates of surface water and sediment concentrations. Therefore, a separate analysis of sediment pore water would not provide any additional information not already provided by the surface water and sediment risk characterizations and is not presented here.

Surface Water Exposure Risk from DMR-Derived Data

Risk to aquatic organisms was characterized by comparing hazard thresholds (COCs) for aquatic organisms to DMR-derived modeled surface water exposures from the Waste handling, treatment and disposal, Incorporation into other formulations, mixtures, or reaction products, Import and repackaging, Application of paints and coatings, and Application of adhesives and sealants OESs. RQs exceeded the benchmark of 1 only for chronic vertebrate exposures from 95th percentile releases from two POTW Waste handling, treatment, and disposal facilities resulting in RQ = 5.26 (Table 5-3 and Appendix G. Two specific facilities and scenarios characterize relatively large amounts of BBP into receiving streams with 7Q10 flow rates at or less than the effluent flow leaving the facility. These scenarios represent 2 of 28 reporting facilities for this OES and may not be representative of the OES in general. Median release volumes from these and the other reporting facilities result in RQs less than the benchmark of 1. RQ values were less than the benchmark of 1 for all other aquatic organism COCs and DMR-derived data. EPA has robust confidence in this risk characterization because of robust confidence in the chronic vertebrate hazard COCs and robust confidence in the exposure concentrations due to modeling with DMR data.

Surface Water Exposure Risk from Generic Scenarios of Water Releases

Risk to aquatic organisms was characterized by comparing hazard thresholds (COCs) for aquatic organisms to generic scenarios of surface water exposures. For first-tier risk screening of the surface water pathway, the OES resulting in the highest estimated water column concentration was PVC plastics compounding for water (Section 3.3) resulting in 4,440 µg/L BBP in water, which exceeded the BBP limit of water solubility (2,690 µg/L) ([U.S. EPA, 2025z](#)). EPA has slight confidence in this water concentration because it exceeds the BBP limit of water solubility and it is three orders of magnitude greater than the maximum concentration reported in U.S. waterbodies (2.65 µg/L; ([U.S. EPA, 2025r](#))). Nevertheless, this estimated exposure concentration was compared to COCs of acute BBP exposures to animals, chronic BBP exposures to animals, and 4-day BBP exposures to algae, resulting in RQs exceeding benchmark (1) for all comparisons. Thus, a second-tier assessment with additional surface water exposure lines of evidence was conducted to increase the confidence in risk estimates and add potential realism to predicted exposure concentrations from generic scenario modeling.

The next tier of screening for surface water BBP risk characterization to aquatic organisms included central tendency (50th percentile or median) release volumes, wastewater treatment removal, and multiple surface water flow rates. The central tendency release volume represents a more typical release rather than a high-end, and conservative release. Estimated exposure concentrations were calculated using 0 and 62 percent wastewater removal ([U.S. EPA, 2025z](#)). Multiple surface water flow rates of slow (18,176 m³/day), medium (250,573 m³/day), and fast (7,446,189 m³/day), represent the 50th percentile (P50), 75th percentile (P75) and 90th percentile (P90) of the 7Q10 (lowest 7-day average flow that occurs in a 10-year period) flows from BBP-releasing facilities ([U.S. EPA, 2025z](#)). Potentially important variables that were not changed in the VVMW-PSC modeling from initial screening to the second-tier screening assessment include values for water (14 days) and sediment (19.3) biodegradation that are on the high-end of the reported ranges (*i.e.*, the slowest biodegradation rates), and continuous release over the length of the estimated number of release days (*i.e.*, 250 days of continuous release and 115 days of no release over a year). BBP is readily biodegradable with reported water half-lives as low as less than 2 days and reported sediment half-lives as low as 2.9 days. Thus, PSC tool runs continued to include conservative input values. Water concentration estimates from second-tier screening were also compared to the maximum BBP measured in U.S. surface waters (2.65 µg/L) ([U.S. EPA, 2025t](#)) for context.

Exposure scenarios that represented the most typical (median) modeled releases, conservative wastewater treatment removal, flow rate that matches facility size with stream size, and resulting in surface water concentrations within an order of magnitude of measured BBP concentrations in the U.S. were determined to be the most realistic and representative of U.S. receiving waterbodies. Specifically, median distribution values (50th percentile) are more typical than high-end (95th percentile) values by definition. Also, the BBP processing life cycle indicates wastewater treatment is a possible step before release into surface water and is relevant for modeling scenarios ([U.S. EPA, 2025t](#)). Although a range of wastewater treatment removal values are reported in the literature, EPA has moderate/robust confidence in 62 percent wastewater removal ([U.S. EPA, 2025z](#)). Finally, EPA recognizes a likely mismatch of higher release amounts with lower flows due to the generic nature of the release assessment and hydrologic flow data. Thus, even the 7Q10 P50 flow represents the median and most typical low flow scenario, in some instances, these modeling results in implausible surface water concentrations (*e.g.*, more than twice the limit of BBP water solubility of 2,690 µg/L([U.S. EPA, 2025z](#))) due to this mismatch. Faster stream flows (7Q10 P75 and 7Q10 P90) were considered a better match than the slowest flow (7Q10 P50) because facilities releasing larger volumes of BBP are more likely to release into larger surface water systems with faster flows across seasons and years. There remain uncertainties about whether 7Q10 P75 or 7Q10 P90 flows more closely represent low flow in BBP-receiving water bodies. By definition, a stream at the 75th percentile of the stream low flow distributions is more typical than a stream at the 90th percentile. Thus, the Agency ranked the surface water concentrations in scenarios with the more typical 7Q10 P75 low flow with a higher strength and more representative of BBP-receiving waterbodies. Detailed descriptions of the weight of scientific evidence used to characterize the second-tier assessment are included in Section 5.3.6.

RQs depended on the estimated release volume, flow, wastewater treatment regime, and aquatic organism COC (Appendix G). The high-end daily release, 7Q10 P50 (slow) flow and no wastewater treatment scenario for PVC plastic compounding generated the highest surface water and sediment exposure estimates and was used as the first-tier screen. RQs greater than 1 were preliminarily identified for all COCs for surface water exposure but not for direct sediment exposure estimates, which is described in the sediment section below. EPA has moderate confidence in RQs based on uncertainties in generic models producing realistic surface water concentrations and robust confidence in hazard COCs. Modeled surface water concentrations approximating measured BBP concentrations (2.65 µg/L)

occurred in the scenarios with central tendency (median) release volumes, medium and fast flows, and with wastewater treatment removal, representing potentially realistic water bodies and increasing confidence in the modeled estimates. These concentrations resulted in RQs that exceeded the benchmark of 1 for two COU/OESs (Table 5-3). The additional lines of evidence provided by additional release volumes, flows, and wastewater treatment removal resulted in more realistic surface water concentrations and increased the confidence in risk estimates.

Table 5-3. OESs with Risk Quotients Exceeding the Benchmark of 1 for Aquatic Organism Hazards and Surface Water BBP Exposures

OES	Daily Release (kg/day)	Flow (m ³ /day)	SWC (µg/L)	Risk Quotient ^a		Overall Confidence
				Chronic Vertebrate	Algae	
Waste handling, treatment, and disposal (DMR data)	0.68 (95th percentile)	18,537	10	5.26 ^b	0.48	Robust
PVC Plastics compounding water release (generic scenario)	40 (median)	250,573 (7Q10, P75)	60.4	31.79 ^c	2.88 ^d	Moderate
PVC plastics converting (generic scenario)	2.41 (median)	250,573 (7Q10, P75)	3.65	1.92 ^e	0.17	Moderate
Manufacturing (multimedia) ^f	303 (median)	250,573 (7Q10, P75)	45.98	24.2 ^g	2.2 ^h	Moderate

^a Risk quotients were based on chronic vertebrate (1.9 µg/L) and algae (21 µg/L) concentrations of concern ([U.S. EPA, 2025p](#)). EPA has robust confidence in the quality, consistency, strength and precision, and relevance of the studies used in determining these COCs.

^b The days of exceedance from modeling resulted in 269 days/year where RQs > 1 and extended beyond the 21-day aquatic vertebrate exposure used to derive the COC.

^c The days of exceedance from modeling resulted in 242 days/year where RQs > 1 and extended beyond the 21-day aquatic vertebrate exposure used to derive the COC.

^d The days of exceedance from modeling resulted in 226 days/year where RQs > 1 and extended beyond the 4-day algal exposure used to derive the COC.

^e The days of exceedance from modeling resulted in 230 days/year where RQs > 1 and extended beyond the 21-day aquatic vertebrate exposure used to derive the COC.

^f Using the draft DEHP risk evaluation, EPA used 10% release of the total volume into water.

^g The days of exceedance from modeling resulted in 269 days/year where RQs > 1 and extended beyond the 21-day aquatic vertebrate exposure used to derive the COC.

^h The days of exceedance from modeling resulted in 240 days/year where RQs > 1 and extended beyond the 4-day algal exposure used to derive the COC.

Acute BBP Exposure to Aquatic Animals: In the refined, second-tier assessment, all OESs that release to wastewater and subsequently surface water, no RQs exceeded the benchmark of 1 for acute exposures to aquatic animals (6.3Appendix G). EPA has moderate confidence in this risk characterization because of robust confidence in the acute animal hazard COC but moderate confidence in the exposure concentrations due to generic scenario modeling.

Chronic BBP Exposure to Aquatic Vertebrates: RQs exceeded the benchmark of 1 in the refined second-tier assessments of release from two OESs (Table 5-3 and 6.3Appendix G). An RQ of 31.79 was determined for chronic vertebrate exposure in Processing/PVC Compounding release scenarios. A chronic RQ of 1.92 was determined for chronic vertebrate exposure in Processing/PVC converting release scenarios with 7Q10 P75 flow but RQ was less than the benchmark of 1 in scenarios with a faster flow rate (7Q10 P90). In all other OESs that release to wastewater and subsequently surface water, no RQs exceeded the benchmark of 1 for chronic exposures to aquatic vertebrates6.3Appendix G. EPA

has moderate confidence in this risk characterization because of robust confidence in the chronic vertebrate hazard COC but moderate confidence in the exposure concentrations due to generic scenario modeling.

Chronic BBP Exposure to Aquatic Invertebrates: In all OESs that release to wastewater and subsequently surface water, no RQs exceeded the benchmark of 1 for chronic (21-day) exposures to aquatic animals (Appendix G). EPA has moderate confidence in this risk characterization because of robust confidence in the chronic invertebrate hazard COC but moderate confidence in the exposure concentrations due to generic scenario modeling.

4-Day BBP Exposure to Algae: RQs exceeded the benchmark of 1 in the refined second-tier assessments of release from one OES (Table 5-3 and Appendix G). An RQ of 1 was determined for algae exposure in the Processing/PVC Compounding release scenario. In all other OESs that release to wastewater and subsequently surface water, no RQs exceeded the benchmark of 1 for exposures to algae (Appendix G). EPA has moderate confidence in this risk characterization because of robust confidence in the algae hazard COC but moderate confidence in the exposure concentrations due to generic scenario modeling.

Surface Water Exposure Risk from Generic Scenarios of Multimedia Releases

Risk to aquatic organisms was characterized by comparing hazard thresholds (COCs) for aquatic organisms to generic scenarios of multimedia water exposures from the Use of laboratory chemicals and Manufacturing OESs.

Every modeled scenario of releases from Use of laboratory chemicals resulted in RQ values less than the benchmark of 1 for all aquatic organism COCs. Appendix G. EPA has robust confidence in this risk characterization because of robust confidence in the chronic invertebrate hazard COC and robust confidence that the conservative exposure concentrations used in all scenarios represent an upper bound for this OES.

RQs exceeded the benchmark of 1 for chronic BBP exposure to aquatic vertebrates in every generic scenario modeled with an initial conservative assumption of 100 percent release to water from the Manufacturing OES. Appendix G. Other aquatic organism COCs and predicted surface water concentrations resulted in RQs greater than the benchmark of 1 for all scenarios except in the fastest flows. Surface water modeling using PSC is sensitive to flow rate, resulting in a linear relationship between release volume and surface water concentration at any given flow rate. Using this relationship (surface water concentration = $3.9875 \times \text{release volume}$), EPA calculated that any release greater than 0.476 kg/site-day results in RQ values greater than the benchmark of 1 for chronic BBP exposure of aquatic vertebrates at 7Q10 P75 flow rates. Thus, any release greater than 0.1 percent of the central tendency release of 303 kg/site-day results in an RQ exceeding 1.

Using the most conservative scenario with a high-end release (566 kg/site-day), no wastewater treatment removal, and the fastest flow rates (7Q10 P90), RQ values are greater than the benchmark of 1 if only 2.5 percent (14.2 kg/site-day) of the total release is to water. A major source of uncertainty about these initial assessments is whether any release into water occurs at all. Therefore, the Agency used an additional line of evidence of water releases from release reports of other phthalates, including DEHP ([U.S. EPA, 2025aa](#)). Approximately 60 percent of the total daily DEHP release from Manufacturing is to water ([U.S. EPA, 2025aa](#)). Initial inspection of 60 percent water release from Manufacturing resulted in daily release estimates (339.6 kg/site-day and 181.8 kg/site-day) that were greater than the range of daily releases from OESs with definitive water releases (*i.e.*, exceeded the maximum of 122 kg/site-day). These high-end releases resulted in an unrealistic surface water concentration (3,070 µg/L) that is

greater than the BBP limit of solubility (2,690 µg/L), leading to slight confidence in these scenarios. Thus, the Agency used a lower and more conservative percent of water release from manufacturing. Using the more conservative estimated release of 10 percent of the total BBP Manufacturing release (i.e., 10% of median release of 303 kg/site-day is 30.3 kg/site-day), the generic scenario with the central tendency release, 62 percent wastewater removal, and medium flow (7Q10 P75) resulted in RQ of 24.2 for chronic (21-day) exposure to aquatic vertebrates with 269 days of exceedance in a year. The realistic release wastewater treatment, and flow scenarios combined with evidence of water release obtained from DEHP, resulted in EPA having moderate confidence in the resulting predicted surface water concentrations. The Agency has moderate overall confidence in this risk characterization because of robust confidence in the chronic vertebrate hazard COC but moderate confidence in the exposure concentrations due to generic scenario modeling.

Sediment

No evidence of hazard effects of BBP in the sediment were available to derive sediment exposure COCs. EPA used the equilibrium partitioning method to estimate a hazard threshold for sediment-dwelling animals using the 48-hour LC50 for the midge, *Chironomus tentans* of 1,640 µg/L BBP (U.S. EPA, 2025p) and the following equation (Di Toro et al., 1991) (ECHA, 2008a):

Equation 5-2.

$$C_s = C_w \times K_{OC} \times f_{OC}$$

Where:

C_s	=	Concentration of BBP in sediment (mg/kg)
C_w	=	Concentration of BBP in water (mg/L)
K_{OC}	=	Organic carbon – water partitioning coefficient of BBP (L/kg OC)
f_{OC}	=	Fraction of organic carbon in the sediment (kg OC/kg).

Using the *C. tentans* LC50 of 1.64 mg/L, K_{OC} of 72,443 (U.S. EPA, 2025z), and f_{OC} of 0.06 (representing 6% organic carbon content in a low flow stream) resulted in 7,130 mg/kg (7.13×10^6 µg/kg) BBP in the sediment as a hazard threshold.

Modeling estimates from the Processing/PVC compounding COU/OES with high-end release volume, no wastewater treatment, and slowest flow rate, resulted in 6.09×10^6 µg/kg BBP in sediment. Using a screening approach with the highest modeled exposure concentration and the hazard threshold of 1,640 µg/L (converted to 7.13×10^6 µg/kg) resulted in an RQ of 0.85. The highest measured BBP sediment concentrations were 3.11×10^5 µg/kg at an unspecified depth and 10,400 µg/kg in the top sediment layer (U.S. EPA, 2025r) where *C. tentans* larvae typically reside. These measured sediment BBP concentrations are one to two orders of magnitude less than the *C. tentans* hazard threshold. Thus, EPA used this screening assessment of the most conservative scenario to arrive at exposures that do not exceed the benchmark of 1.

EPA has moderate confidence in this sediment assessment based on uncertainties in generic models and moderate confidence in the hazard COC derived using equilibrium partitioning. The highest sediment exposure concentrations did not exceed the benchmark of 1.

5.3.4 Risk Characterization for Terrestrial Organisms

Environmental risk of BBP to terrestrial organisms was characterized by qualitative descriptions of risk for all COU/OES because either exposure or hazard effects estimates were not reasonably available or evidence indicates that BBP is unlikely to be bioavailable in air, landfill, biosolid, and trophic transfer

exposure scenarios (Table 5-2). A hazard threshold of 311 mg/kg/day dietary BBP exposure to terrestrial mammals was qualitatively compared to potential exposure via air deposition to soil, soil via biosolids or landfill routes, and food webs through trophic transfer.

Air

No studies on the hazardous effects of BBP inhalation were reasonably available for EPA to review. Only one study that monitored ambient BBP air concentrations were reasonably available for the Agency to review. The available data was limited to a single study from China that measured concentrations of several phthalates including BBP ([Zhu et al., 2016](#)) where BBP concentrations were in the low ng/m³ range. EPA modeled estimated air concentrations across all modeled COU release scenarios to evaluate exposures near a releasing facility in the *Draft Environmental Media, General Population, and Environmental Exposure Assessment for Butyl Benzyl Phthalate (BBP)* ([U.S. EPA, 2025r](#)). The maximum total concentration was the sum of the separately modeled maximum fugitive releases from the Processing – incorporation into adhesives and sealants COU/OES and maximum stack releases from the Industrial use application of paints and coatings OES BBP concentrations at 100 m from a releasing facility and was determined to be 34.45 µg/m³. EPA qualitatively assessed risk using this low air exposure estimate along with no available evidence of air inhalation hazard to organisms, resulting in a preliminary indication of no risk.

EPA also modeled estimated air releases resulting in BBP deposition rates across using the same maximum fugitive and stack air release OES described above to evaluate total deposition rates to soil near a releasing facility resulting in a maximum of 5.71×10^{-5} mg/kg/day BBP ([U.S. EPA, 2025r](#)).

No evidence of BBP soil hazard to terrestrial invertebrates or birds was reasonably available. The hazard threshold of 311 mg/kg-day BBP of mammal diet exposure was compared to the maximum modeled air to soil deposition rate in the event of incidental mammal ingestion of soil containing BBP. This exposure concentration (5.71×10^{-5} mg/kg-day) was miniscule compared to the dietary hazard threshold for BBP mammal ingestion of soil (311 mg/kg-day). Thus, EPA qualitatively assessed risk using this low exposure estimate via the air to soil deposition pathway and the dietary mammal hazard threshold resulting in a preliminary indication of no risk to mammals.

Biosolids

EPA qualitatively assessed risk of biosolids to soil BBP exposure to terrestrial organisms. BBP is not expected to be persistent in topsoil if it is applied to land through biosolids applications. There are limited measured data on concentrations of BBP in biosolids or soils receiving biosolids. High-quality biodegradation rates and physical and chemical properties suggest that BBP will have limited persistence potential and mobility in soils receiving biosolids ([U.S. EPA, 2025r](#)). EPA estimated a high-end soil concentration from biosolid addition of 0.01 mg/kg BBP that would likely sorb strongly to organic matter, thereby limiting its mobility and bioavailability. No hazard data were reasonably available for soil-dwelling animals or plants. EPA used the available evidence to determine the low likelihood of soil BBP concentrations from biosolid additions exceeding soil organism hazard thresholds and thus a preliminary indication of no risk. Empirical toxicity data for rats and mice were used to estimate a hazard threshold value for terrestrial mammals at 311 mg/kg-bw-day ([U.S. EPA, 2025p](#)). EPA qualitatively considered the risk of BBP trophically transferring through food webs using the high-end estimate of BBP in soil (0.01 mg/kg), the dietary mammal hazard threshold, and the low bioaccumulation potential of BBP ([U.S. EPA, 2025p](#)). EPA determined a low likelihood of BBP transferring from biosolids to soil and through food webs to reach the terrestrial mammal threshold value of 311 mg/kg-bw-day and thus arrive at a preliminary indication of no risk.

Landfills

EPA qualitatively assessed risk of landfills to groundwater and soil BBP exposure to aquatic and terrestrial organisms. No hazard data were reasonably available for groundwater-dwelling or soil-dwelling animals or plants. Empirical toxicity data for rats and mice were used to estimate a hazard threshold value for terrestrial mammals at 311 mg/kg-bw-day ([U.S. EPA, 2025p](#)). EPA qualitatively assessed risk using the low to negligible bioavailability in landfills and soil and the dietary mammal hazard threshold resulting in a preliminary indication of no risk to mammals.

Trophic Transfer

EPA did not conduct a quantitative modeling analysis of the trophic transfer of BBP through food webs. This is because of the chemical properties and fate ([U.S. EPA, 2025z](#)) and empirical food web data ([Mackintosh et al., 2004](#)) of BBP indicate low potential for bioaccumulation or biomagnification. Specifically, EPA does not expect BBP to persist in surface water, groundwater, or air. BBP 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 BBP bioavailability is expected to be limited ([U.S. EPA, 2025z](#)). BBP is expected to have low bioaccumulation potential, biomagnification potential, and low potential for uptake based on a bioconcentration factor (BCF) of 12.4 and a BAF of 40.1 ([U.S. EPA, 2025z](#)). For example, a worst-case scenario screening that uses the upper bound of water solubility as the water concentration (2,690 µg/L BBP) and BAF of 40.1, results in 107.9 mg/kg-bw DCHP in fish. A similar calculation results in 174 mg/kg-bw BBP in fish if the highest modeled concentration from EPA's VVM-PSC (4,440 µg/L) is used. These values are less than the terrestrial mammal threshold value of 311 mg/kg bw-day over 130 days. Also, these values would only be lower in simulations that incorporate other release and exposure scenarios in a trophic transfer model. Finally, Mackintosh ([2004](#)) reported trophic magnification factors below 1, indicating BBP biodilution in an empirical food web. EPA also did not find reasonably available data sources that report the terrestrial biota-sediment accumulation or terrestrial bioconcentration of BBP. Therefore, the Agency determined a low likelihood of BBP transferring through food webs to reach the terrestrial mammal threshold value of 311 mg/kg bw-day and thus a preliminary indication of no risk.

Disposal

Environmental releases can occur from consumer products and articles containing BBP via their end-of-life disposal and demolition in the built environment or landfills, as well as from associated down-the-drain releases of BBP. It is difficult for EPA to quantify these end-of-life and down-the-drain exposures due to limited reasonably available information on source attribution of the consumer COUs. Although the Agency acknowledges that there may be BBP releases to the environment via the cleaning and disposal of adhesives, sealants, paints, coatings, and cleaning and furnishing care products, EPA did not quantitatively assess these products (Section 3.1.4). The Agency expects that environmental releases of BBP from consumer disposal will be negligible and not expected to exceed hazard to ecological receptors and therefore arrived at a preliminary indication of no risk.

Distribution in Commerce

EPA evaluated activities resulting in exposures associated with distribution of BBP in commerce throughout the various life cycle stages and COUs (e.g., manufacturing, processing, industrial use, commercial use, disposal) rather than a single distribution scenario. Data were not reasonably available for the Agency to assess risks to the environment from environmental releases and exposures related to distribution of BBP in commerce as a single OES. However, EPA expects that environmental releases from distribution in commerce will be negligible and not expected to exceed hazard to ecological receptors.

5.3.5 Summary of Environmental Risk Characterization

In summary, EPA's environmental risk characterization indicates that environmental concentrations of BBP may exceed hazard values for aquatic organisms in surface water for the Disposal/waste handling, treatment, and disposal, Processing/PVC plastic compounding, Processing/PVC plastic converting, and Manufacturing COUs/OESs (Table 5-2). RQ values were determined for surface water exposure to aquatic organisms for five OES scenarios using DMR data. The RQ exceeded the benchmark of 1 for the Waste handling, treatment, and disposal OES (RQ = 5.26 for chronic [21-day] vertebrate exposure. EPA has robust confidence in risk estimates to aquatic species from these OES scenarios. In generic scenario modeling of water releasing OESs, a second-tier and refined assessment resulted in RQs greater than 1 for chronic (21-day) BBP exposures to vertebrates in surface waters due to modeled water releases from two COUs/OESs that release into water: Processing/PVC compounding, and Processing/PVC converting (Table 5-3). The RQ was 31.79 for chronic vertebrate exposure and 2.88 for 4-day BBP exposure to algae in the Processing/PVC compounding release scenario. The RQ was 1.92 for chronic vertebrate exposure in the Processing/PVC converting release scenario. The refined assessment resulted in no RQs exceeding 1 for acute (2- to 4-day) BBP exposures to aquatic animals and chronic (21-day) BBP exposures to invertebrates in surface water (Appendix G).

EPA has moderate confidence in risk estimates to aquatic species from these refined scenarios. RQ values were determined for the Manufacturing OES by assuming 10 percent of the multimedia (water, incineration, or landfill) release is to water and median release, 62 percent wastewater removal, and medium flow rates (RQ = 24.2 for chronic vertebrate exposure and 2.2 for 4-day exposure to algae). EPA has moderate confidence in risk estimates to aquatic species from these refined scenarios.

Exposure concentrations did not exceed hazard thresholds for exposures to terrestrial mammals from BBP releases to soil (*i.e.*, biosolids, landfill, air to soil deposition) or from trophic transfer through aquatic or terrestrial food webs. No hazard threshold for BBP exposure to soil invertebrates was derived because one medium-quality study did not find mortality at any experimental BBP concentration. No hazard threshold for BBP exposure to terrestrial plants was derived because four high or medium-quality studies did not find BBP effects on plant growth. EPA has robust confidence in no risk estimates being identified for exposures to terrestrial species.

5.3.6 Overall Confidence and Remaining Uncertainties Confidence in Environmental Risk Characterization

The overall confidence in the environmental risk characterization synthesizes confidence from both environmental exposures and environmental hazards. Exposure confidence in first-tier screening with high-end release and slow flow scenarios is detailed in the *Draft Environmental Media, General Population, and Environmental Exposure Assessment for Butyl Benzyl Phthalate (BBP)* ([U.S. EPA, 2025r](#)). Environmental hazard confidence is detailed in the *Draft Environmental Hazard Assessment for Butyl Benzyl Phthalate (BBP)* ([U.S. EPA, 2025p](#)). Confidence determinations for each group of environmental exposures pathways (Table 5-1) are provided below.

Surface Water and Sediment Pore Water Risk Characterization Confidence

Risk to aquatic organisms was characterized by comparing hazard thresholds (COCs) for aquatic organisms to DMR-derived modeled surface water exposures from the Waste handling, treatment and disposal, Incorporation into other formulations, mixtures, or reaction products, Import and repackaging, Application of paints and coatings, and Application of adhesives and sealants OESs. EPA has robust confidence in this risk characterization because of robust confidence in the chronic vertebrate hazard COCs and robust confidence in the exposure concentrations due to modeling with DMR data.

EPA has slight confidence in the first-tier assessment that considered the highest exposures across all COUs of a high-end (95th percentile) release from the Processing – PVC plastic compounding, no wastewater treatment, and slowest flow scenario (Appendix H). Similar screening assessments for surface water exposure to the general population as well as drinking water had moderate confidence ([U.S. EPA, 2025r](#)). However, for environmental risk, RQ values for all aquatic organism COCs exceeded the benchmark (1). The high uncertainty and slight confidence in estimated surface water concentrations is because of the low reliability of the surface water estimate (4,340 µg/L) that exceeded the BBP limit of water solubility (2,690 µg/L) and was three orders of magnitude greater than the maximum measured concentration from U.S. waters (2.65 µg/L). Because of this uncertainty and slight confidence in the results of the screening approach, EPA considered the scenarios with median (central tendency) release, wastewater treatment removal, and faster stream flows in a second-tier assessment that provided estimates of surface water concentrations with higher confidence.

EPA has moderate confidence overall in the second tier of RQ values of BBP exposure to aquatic species in water. The Agency's overall confidence weighs the uncertainties and lines of evidence of the exposure estimates and the hazard COCs that were used to calculate RQ values. EPA has moderate confidence in the exposure estimates due to the weight of scientific evidence and uncertainties in the generic scenarios that modeled BBP releases into water, but robust confidence in the COCs because they represent protective concentrations supported by the quality, consistency, strength and precision, and relevance of the available scientific evidence ([U.S. EPA, 2025p](#)).

EPA systematically characterized the weight of scientific evidence in assessing the BBP water exposures by rating each line of evidence by relevance, strength, and reliability ([Miglin and Holmes, 2023](#)). All lines of evidence were considered relevant. The strength of a line of evidence was the degree of certainty with which it addressed the predicted exposure concentration. The reliability of a line of evidence was a rating of the quality of its methodology or quality or quantity of data sources.

Due to the lack of release data for facilities discharging BBP to surface waters, releases were modeled, and the high-end (95th percentile) and central tendency (50th percentile or median) estimates for each COU were used as inputs for surface water modeling ([U.S. EPA, 2025t](#)). EPA has moderate confidence that the release estimates modeled from databases captures the high-end and central tendency exposure scenarios because they provide a plausible estimate of releases that considered the strengths and limitations of the reasonably available data (Section 3.2). High-end release estimates were useful for establishing conservative and highly protective scenarios in the first-tier screening that identified risk. Median releases represent a central tendency statistic and were ranked with a higher strength than the 95th percentile because they represent more typical releases used in the second-tier screening assessment. The reliability of both 95th percentile and median releases were equivalent because both were estimated through Monte Carlo analyses ([U.S. EPA, 2025t](#)).

Stream flow data were derived from National Hydrography Dataset (NHD) modeled (EROM) flow data in lieu of facility-specific data. EPA has moderate to robust confidence in the modeled low flow rates as being a reliable representation of streams near BBP-releasing facilities. The Agency recognizes however, a likely mismatch of higher release amounts with lower flows due to the generic nature of the release assessment and hydrologic flow data. The 7Q10 P50 flow represents the median and most typical low flow scenario, but in some instances, this results in implausible surface water concentrations due to this mismatch. Faster stream flows (7Q10 P75 and 7Q10 P90) were ranked with a higher strength than the slowest flow (7Q10 P50) because facilities releasing larger volumes of BBP are more likely to release into larger surface water systems with faster flows across seasons and years. There remain uncertainties about whether 7Q10 P75 or 7Q10 P90 flows more closely represent low flow in BBP-

receiving water bodies. By definition, a stream at the 75th percentile of the stream low flow distributions is more typical than a stream at the 90th percentile. Thus, the Agency ranked the surface water concentrations in scenarios with the more typical 7Q10 P75 low flow with a higher strength. Additional uncertainties include the regression-based calculations applied to NHD-acquired flow data to estimate flow statistics ([U.S. EPA, 2025r](#)).

The BBP processing life cycle indicates wastewater treatment is a possible step before release into surface water and is relevant for modeling scenarios ([U.S. EPA, 2025t](#)). Although a range of wastewater treatment removal values are reported in the literature, EPA has moderate/robust confidence in 62 percent wastewater removal ([U.S. EPA, 2025z](#)). Thus, the Agency has moderate/robust confidence in the relevance, strength, and reliability of surface water concentrations estimated with wastewater removal.

EPA used estimated release amounts and estimated receiving waterbody flow rates from a distribution of known releasing facilities in PSC modeling to estimate concentrations of BBP within surface water. The Agency has moderate confidence in the modeled concentrations as being representative of actual releases, with a slight bias toward over-estimation ([U.S. EPA, 2025r](#)). Additionally, EPA has robust confidence that no surface water release scenarios exceed the concentrations presented in this evaluation.

EPA has slight confidence in any one surface water exposure value but has moderate confidence that the modeled range of estimated concentrations encompass the range of actual releases ([U.S. EPA, 2025t](#)). In this case the estimated water concentrations ultimately ranged from 2.0×10^{-3} µg/L BBP, which is at or below analytical detections limits, to 4,440 µg/L BBP, which exceeds the BBP limit of water solubility (2,690 µg/L) (Section 5.3). Release and flow uncertainties from high release, low flow combinations lead to robust confidence for screening first-tier and worst-case scenarios. However, PSC Models that used the worst-case scenarios resulted in implausible surface water concentrations (e.g., 4,440 µg/L) that exceed the BBP limit of water solubility (2,690 µg/L) and are more than three orders of magnitude greater than the maximum BBP measured in U.S. surface waters (2.65 µg/L) ([U.S. EPA, 2025t](#)). Second-tier screening used various modeled release, flow, and wastewater treatment scenarios ultimately resulting in concentrations approximating 2.65 µg/L. Thus, EPA has moderate confidence that combinations of release, flow, and wastewater treatment in generic scenarios represent a BBP COU release that result in relevant and reliable water concentrations. This moderate confidence is due the accumulation of uncertainties in any one specific estimated release volume, representative flow rate, and PSC modeling output. Thus, EPA has moderate confidence in the water exposure concentrations used to calculate RQ values in the second-tier screening.

Risk to aquatic organisms was characterized by comparing hazard thresholds (COCs) for aquatic organisms to generic scenarios of multimedia water exposures from the Use of laboratory chemicals and Manufacturing OESs. The realistic release wastewater treatment and flow scenarios combined with evidence of water release obtained from DEHP, resulted in EPA having moderate confidence in the resulting predicted surface water concentrations. The Agency has moderate overall confidence in this risk characterization because of robust confidence in the chronic vertebrate hazard COC but moderate confidence in the exposure concentrations due to generic scenario modeling.

EPA acknowledges additional uncertainties about aquatic species hazard effects due to the estimated exposures despite robust confidence in the hazard COCs themselves. Specifically, the COCs for chronic effects of BBP exposure to vertebrates (*D. rerio*) were derived from 3 percent reductions in fecundity, and larger effects on mechanistic endpoints such as hormone production and gonad size ([Battelle, 2018](#)).

The extent to which these reproductive effects on individual fish subsequently scale up to aquatic vertebrate populations is uncertain. Additionally, the timing of low flow events in U.S. streams might not overlap with the seasonality of aquatic vertebrate life histories. In temperate streams and rivers, reproduction tends to occur in spring higher flow conditions. Thus, the possible mismatch between the timing of low stream flow and the lack of reproductively active adults and larvae adds uncertainty.

Overall, despite having robust confidence in COC values, EPA has moderate confidence in water exposure values due to the previously outlined reasons, leading to moderate confidence in the resulting RQ values.

Sediment Risk Characterization Confidence

EPA has moderate confidence in the preliminary identification of no risk of sediment BBP exposure to sediment-dwelling organisms. Due to the lack of release data for facilities discharging BBP to surface waters, releases were modeled, and the high-end estimate for each COU was used as an input for surface water modeling resulting in conservative high-end estimates of BBP in sediment. Uncertainties around the confidence in first-tier screening with high-end release and slow flow scenarios is described in the *Draft Environmental Media, General Population, and Environmental Exposure Assessment for Butyl Benzyl Phthalate (BBP)* ([U.S. EPA, 2025r](#)) and described as moderate. EPA has robust confidence in environmental hazard COCs as described in detailed in the *Draft Environmental Hazard Assessment for Butyl Benzyl Phthalate (BBP)* ([U.S. EPA, 2025p](#)). However, the Agency made assumptions about equilibrium conditions and stream organic carbon content to convert a water exposure hazard threshold to a sediment exposure threshold, thus adding additional uncertainties. Therefore, EPA has moderate confidence in the hazard threshold for sediment exposure to *C. tentans* and overall moderate confidence in the qualitative screening resulting in sediment exposures not exceeding the benchmark.

Terrestrial Risk Characterization Confidence

BBP did not have facility-reported release data (e.g., TRI or NEI). Therefore, BBP releases were estimated and used as a direct input to the IIOAC Model. EPA has moderate confidence in the IIOAC-modeled results used to characterize exposures and deposition rates ([U.S. EPA, 2025t](#)). Information on the presence of BBP in landfills is limited and there are uncertainties in the relevancy of the landfill leachate monitoring data to the COUs considered in this evaluation. However, BBP is unlikely to be present in landfill leachates and migrate through groundwater. EPA has high confidence in these conclusions based on the qualitative assessment of BBP in landfills and review of readily available literature. Considerable uncertainty exists in the applicability of using generic release scenarios and wastewater treatment plant modeling software to estimate concentrations of BBP in biosolids. There are limited measured data on concentrations of BBP 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 suggest that BBP will have limited persistence potential and mobility in soils receiving biosolids. There is robust confidence that BBP in soils will not be mobile and will have low persistence potential due to the high confidence in the biodegradation rates and physical and chemical properties.

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Table 5-4. BBP Evidence Table Summarizing Overall Confidence Derived for Environmental Risk Characterization

Exposure Pathway	Exposure Confidence	Hazard Confidence	Risk Characterization Confidence
Surface water and sediment pore water	Robust confidence in exposure concentrations derived from DMR data Moderate confidence in modeled concentrations as being representative of actual releases with a slight bias toward over-estimation ^a	Robust: Acute exposure resulting in aquatic vertebrate and invertebrate species mortality ^d	Moderate
		Robust: Chronic exposure to aquatic vertebrate species (reduced fish [<i>Danio rerio</i>] reproduction over 21 days) ^d	Robust/Moderate
		Robust: Chronic exposure to aquatic invertebrate species (reduced waterflea [<i>Daphnia magna</i>] reproduction over 21 days) ^d	Moderate
		Robust: Reduced algae (<i>Raphidocelis subcapitata</i>) population growth over 4 days ^d	Moderate
Sediment	Moderate confidence in modeled sediment concentrations from high-end release, low flow screening	Moderate: Hazard threshold derived from equilibrium partitioning calculation	Moderate
Air to soil deposition	Moderate confidence in the IIOAC-modeled results used to characterize air deposition rates onto soil ^b	Robust: Chronic hazard threshold for terrestrial mammals ^d Moderate: Mammal threshold relevance to wild mammal populations	Robust
Biosolids	Robust confidence in the biodegradation rates and physical and chemical data, and that BBP in soils will not be mobile and will have low persistence potential.	Moderate: Mammal threshold relevance to wild mammal populations	Robust
Landfills	Robust confidence in high-quality physical and chemical property data, and that BBP is unlikely to be present in landfill leachates	Moderate: Mammal threshold relevance to wild mammal populations	Robust
Trophic transfer from water or soil	Robust confidence that BBP has low potential for trophic transfer through food webs ^c	Moderate: Mammal threshold relevance to wild mammal populations	Robust
^a Due to the lack of release data for facilities discharging BBP to surface waters, releases were modeled (U.S. EPA, 2025t) and subsequent surface water concentrations were modeled using the VVWM-PSC Tool (U.S. EPA, 2019d) (U.S. EPA, 2025r). ^b EPA used the IIOAC Model to estimate daily-average and annual-average concentrations of BBP in the ambient air exposure and deposition rates (U.S. EPA, 2025r). ^c BP is not readily found or if found is in relatively low concentrations in biota and has low bioaccumulation and biomagnification potential in aquatic and terrestrial organisms (U.S. EPA, 2025r). ^d EPA has robust confidence in the quality, consistency, strength and precision, and relevance of the studies used in determining the acute aquatic, chronic vertebrate, chronic invertebrate, and algal hazard thresholds (U.S. EPA, 2025p).			

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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 PESS identified by EPA as relevant to this risk evaluation, under the COUs.

EPA is preliminarily determining that BBP presents unreasonable risk of injury to human health and the environment based on (1) identified significant contributions to unreasonable risk to workers, via dermal exposure, from 16 COUs out of the 27 total occupational COUs (see Table 6-1 for PPE considerations); and (2) identified significant contributions to unreasonable risk to the environment from 4 COUs out of the 38 total COUs. Two of these COUs have significant contributions to unreasonable risk for both human health and the environment. The preliminary unreasonable risk determination is driven by risk identified for 18 out of 38 total COUs for BBP. EPA preliminarily did not identify unreasonable risk to consumers or the general population.

Table 4-14 and Table 6-1 show when dermal protection is used, the high-end and central tendency MOEs for all the occupational COUs are increased to above benchmark for dermal exposures (see Section 4.3.2.2 for additional information). EPA does not currently have reasonably available information regarding use of PPE or handwashing practices under the COUs, and therefore, this draft unreasonable risk determination does not reflect use of PPE. The individual chemical analysis for BBP did not identify contributions to unreasonable risk for consumers for the 11 consumer COUs assessed. Of the 38 total COUs, after refinements including consideration of wastewater treatment, 4 COUs have significant contributions to unreasonable risk to aquatic vertebrates due to chronic exposure, and of those 4 COUs, 2 COUs additionally have significant contributions to unreasonable risk to algae due to acute (4-day) exposure based on releases of BBP to surface water (see Table 6-2). This preliminary unreasonable risk determination is based on the information in previous sections of this risk evaluation, the appendices, and technical support documents of this risk evaluation in accordance with TSCA section 6(b). This preliminary 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)).

As noted in the Executive Summary, BBP is primarily used as a plasticizer in polyvinyl chloride (PVC) in consumer, commercial, and industrial applications—although it is also used in adhesives, sealants, paints, coatings, rubbers, and non-PVC plastics, as well as for other applications.

EPA notes that human or environmental exposure to BBP through non-TSCA uses (*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 by the Agency because these uses are explicitly excluded from TSCA's definition of chemical substance. Thus, it is not appropriate to extrapolate from this preliminary risk determination to form conclusions about uses of BBP that are not subject to TSCA and that EPA did not evaluate.

Additionally, where relevant, the Agency conducted analyses on aggregate exposures and cumulative risk. Aggregate exposure analyses consider effects on populations that are exposed to BBP via multiple routes (*e.g.*, dermal contact, ingestion, and inhalation). Cumulative risk refers to human health risks related to exposures to multiple chemicals. EPA included BBP in its draft cumulative risk analysis TSD along with five other toxicologically similar phthalate chemicals (*i.e.*, DEHP, DINP, DIBP, DBP, and DCHP) that are also being evaluated under TSCA ([U.S. EPA, 2025ad](#)). Based on the revised draft CRA TSD ([U.S. EPA, 2025ad](#)), the Agency has considered the draft cumulative risk (*i.e.*, human health risks related to exposures to multiple phthalates) and the NHANES biomonitoring data in this preliminary

BBP unreasonable risk determination. The Agency concluded that the draft cumulative risk analysis reflects decreased MOEs for all COUs compared to the individual chemical analysis for BBP because the index chemical's POD is approximately 5.7-fold lower (*i.e.*, more sensitive) than the individual BBP POD. In addition, scaling the exposure by the relative potency factor (RPF) decreases exposure by 48 percent when expressed in terms of index chemical (*i.e.*, DBP) equivalents, which overall leads to MOEs that are approximately 3.2 to 3.5 times more sensitive than in the individual BBP analysis. However, the addition of the NHANES data alone did not lead to COUs significantly contributing to the unreasonable risk. Additional information on the cumulative risk considerations is provided in Section 4.4.

EPA has preliminarily determined that the following two COUs significantly contribute to unreasonable risk to human health *and* to the environment. Note, these two COUs do not appear in the lists below for COUs that significantly contribute to the unreasonable risk for human health only and for COUs that significantly contribute to the unreasonable risk to the environment only:

- Manufacturing – domestic manufacturing (dermal exposure for workers, and aquatic vertebrates and algae through surface water); and
- Processing – incorporation into formulation, mixture, or reaction product – plasticizers (custom compounding of purchased resin; plastic material and resin manufacturing; rubber manufacturing; adhesive manufacturing; paints and coatings manufacturing; ink, toner, and colorant manufacturing) (dermal exposure for workers, and aquatic vertebrates and algae through surface water)

EPA has preliminarily determined that the following 14 COUs significantly contribute to unreasonable risk to *human health only*:

- Manufacturing – importing (dermal exposure for workers);
- Processing – incorporation into formulation, mixture, or reaction product – laboratory chemical manufacturing (dermal exposure for workers);
- Processing – repackaging (dermal exposure for workers);
- Industrial use – construction, paint, electrical, and metal products – paints and coatings (dermal exposure for workers and ONUs);
- Industrial use – construction, paint, electrical, and metal products – adhesives and sealants (dermal exposure for workers);
- Industrial use – packaging, paper, plastic, toys, hobby products – ink, toner, and colorant products (dermal exposure for workers and ONUs);
- Industrial use – other uses – hydraulic fluid (dermal exposure for workers);
- Industrial use – other uses – castings (dermal exposure for workers);
- Industrial use – other uses – automotive products, fluids (dermal exposure for workers);
- Commercial use – construction, paint, electrical, and metal products – paints and coatings; (dermal exposure for workers and ONUs);
- Commercial use – construction, paint, electrical, and metal products – adhesives and sealants (dermal exposure for workers);
- Commercial use – packaging, paper, plastic, toys, hobby products – ink, toner, and colorant products (dermal exposure for workers and ONUs);
- Commercial use – other uses – castings (dermal exposure for workers); and
- Commercial use – other uses – automotive products, other than fluids (dermal exposure for workers).

EPA has preliminarily determined that the following two COUs significantly contribute to unreasonable risk to *the environment only*:

- Processing – incorporation into articles – plasticizers (adhesive manufacturing; fabric, textile, apparel, and leather products manufacturing; building and construction materials manufacturing; plastics product manufacturing; rubber product manufacturing; transportation equipment manufacturing) (aquatic vertebrates through surface water); and
- Disposal (aquatic vertebrates through surface water).

EPA did not preliminarily identify contributions to unreasonable risk of injury to human health or the environment from the following 20 COUs:

- Processing – recycling;
- Distribution in commerce;
- Industrial use – other uses – automotive articles;
- Commercial use – furnishing, cleaning, treatment/care products – flooring coverings; construction and building materials covering large surface areas including stone, plaster, cement, glass and ceramic articles; fabrics, textiles, and apparel;
- Commercial use – furnishing, cleaning, treatment/care products – fabric, textile, and leather products;
- Commercial use – packaging, paper, plastic, hobby products – packaging (excluding food packaging) and other articles with routine direct contact during normal use, rubber articles; plastic articles (hard); plastic articles (soft);
- Commercial use – packaging, paper, plastic, hobby products – toys, playground, and sporting equipment;
- Commercial use – other uses – laboratory chemicals;
- Commercial use – other uses – automotive articles;
- Consumer use – construction, paint, electrical, and metal products – paints and coatings;
- Consumer use – construction, paint, electrical, and metal products – adhesives and sealants;
- Consumer use – furnishing, cleaning, treatment/care products – fabric, textile, and leather products;
- Consumer use – furnishing, cleaning, treatment/care products – floor coverings; construction and building materials covering large surface areas including stone, plaster, cement, glass and ceramic articles; fabrics, textiles, and apparel;
- Consumer use – packaging, paper, plastic, hobby products – arts, crafts, and hobby materials;
- Consumer use – packaging, paper, plastic, hobby products – toys, playground, and sporting equipment;
- Consumer use – packaging, paper, plastic, hobby products – ink, toner, and colorant products;
- Consumer use – packaging, paper, plastic, hobby products – packaging (excluding food packaging) and other articles with routine direct contact during normal use, rubber articles; plastic articles (hard); plastic articles (soft);
- Consumer use – other uses – automotive products, fluids;
- Consumer use – other uses – automotive articles; and
- Consumer use – other use – novelty articles.

For some COUs, the Agency has limited reasonably available information to derive risk estimates, such as MOEs or 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-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 are a best estimate of 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 considers 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 considers, 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 represented the COU. Additionally, in this draft risk evaluation, 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, EPA’s confidence in risk is indeterminate for those receptors.

This draft risk evaluation discusses important assumptions and key sources of uncertainty in the risk characterization, and 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 3.2.2 and 3.2.3), environmental concentrations (Section 3.3.1), environmental exposures and hazards (Section 5.3.4), and human health exposures and hazards (Sections 4.1.1.5, 4.1.2.4, and 4.1.3.3). It also includes overall confidence and remaining uncertainties sections for human health (Section 4.3.2.1, 4.3.3.1, and 4.3.4.1) and environmental risk characterizations (Section 5.3.6). In general, EPA makes an unreasonable risk determination 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.

6.1 Human Health

Calculated non-cancer risk estimates (MOEs⁶) can provide a risk profile of BBP 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.*, test order information, site visits) regarding the use of respiratory protection or other PPE.⁷ This allows the Agency to make unreasonable risk determinations based on the

⁶ EPA derives non-cancer MOEs by dividing the non-cancer POD (HEC [mg/m³] or HED [mg/kg-day]) by the exposure estimate (mg/m³ or mg/kg-day). Section 4.2 has additional information on the risk assessment approach for human health.

⁷ It should be noted that, 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.

available information regarding workers. In addition, the risk estimates may be based on exposure scenarios with monitoring data that reflect existing industry or sector best practices. In this risk evaluation, some of the risk estimates calculated do not reflect use of PPE; however, Section 4.3.2.1 and Table 4-15 provides more information on PPE, including risk estimates calculated with PPE, that could be used to reduce the exposures so that the risk estimates are above the benchmark MOE. Because EPA does not currently have information regarding use of PPE under the COUs, the preliminary unreasonable risk determination is based on the risk estimates that do not reflect use of PPE. Any additional information received in public comment further describing current PPE practices would be considered in the final risk evaluation.

To characterize risk from non-cancer endpoints, the estimated MOEs are compared to their respective benchmark MOE. The benchmark MOE accounts for the total uncertainty in a POD. The benchmark MOE is the total of several individual uncertainty factors relevant to a given POD with values usually of 1, 3 or 10. For BBP, two uncertainty factors were used to derive a benchmark MOE: (1) UF_A of $3\times$ for the uncertainty in extrapolating animal data to humans (*i.e.*, interspecies variability); and (2) UF_H of $10\times$ for the variation in sensitivity among the members of the human population (*i.e.*, intrahuman/intraspecies variability). Therefore, the benchmark MOE for BBP is $30\times$ based on effects on the developing male reproductive system, consistent with a disruption of androgen action and phthalate syndrome—specifically the decrease in anogenital distance (AGD)—and was used to characterize risk from exposure to BBP for acute, intermediate, and chronic exposure scenarios. A lower benchmark MOE (*e.g.*, 30) indicates greater certainty in the data (because the total uncertainty factor [UF] for the relevant POD is low). A higher benchmark MOE (*e.g.*, 100) would indicate more extrapolation uncertainty for specific hazard endpoints and scenarios. Additional information regarding the non-cancer hazard identification and the benchmark MOE is in Section 4.2.2 of this draft risk evaluation. An MOE that is less than the benchmark MOE is a starting point for informing a determination of unreasonable risk of injury to health, based on non-cancer effects. It is important to emphasize that these calculated risk estimates alone are not “bright-line” indicators of unreasonable risk.

6.1.1 Populations and Exposures EPA Assessed for Human Health

EPA has evaluated risk to workers (16+ years old), including ONUs and females of reproductive age directly working with BBP; consumers and bystanders (adults and children); and the general population (including fenceline communities), using reasonably available monitoring and modeling data for inhalation, dermal, and ingestion exposures, as applicable. EPA has evaluated risk from inhalation and dermal exposure of BBP to workers. The Agency assessed the exposure of two occupational exposure groups, which are workers and occupational non-users (ONUs). Workers work in close proximity to BBP and may handle BBP while ONUs do not directly handle BBP but may be indirectly exposed to it as part of their employment. The Agency also has evaluated risk from inhalation, dermal, and ingestion exposures to consumers. For the general population, EPA has evaluated risk from the following: (1) ingestion exposure via drinking water, incidental surface water ingestion, fish ingestion (including subsistence and tribal fishers), and soil ingestion by children; (2) dermal exposure to surface water during swimming; (3) acute and chronic inhalation exposure; and (4) exposures measured through urinary biomonitoring (*i.e.*, NHANES data). EPA concluded it is not necessary to separately model risks to infants consuming the human milk of exposed individuals because the POD used in the assessment are based on fetal and infant effects following maternal exposure during the most sensitive periods of development. The Agency therefore has confidence that the risk estimates calculated based on maternal exposures are protective of a nursing infant’s greater susceptibility during this unique lifestage whether due to sensitivity or greater exposure per body weight. Descriptions of the data used for human health exposure and human health hazards are provided in Sections 4.1 and 4.2. Uncertainties for overall

exposures are presented in the respective occupational, consumer, and general population exposure sections of this draft risk evaluation and are considered in the unreasonable risk determination.

6.1.2 Summary of Human Health Effects

EPA has preliminarily determined that BBP presents unreasonable risk to human health because of non-cancer effects in the following populations:

- workers including female workers of reproductive age from acute, intermediate, and chronic dermal exposures; and
- ONUs from acute, intermediate, and chronic dermal exposures.

With respect to the health endpoint upon which EPA has based this unreasonable risk determination, the significant decrease in AGD is indicative of disruption of androgen action and phthalate syndrome-related outcomes, which is characterized as adverse effects on the developing male reproductive system. Risk estimates based on the selected POD are relevant for females of reproductive age and males at any lifestage. Females of reproductive age are relevant due to the possibility of exposure during critical windows of development, leading to effects in the developing male fetus. Additionally, epidemiological evidence provides support for an association of BBP exposure adversely affecting the developing male reproductive system consistent with phthalate syndrome in males of any age. EPA identified four prenatal oral exposure studies in rodents that supported the developing male reproductive system as the most sensitive and robust non-cancer hazard endpoint. The studies have data quality ratings from medium to high. A NOAEL/LOAEL approach was used to establish the POD based on decreased AGD measurements as the most sensitive endpoint from one multi-generation study, amongst a cluster of anti-androgenic outcomes in additional studies (e.g., slight testicular histopathological effects and decreased fetal testicular testosterone production). BBP exposure at higher concentrations than the selected POD can cause other health effects in females as well (e.g., liver and kidney toxicity) (see *Draft Non-Cancer Human Health Hazard Assessment for Butyl Benzyl Phthalate (BBP)* ([U.S. EPA, 2025v](#))). Therefore, EPA considers the proposed POD to be relevant across sex, lifestage, and durations to calculate risk estimates for the human health individual BBP risk assessment.

With respect to carcinogenicity, overall, the Agency considers there to be evidence to support the conclusion that chronic oral exposure to BBP causes pancreatic tumors in rats. Under the *Guidelines for Carcinogen Risk Assessment* ([U.S. EPA, 2005](#)), EPA reviewed the weight of scientific evidence for the carcinogenicity of BBP and has preliminarily determined that there is *Suggestive Evidence of Carcinogenic Potential* of BBP in rodents. According to the Guidelines ([U.S. EPA, 2005](#)), when there is *Suggestive Evidence*, “the Agency generally would not attempt a dose-response assessment, as the nature of the data generally would not support one.” Consistently, EPA is not conducting a dose-response assessment for BBP or evaluating BBP for carcinogenic risk to humans.

The Agency has robust overall confidence in the proposed developmental toxicity POD. The confidence was based on the consideration of all reasonably available information on the potential human health hazards of BBP and the weight of scientific evidence supporting the BBP non-cancer hazard endpoint. The descriptions of the data used to determine the non-cancer human health effects POD from BBP are explained in Section 4.3.5, along with information about EPA’s confidence in the proposed health hazard of BBP. Additional information about the Agency’s confidence in the health hazard of BBP is provided in Section 4.2.

The health risk estimates for consumers and bystanders and the general population are presented and characterized in Section 4.3. Health risk estimates for workers, including ONUs, are presented in Table 4-16 and are characterized in Section 4.3. Again, the benchmarks are not “bright-lines,” and EPA has

discretion to consider other risk-related factors when concluding whether a COU may significantly contribute to unreasonable risk of the chemical substance.

6.1.3 Basis for Unreasonable Risk to Human Health

In developing the exposure and hazard assessments for BBP, EPA has 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 BBP. For the BBP draft risk evaluation, EPA has accounted for the following PESS: females of reproductive age, pregnant women, infants, children and adolescents, people who frequently use consumer products and/or articles containing high concentrations of BBP, people exposed to BBP in the workplace, and Tribes whose diets include large amounts of fish. Section 4.3.5 summarizes how PESS were incorporated into the risk evaluation through consideration of potentially increased exposures and/or potentially increased biological susceptibility and summarizes additional sources of uncertainty related to consideration of PESS.

Because EPA was able to calculate risk estimates for PESS groups in this assessment (*e.g.*, female workers of reproductive age, and infants and children), the Agency did not always use risk estimates based on high-end exposure levels as the basis of the unreasonable risk determination for BBP. Additionally, EPA considered whether high-end risk estimates represented sentinel exposure levels accurately. As explained in the human health risk characterization, for most occupational COUs, central-tendency risk estimates were used to preliminarily determine unreasonable risk. Similarly, for consumer uses, high intensity risk estimates were used to preliminarily determine unreasonable risk except for the consumer use of synthetic leather furniture and clothing due to uncertainties explained in the *Draft Consumer and Indoor Exposure Assessment for Butyl Benzyl Phthalate (BBP)* ([U.S. EPA, 2025d](#)). The UF of 10 for human variability that EPA has applied to MOEs accounts for increased susceptibility of populations. The non-cancer POD for BBP selected by EPA is based on the most sensitive developmental effect (*i.e.*, decreased AGD) and is expected to be protective of susceptible populations. More information on how EPA characterized sentinel and aggregate risks is provided in Section 4.1.5, and more information on how PESS risks were characterized is provided in Section 4.3.5.

Additionally, EPA did not consider aggregate exposure scenarios across COUs because the Agency did not find any evidence to support such an aggregate analysis (*e.g.*, 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). Although the Agency aggregated exposures across routes for workers, ONUs, and consumers for COUs with quantitative risk estimates, EPA did not consider aggregate exposure for the general population. As described in Section 4.1.3, the Agency employed a risk screening approach for the general population exposure assessment. More information on how EPA characterized sentinel and aggregate risks is provided in Section 4.1.5.

In addition to the analysis done for BBP alone (referred to as “individual BBP analysis”), EPA applied both the methods and principles of CRA—*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, 2023g](#)) as well as the *Revised Draft 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, 2025ad](#))—to derive non-cancer risk estimates for occupational and consumer exposures. EPA’s draft CRA includes cumulative exposure to other toxicologically similar phthalates being evaluated under TSCA (*i.e.*, DEHP, DBP, DCHP, DIBP, and DINP) and uses an “relative potency factor (RPF) analysis” to characterize risk. To

derive RPFs for DEHP, DBP, BBP, DIBP, DCHP, and DINP, reduced fetal testicular testosterone was chosen as the common toxicological endpoint for meta-analysis and benchmark dose (BMD) modeling because of its association with the mechanism of action underlying phthalate syndrome and the availability of dose response data. An index chemical was chosen as a point of reference for standardizing the common toxicity of the other chemicals being evaluated as part of the cumulative chemical group. EPA derived an RPF for BBP of 0.52 based on the ratio of the potency of the individual component to that of the index chemical. This means that BBP exposures, when multiplied by the RPF and expressed in terms of index chemical (*i.e.*, DBP) equivalents, decreased by 48 percent.

DBP was preliminarily selected as the index chemical because of the quality and quantity of its toxicological database that characterizes the fetal testicular testosterone endpoint. The index chemical (*i.e.*, DBP) POD is approximately 5.7-fold lower (*i.e.*, more sensitive) than the individual BBP POD, which contributes to the lower RPF analysis MOEs as compared with the individual non-scaled BBP risk estimates. Non-cancer risk associated with exposure to an individual phthalate or a mixture can then be assessed by calculating an MOE, which is then compared with the benchmark MOE. Because the draft RPFs are based on reduced fetal testicular testosterone, EPA considers the draft RPFs most directly applicable to pregnant women, females of reproductive age, and male infants. EPA has robust confidence in the POD and the draft factors used in the RPF analysis. The robust confidence in the POD for the index chemical is based on the high-quality toxicological database for DBP, confidence that the chosen endpoint is consistent with DEHP, DBP, BBP, DIBP, DCHP, or DINP exposure to induce effects on the developing male reproductive system, and the meta-analysis and benchmark dose modeling approach. See Section 4.4.1 for additional information.

The revised draft CRA TSD also includes the addition of cumulative exposure to DEHP, DBP, BBP, DIBP, and DINP as estimated from NHANES urinary biomonitoring data using reverse dosimetry ([U.S. EPA, 2025ad](#)). (Note that DCHP was not included as part of this exposure assessment, because DCHP was excluded from NHANES after the 2009/10 cycle due to low and infrequent detection in human urine.) The NHANES exposure is non-attributable—meaning it cannot be attributed to specific TSCA COUs or other sources that may result in high-dose exposure scenarios (*e.g.*, occupational exposures to workers), but likely includes exposures attributable to both TSCA COUs and other non-TSCA sources (*e.g.*, diet, food packaging, cosmetics). EPA has determined that there is little additional risk by adding the non-attributable cumulative exposure from NHANES to the single chemical risk estimates for BBP; that is, cumulative exposure adds 1.4 to 15.5 percent to the risk cup, depending upon the population under consideration. Furthermore, NHANES data alone did not lead to a COU significantly contributing to the unreasonable risk of injury to human health.

As previously described above, the cumulative risk analysis presented in Section 4.4 of the draft risk evaluation has two components to the calculation of cumulative risk estimates. The first step is scaling the exposure of the chemical by the RPF to express it in index chemical equivalents, and the calculation of the MOE using the POD of the index chemical (*i.e.*, RPF risk analysis). After this step, the risk due to non-attributable cumulative phthalate exposure is determined through the addition of the NHANES biomonitoring data to the RPF MOEs (*i.e.*, cumulative risk analysis).

The draft RPFs and the selection of DBP as the index chemical will be peer reviewed by the Science Advisory Committee on Chemicals (SACC) in August 2025. Following peer review and public comment, EPA will take into consideration SACC's recommendations for the final BBP risk evaluation.

6.1.4 Workers

Based on the occupational risk estimates and related risk factors, EPA is preliminarily determining that BBP presents unreasonable risk due to:

- non-cancer risks from acute, intermediate, and chronic dermal exposure to workers, including female workers of reproductive age; and
- non-cancer risks from acute, intermediate, and chronic dermal exposure to ONUs for four COUs, (1) Industrial use – construction, paint, electrical, and metal products – paints and coatings, (2) Industrial use – packaging, paper, plastic, hobby products – ink, toner, and colorant products, (3) Commercial use – construction, paint, electrical, and metal products – paints and coatings, and (4) Commercial use – packaging, paper, plastic, hobby products – ink, toner, and colorant products.

EPA is preliminarily determining that 16 COUs significantly contribute to unreasonable risk of injury to human health for workers, including 4 COUs due to dermal exposure for ONUs.

The risk estimates calculated for workers and ONUs in the individual BBP analysis were used as the basis for preliminarily determining if a COU presents unreasonable risk to human health. ONUs are defined as male and female adolescents and adults (16+ years old) indirectly exposed to BBP within the same area as workers. Dermal exposure for ONUs was assessed where contact with BBP-containing mist or dust on surfaces was expected under 17 COUs. Because EPA was not able to estimate ONU inhalation exposure from monitoring data or models, it was assumed to be equivalent to the central tendency experienced by workers for the corresponding OES.

For all COUs, EPA considered the central tendency risk estimates for inhalation and dermal exposures of all durations, due to uncertainties associated with each OES mapped to occupational COUs, such as limited inhalation data points, the composition of workplace dust, and the representativeness of the skin permeability data in the dermal exposure estimate, as described in Section 4.3.2.

As mentioned above, four COUs significantly contribute to the unreasonable risk of injury to human health for ONUs. The Application of paints and coatings OES was mapped to four COUs—(1) Industrial use – construction, paint, electrical, and metal products – paints and coatings, (2) Industrial use – packaging, paper, plastic, hobby products – ink, toner, and colorant products, (3) Commercial use – construction, paint, electrical, and metal products – paints and coatings, and (4) Commercial use – packaging, paper, plastic, hobby products – ink, toner, and colorant products—which resulted in MOEs below the benchmark for acute, intermediate, and chronic dermal exposures (MOEs between 7–10 depending on duration; see Table 6-1). For these four COUs, ONUs would include supervisors, managers, and other employees that do not directly handle paint or coating equipment but may be present in the application area. It was assumed that ONUs are potentially exposed to BBP through the inhalation of mist and dermal contact with surfaces where mist has been deposited. Dermal exposures to ONUs are represented by incidental skin contact equal to the surface area of only a single hand (or 1 side of 2 hands) and used half the mean values for two-hand surface areas (*i.e.*, 535 cm²). See the *Draft Environmental Release and Occupational Exposure Assessment for Butyl Benzyl Phthalate* for more details ([U.S. EPA, 2025t](#)).

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. The Agency did not identify relevant chemical-specific inhalation exposure monitoring data for all OESs. In the absence of inhalation monitoring data, EPA used inhalation exposure models to estimate central tendency and high-end exposures. For inhalation exposure to dust in occupational settings, the Agency used the data and

approaches from the PNOR Model ([U.S. EPA, 2021b](#)). 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 BBP in workplace dust is the same as the maximum concentration of imported BBP. However, it is likely that the concentration of BBP in workplace dust is less than the concentration of BBP in the imported product.

In all cases of occupational dermal exposure to BBP, EPA used flux-limited dermal absorption values derived from literature sources ([DuPont, 2006a, b](#)) to estimate high-end and central tendency dermal exposures for workers in each OES to assess COUs. The flux-limited approach for solid and liquid likely results in overestimations due to the assumption about excess BBP in contact with skin. Both methods are described in the *Draft Environmental Release and Occupational Exposure Assessment for Butyl Benzyl Phthalate (BBP)* ([U.S. EPA, 2025t](#)). The value of absorptive flux for liquid (*i.e.*, 3.23×10^{-2} mg/cm²/h) was taken from Dupont *et al.* ([2006b](#)) of BBP applied to *in vitro* human skin. The concentration of the chemical and co-formulants may influence absorption rates for liquids, which adds additional uncertainty to these dermal risk estimates. The value of absorptive flux for solids (*i.e.*, 1.113×10^{-4} mg/cm²/h) was taken from Dupont *et al.* ([2006a](#)) of BBP in a film applied to *in vitro* human skin. EPA determined that all data were of acceptable quality without notable deficiencies and integrated all the data into the final exposure assessment. A more detailed description of the strengths and uncertainties in the dermal exposure estimates for workers is provided in Section 4.1.1.4 and Table 4-4.

For occupational dermal exposure assessment, EPA assumed a standard 8-hour workday. Because BBP has low volatility and relatively low absorption, it is possible that the chemical remains on the surface of the skin after dermal contact until the skin is washed. Thus, in absence of exposure duration data, EPA has assumed that absorption of BBP from occupational dermal contact with materials containing BBP may extend up to 8 hours per day ([CEB, 1991](#)). However, if a worker uses proper PPE or washes their hands after contact with BBP or BBP-containing materials, dermal exposure will be reduced. Therefore, the assumption of an 8-hour exposure duration for BBP may lead to overestimation of dermal exposure. Regarding surface area of occupational dermal exposure, the Agency assumed a high-end value of 1,070 cm² for male workers and 890 cm² for female workers. These high-end occupational dermal exposure surface area values are based on the mean two-hand surface area for adults in the *Exposure Factors Handbook* ([U.S. EPA, 2011a](#)). For central tendency estimates, EPA assumed the exposure surface area was equivalent to only a single hand (or 1 side of 2 hands) and used half the mean values for two-hand surface areas (*i.e.*, 535 cm² for male workers and 445 cm² for female workers). These conservative assumptions may lead to overestimation of dermal exposure.

For situations where COUs were evaluated using multiple OESs, EPA considered MOEs from all associated OESs for the purposes of making an unreasonable risk determination (see Table 3-1 and Table 3-2); for example, six OESs—(1) Formulation into adhesives and sealants (liquid); (2) Formulation into adhesives and sealants (solid); (3) Formulation into paints and coatings (liquid); (4) Incorporation into other formulation, mixture, or reaction products (liquid); (5) Non-PVC plastics compounding; and (6) PVC plastics compounding—were used to evaluate the single COU: Processing – incorporation into formulation, mixture, or reaction product – plasticizers (custom compounding of purchased resin; plastic material and resin manufacturing; rubber manufacturing; adhesive manufacturing; paints and coatings manufacturing; ink, toner, and colorant manufacturing). The Incorporation into adhesives and sealants (liquid), Incorporation into paints and coatings (liquid), and Incorporation into other formulations, mixtures, or reaction products (liquid) OESs had MOEs (ranging from 3–6 at the high-end and 7–11 at central tendency) below the benchmark for all populations and durations assessed for high-end and central tendency dermal exposure in the individual BBP analysis.

For these OESs, it was assumed that exposure was only to the liquid form of BBP. The PVC plastics compounding and non-PVC plastics compounding OES had MOEs below benchmark for all populations and durations assessed for high-end and central tendency dermal exposure in the individual BBP analysis. For these OESs, it was assumed that workers would be exposed to both liquid BBP, and BBP incorporated into a solid. Dermal exposure to the liquid was the driver of risk with MOEs ranging from 3 to 6 at the high-end and 7 to 11 at central tendency for all populations and durations assessed. The Incorporation into adhesives and sealants (solid) OES assumes that workers are only exposed to solid BBP, and the MOEs were above the benchmark (ranging from 1,008—2,942 at the high-end and 2,015—3,201 at the central tendency in the individual BBP analysis) for all populations and durations assessed.

The dermal absorption data used to estimate worker exposures to liquid BBP within the various OESs had an overall data quality evaluation rating of medium (see Table 4-1) and the confidence in the estimated values themselves were moderate (see Table 4-4). However, EPA has robust confidence that the dermal liquid exposure estimates are realistic exposure scenarios. Therefore, the Agency is preliminarily determining that Processing – incorporation into formulation, mixture, or reaction product – plasticizers (custom compounding of purchased resin; plastic material and resin manufacturing; rubber manufacturing; adhesive manufacturing; paints and coatings manufacturing; ink, toner, and colorant manufacturing) significantly contributes to unreasonable risk of injury to health for workers due to dermal exposure to liquid BBP.

Scaling high-end and central-tendency BBP acute exposure estimates from individual COUs by relative potency factors and adding non-attributable cumulative exposure (estimated from NHANES urinary biomonitoring using reverse dosimetry) resulted in decreased MOEs for acute exposures for females of reproductive age. However, there are only notable differences in the risk estimates from the individual BBP analysis and the RPF analysis for one OES, which represents four COUs (see discussion below). For four COUs, all of which have the same risk estimates—(1) Industrial use – packaging, paper, plastic, hobby products – paints and coatings; (2) Industrial use – packaging, paper, plastic, hobby products – ink, toner, and colorants; (3) Commercial use – packaging, paper, plastic, hobby products – paints and coatings; and (4) Commercial use – packaging, paper, plastic, hobby products – ink, toner, and colorants—the RPF analysis shows additional risk due to acute inhalation exposures to female workers of reproductive age. These same four COUs had risk to workers and ONUs due to acute, intermediate, and chronic dermal exposures in the individual BBP analysis. The risk estimates using the draft RPF analysis for acute inhalation exposure decrease to below the benchmark of 30 for females of reproductive age using the recommended central tendency estimates (MOE = 43 in the individual BBP analysis and MOE = 14 using the RPF analysis). More information and discussion can be found in Section 4.4.4. As indicated previously (see Section 4.4), the approach to the calculation of cumulative risk estimates will be subject to peer review; thus, EPA is not considering the RPF analysis in the unreasonable risk determination at this time. Based on peer review, EPA may consider the RPF analysis differently in the final unreasonable risk determination.

EPA has assessed one occupational COU without deriving risk estimates:

- Distribution in commerce: For the purpose of this draft risk evaluation, distribution in commerce is the transportation of BBP containing products and articles between sites at which BBP manufacturing, processing, and use occurs or the transportation of BBP-containing wastes for recycling or disposal. EPA expects all of the above-mentioned materials to be transported in closed system or otherwise to be transported in a form (*e.g.*, articles containing BBP) such that there is negligible potential for releases except during an incident. Therefore, the Agency did not assess environmental releases of and occupational exposure to BBP as a result of distribution in

commerce (see Table 3-1 for a crosswalk between OESs and COUs). As discussed in Section 4.3.2, exposures from distribution in commerce were not assessed directly, but levels of exposure are expected to be similar to import/repackaging of solids. Consequently, aggregate MOEs associated with distribution in commerce are expected to be above the benchmark MOE of 30. Therefore, distribution in commerce would not result in unreasonable risk.

As described in Section 4.1.1, for the individual BBP analysis, EPA has moderate confidence in the inhalation exposure estimates for females of reproductive age and adult workers and moderate confidence in dermal exposure estimates. The Agency has slight to moderate confidence in the assessed inhalation and dermal exposures for ONUs since it was assumed that ONU exposures are equal to worker central tendency exposures. The designation of slight to moderate confidence suggests that some aspects of the analysis are reasonably adequate but that other aspects are not adequate or sufficiently understood to characterize the exposure. Additional information on EPA's confidence in these risk estimates and the uncertainties associated with them can be found in Section 4.1.1.5. The Agency's overall risk characterization confidence for workers is summarized in Section 4.3.2.1. EPA's overall risk characterization confidence for the individual chemical analysis for workers is summarized in Section 4.3.2.

6.1.5 Consumers

Based on the consumer risk estimates and related risk factors, EPA is preliminarily determining that BBP does not present unreasonable risk of injury to human health for consumers.

Consumer COUs were assessed using high-, medium-, and low-intensity exposure scenarios resulting in only one COU with an MOE equal to 30 in the individual BBP analysis. For the COU, Consumer use – construction, paint, electrical, and metal products – adhesives and sealants COU, the high-intensity exposure scenario in the individual BBP analysis had an MOE of 30 in adults due to acute dermal exposure (see Section 4.3.3 and Table 4-18). In the RPF analysis, acute, high-intensity dermal risk estimates for this COU were below the benchmark of 30 with MOEs between 20 to 22 (young teens) and 10 to 11 (teen and adults) (see Section 4.4.5 and Table 4-22). EPA is preliminarily determining that this COU does not significantly contribute to the unreasonable risk of injury of human health to consumers for reasons described below. Furthermore, in the RPF analysis, when the individual phthalates were scaled by relative potency factor per chemical and expressed in terms of index chemical (DBP) equivalents, two consumer COUs dropped below the benchmark (see Section 4.4.5 and Table 4-23). The COUs are (1) Consumer use – construction, paint, electrical, and metal products – paints and coatings; and (2) Consumer use – other uses – automotive products, fluids. EPA is preliminarily determining that these two COUs do not significantly contribute to the unreasonable risk of injury to consumers for reasons described below.

Exposure via inhalation and ingestion routes were modeled using EPA's Consumer Exposure Model (CEM), Version 3.2 ([U.S. EPA, 2023c](#)). See Section 4.3.3 and the *Draft Consumer and Indoor Dust Exposure Assessment for Butyl Benzyl Phthalate (BBP)* ([U.S. EPA, 2025d](#)) for additional discussion and characterization. The use of the CEM for dermal absorption, which relies on total concentration rather than aqueous saturation concentration, would greatly overestimate exposure to BBP in liquid and solid products and articles. See *Draft Consumer and Indoor Dust Exposure Assessment for Butyl Benzyl Phthalate (BBP)* U.S. EPA ([2025d](#)) for more details. Because of the likelihood of overestimation, dermal modeling was conducted outside of CEM. For dermal exposure, EPA used a dermal flux approach, which was estimated based on BBP *in vitro* dermal absorption in humans. EPA used a screening approach with a range of expected uses input parameters for contact surface area, duration and frequency of contact ranging from conservative to being representative of expected uses. The flux-limited screening dermal absorption approaches for liquid and solid products and articles assumes a

constant rate of absorption of BBP in contact with the skin. Dermal flux values (liquid and solid products) were calculated and applied in the corresponding scenario using Dupont (2006b) for liquid products (3.22×10^{-2} mg/cm²/h) and Dupont (2006a) for solid products (1.113×10^{-4} mg/cm²/h). The flux-limited value for liquids is two orders of magnitude larger than for solids, which is expected because solids have a slower migration from article matrix to skin. The flux-limited screening approach provides a representative upper bound of dermal absorption of BBP (see Section 4.1.2.4 for discussion on limitations, strengths, and confidence of this approach).

EPA reviewed the parameters for the exposure scenarios analyzed under each COU and preliminarily determined risk based on the most representative intensity assessed and risk estimates from the individual BBP and RPF risk analyses. The high intensity was chosen for six COUs, even after considering the conservative assumptions used in the dermal assessment. However, for Consumer use – furnishing, cleaning, treatment/care products – fabric, textile, and leather products; furniture and furnishings, the high-intensity use scenario risk estimates were not considered due to the high uncertainty in the dermal risk estimates as explained in the *Draft Consumer and Indoor Exposure Assessment for Butyl Benzyl Phthalate (BBP)* (U.S. EPA, 2025d). For the remaining four COUs, the medium-intensity exposure scenario risk estimates were considered more representative of typical use patterns for reasons further described below. For those four COUs, some risk was indicated for one or more exposure scenarios, but EPA preliminarily determined that these four consumer COUs do not significantly contribute to the unreasonable risk.

EPA has preliminarily determined that the COU Consumer use – construction, paint, electrical, and metal products – paints and coatings, does not contribute to the unreasonable risk based on acute dermal exposure for teenagers and adults in the RPF analysis. The COU, Consumer use – construction, paint, electrical, and metal products – paints and coatings, was assessed using three exposure scenarios: (1) sealing and refinishing sprays (indoor use); (2) sealing and refinishing sprays (outdoor use); and (3) touch up auto paint. For two of the three exposure scenarios, there were dermal risk estimates at the acute high-intensity in the RPF analysis that were below the benchmark. Of these three scenarios, touch up auto paint was not quantitatively assessed because appropriate use of the product avoids dermal contact and due to the small amount used per event, inhalation and ingestion exposures are expected to be smaller than the other scenarios assessed in this COU. In the RPF analysis, consumer, acute high- and medium-intensity dermal risk estimates were below the benchmark of 30 with MOEs of 13 (teens and adults) for high-intensity use scenarios, and 25 (adults) to 27 (teens) for the medium-intensity use scenario. Comparatively, acute high-intensity dermal risk estimates for sealing and refinishing spray (indoor use) ranged from 37 to 40 for teens and adults in the individual BBP analysis for both scenarios. An overall moderate confidence in dermal assessment of paints and coatings was assigned. Uncertainties about the effect formulations have in overall absorption increase uncertainty. See Table 4-17 and Table 4-22 for more information on the risk estimates for the individual BBP and RPF analysis, respectively.

EPA identified three BBP-containing sealing and refinishing spray products that were suitable for use in a quantitative assessment, and two of the products were modeled for indoor use. These include a spray paint product used for repairing or renewing surfaces such as bathtubs, sinks and vanities (Multi-Tech Products Corp, 2015). The outdoor product quantitatively assessed is an ultraviolet (UV) and waterproof coating applied to exterior building surfaces; manufacturer suggested uses with potential relevance for home DIY repairs include application under roofing materials and structural facades. For both sealing and refinishing spray use scenarios, the duration of skin contact used were 480, 240, and 120 minutes for the high-, medium-, and low-intensity exposure scenarios. The contact area for the exposure scenarios corresponded to 10 percent of the hands (some fingers). A screening level assessment for consumers considers high-intensity exposure scenarios risk estimates and relies on conservative assumptions to

assess exposures that would be expected to be on the high-end of the expected exposure distribution. It is possible that the duration of skin contact is overestimated in the high-intensity scenario, but the dermal risk estimates for consumers are still below benchmark in the medium-intensity exposure scenario. Due to the type of paint and coatings identified by EPA for both use scenarios and the assumptions about exposure contact area, duration, and days used (*i.e.*, 1 day for acute exposure), the medium-intensity dermal exposure scenarios for sealing and refinishing sprays are reasonably expected to occur.

As discussed in Section 4.4.5, RPFs used to scale for relative potency were calculated based on a common hazard endpoint—reduced fetal testicular testosterone—from data from multiple studies evaluating effects of phthalates on fetal testicular testosterone using a meta-analysis and BMD modeling approach for each of the six phthalates included in the CRA (see ([U.S. EPA, 2025ad](#)) for further details). Although this analysis provides a robust basis for assessing the dose-response for reduced fetal testicular testosterone across the six phthalates and overall, EPA has robust confidence in the draft RPFs used in this CRA (Section 4.4.1), there is some uncertainty associated with the applicability of the BBP RPF at low response levels (*i.e.*, 5 and 10% decreases in fetal testicular testosterone). This is because RPFs could not be estimated for BBP at the 5 or 10 percent response levels due to lack of data at the low-end range of the dose-response curve. Furthermore, the differences in hazard values or PODs are the primary factor leading to differences in MOEs between the individual BBP assessment and the RPF analysis. The ratio of the BBP POD (HED of 12 mg/kg-day, based on NOAEL) used in the individual BBP assessment and the index chemical (DBP) POD (HED of 2.1 mg/kg-day, based on a BMDL₅) is approximately 5.7—indicating that the index chemical is 5.7 times more potent than BBP while the RPF for BBP of 0.52 indicates DBP is approximately 2 times more potent than BBP. As discussed previously in Sections 4.2 and 4.4.1 (and in more detail in ([U.S. EPA, 2025v](#), [2025ad](#))), there are strengths and uncertainties associated with the RPF and PODs used for both analyses. As indicated before, the approach to the RPF and cumulative analyses will be subject to peer review; thus, EPA is not considering the RPF analysis in the unreasonable risk determination at this time. Based on peer review, the Agency may consider the RPF analysis differently in the final unreasonable risk determination.

EPA has preliminarily determined that the COU, Consumer use – construction, paint, electrical, and metal products – adhesives and sealants, does not contribute to the unreasonable risk. Three different exposure scenarios were assessed under the COU, Consumer use – Construction, paint, electrical, and metal products – adhesives and sealants: (1) adhesives for small projects; (2) caulking products; and (3) patching and repair products for exterior surfaces. In two of the three exposure scenarios, there were dermal risk estimates at the acute high-intensity in the RPF analysis that were below the benchmark. However, as further described below, the medium-intensity exposure scenario dermal risk estimates are more reflective of a typical use pattern while the high-intensity exposure scenario relies on conservative assumptions to assess exposures that would be expected to be on the high-end of the expected exposure distribution. In both the individual BBP and RPF analyses, consumer dermal risk estimates were above the benchmark for all lifestages assessed in the exposure scenarios for BBP-containing adhesives for small projects. In the RPF analysis, acute high-intensity dermal risk estimates were below the benchmark of 30 with MOEs between 20 to 22 (young teens) and 10 to 11 (teen and adults) for caulking products and patching and repair products for exterior surface, respectively. Comparatively, in the individual BBP analysis acute high-intensity dermal risk estimates for patching and repair products for exterior surface ranged from 30 to 32 and the high-intensity risk estimates for caulking product for young teens, teens, and adults ranged from 59 to 64. An overall moderate confidence in dermal assessment of adhesives was assigned. Uncertainties about the effect formulations have in overall absorption increase uncertainty. See Table 4-18 and Table 4-23 for more information on the risk estimates for the individual BBP and RPF analyses, respectively.

For caulking products, the products are expected to be used in smaller scale projects, and duration of skin contact were modeled at use durations of 60, 30, and 15 minutes for the high-, medium-, and low-intensity scenarios. EPA identified five products used for various indoor or outdoor repair and sealing applications, including for perimeter caulking (doors, windows), expansion and control joints, kitchen and bath, as well as five products used for various patching and repairs of exterior surfaces, including for concrete, mortar, blacktop, stucco, and roofing. For patching and repair products for exterior surfaces, the duration of skin contact used were 120, 60, and 30 minutes for the high-, medium-, and low-intensity use scenarios. The contact area for the acute high-intensity and medium-intensity exposure scenarios corresponded to the inside of two hands including palms and fingers for both adhesive exposure scenarios. Due to the type of adhesives identified in scenarios and the assumptions about the combination of duration of skin contact and contact surface area, the acute high-intensity dermal exposure scenarios for caulking products and patching and repair products for exterior surface are not reasonably expected to occur and the medium intensity is more reflective of a typical use. Medium intensity dermal risk estimates for patching and repair products for exterior surfaces for teenagers and adults were 130 and 120, respectively, in the individual BBP analysis. In the RPF analysis, the dermal risk estimates were 43 and 40 for teenagers and adults, respectively. In the RPF analysis, the medium intensity dermal risk estimates for caulking products were 79, 86, and 81 in young teens, teenagers, and adults.

EPA has preliminarily determined that the Consumer use – other uses – automotive products, fluids COU does not contribute to the unreasonable risk. The COU Consumer use – other uses – automotive products, fluids, was assessed using two exposure scenarios: (1) automotive lubricants; and (2) interior car care. Only the acute dermal risk estimates for the interior car care exposure scenario were below benchmark in the RPF analysis, and there were no MOEs above benchmark for every lifestage and duration assessed for the use of automotive lubricants in either analysis. However, based on the conservative assumptions used in the assessment, the duration used in the high-intensity scenarios likely overestimates potential exposure while the medium-intensity is a more representative scenario of exposure for this COU. The consumer use was assessed for teenagers and adults in both exposure scenarios. The high-intensity dermal risk estimates in the individual BBP analysis for acute consumer exposure to interior car products for teenagers and adults were 85 and 80, respectively. In the RPF analysis, the acute high-intensity dermal risk estimates for acute consumer exposure to interior car products were 29 and 27 for teenagers and adults, respectively. The confidence in the dermal risk estimates is moderate. Per the *Draft Consumer Exposure Analysis for Butyl Benzyl Phthalate (BBP)* ([U.S. EPA, 2025e](#)), one BBP containing interior car care product was identified. The product was modeled at use durations of 45, 30, and 15 minutes for the high-, medium-, and low-intensity exposure scenarios, respectively. Medium-intensity exposure risk estimates for the interior car products were 86 and 81 for teenagers and adults in the RPF analysis.

EPA is preliminary determining that the COU, Consumer Use – furnishing, cleaning, treatment/care products – floor coverings; construction and building materials covering large surface areas including stone, plaster, cement, glass and ceramic articles; fabrics, textiles, and apparel, does not contribute to unreasonable risk. The COU Consumer use – furnishing, cleaning, treatment/care products – floor coverings; construction and building materials covering large surface areas including stone, plaster, cement, glass and ceramic articles; fabrics, textiles, and apparel, was assessed using the vinyl flooring exposure scenario. In this scenario, inhalation and ingestion of BBP-containing settled dust on vinyl flooring, dermal, and aggregate exposure were assessed for all lifestages. In the individual BBP analysis, the aggregate risk estimate for the acute high-intensity exposure scenario was 120 for the infant population (see Table 4-18). The aggregate risk estimate for the acute high-intensity scenario was 33 for infants and 34 for toddlers in the cumulative risk analysis (see Table 4-23). The aggregate MOE

calculation for the cumulative risk analysis is presented in Equation 4-4 and is the reciprocal of the sum of the individual MOEs from the routes of exposure and the MOE for the non-attributable cumulative exposure (*i.e.*, NHANES). The non-attributable cumulative exposure for infants added 15.5 percent to the risk cup with a benchmark MOE of 30. As further described below, the high-intensity exposure scenario relies on conservative assumptions to assess exposures that would be expected to be on the high-end of the expected exposure distribution. The conservative assumptions coupled with the uncertainties in the individual exposure route risk estimates leads to the conclusion that the medium-intensity scenario risk estimates (aggregate MOEs in the cumulative analysis of 82 for infants and 85 for toddlers) are more representative of typical use. Section 4.4 has more information on the calculation of the aggregate MOEs for the cumulative risk analysis.

Inhalation of surface dust is the main contributor to the overall aggregate MOE value in both the RPF and individual BBP analyses for the Consumer use – furnishing, cleaning, treatment/care products – floor coverings; construction and building materials covering large surface areas including stone, plaster, cement, glass and ceramic articles; fabrics, textiles, and apparel COU. However, the inhalation estimates likely represent an upper boundary for exposure and may, in some cases, overestimate the highest possible dose expected. CEM assumes that 100 percent of the chemical that is on the dust or particulate matter will be absorbed when the dust or particulate matter is inhaled or ingested. This is highly unlikely to be the case as bioavailability is generally reduced in inhaled particles as compared to gas phase or aerosol chemicals. The bioavailable fraction of BBP in dust and particulate matter would be difficult to quantify due to the absence of quantitative data in literature. EPA recognizes that the assumption of 100 percent absorption through inhalation of BBP in dust/particulate matter likely overestimates exposure. Furthermore, although not main contributors to the aggregate MOE, there are also uncertainties in the calculation of the dermal and ingestion high-intensity scenario risk estimates for Consumer use – furnishing, cleaning, treatment/care products – floor coverings; construction and building materials covering large surface areas including stone, plaster, cement, glass and ceramic articles; fabrics, textiles, and apparel.

The overall confidence in the aggregated MOE originates from compounding and intensifying the uncertainties from each exposure route. The overestimation in high-intensity exposure routes suggests that the aggregate scenario may not reflect or capture realistic exposures. Therefore, EPA is preliminarily determining that the COU, Consumer Use – furnishing, cleaning, treatment/care products – floor coverings; construction and building materials covering large surface areas including stone, plaster, cement, glass and ceramic articles; fabrics, textiles, and apparel, does not contribute to unreasonable risk. More information on the relative potency factor and non-attributable cumulative exposures considerations are provided in Section 4.4. Further information on the approaches and uncertainties used for the calculation of dermal, inhalation, and ingestion risk estimates are detailed in Section 4.1.2.

EPA's overall confidence in the acute, intermediate, and chronic consumer inhalation, ingestion, and dermal risk estimates ranges from moderate to robust. Overall, EPA has moderate to robust confidence in the cumulative risk estimates calculated for consumer exposure scenarios (Table 4-23). More information on the consumer analysis can be found in Sections 4.1.2, 4.3.3, and 4.4.5 of the risk evaluation.

6.1.6 General Population

Based on the risk estimates, EPA did not identify risk to the general population from the following exposure routes and pathways for BBP:

- exposure via the land pathway (*i.e.*, application of biosolids and landfills);

- incidental ingestion and dermal contact from swimming, and ingestion of drinking water;
- acute and chronic ingestion of drinking water;
- acute and chronic inhalation exposure to ambient air;
- acute and chronic ingestion exposure from fish consumption;
- acute and chronic inhalation exposure to ambient air in proximity to releasing facilities, including fenceline communities; and
- soil ingestion exposure from air deposition to soil.

As stated in Section 4.3.4, EPA evaluated surface water, drinking water, fish ingestion, ambient air, and soil via deposition from ambient air pathways quantitatively for BBP releases associated with COUs (see *Draft Environmental Media, General Population, and Environmental Exposure Butyl Benzyl Phthalate (BBP)* ([U.S. EPA, 2025r](#)) and Section 4.1.3 for additional details about the assessment and assessment process). Land pathways (*i.e.*, landfills and application of biosolids) were assessed qualitatively for releases from facilities and down-the-drain releases of consumer products and landfill disposal of consumer articles (see Section 3.1.4 for details on the qualitative assessment of consumer disposal of BBP-containing products and articles). For pathways assessed quantitatively, EPA used high-end inputs to provide upper bound estimates of BBP concentration in the various environmental media for screening level purposes. EPA also used an MOE approach using upper bound exposure estimates with the human health POD to determine whether an exposure pathway had non-cancer risks risk estimates below the benchmark. Upper bound exposure estimates were defined as those associated with the manufacturing, 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 for a COU and given exposure pathway, then EPA determined that the pathway was not a pathway of concern and it was not further evaluated. If any pathways were identified as pathways of concern for the general population, further exposure assessments for that pathway would be conducted to include higher tiers of modeling if available and 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 of 30, even under very conservative exposure scenarios. Based on the screening level approach described in Section 4.1.3, EPA did not identify risk to the general population from exposure to BBP through biosolids, landfills, surface water, drinking water, fish ingestion, ambient air, and soil via deposition from ambient air.

As discussed in Section 4.1.3, EPA has robust confidence in its qualitative assessment of biosolids and landfills. General population exposure is not expected based on the high-quality biodegradation rates and physical and chemical properties suggesting that BBP 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 the quantitative assessment, despite moderate confidence in the estimated values themselves, confidence in exposure estimates capturing upper bound exposure scenarios that were appropriately conservative. Therefore, EPA has robust confidence that no exposure scenarios will lead to greater doses than presented in this draft risk evaluation.

6.2 Environment

Based on the environmental assessment, EPA is preliminarily determining that BBP presents unreasonable risk of injury to the environment due to acute (4-day) and chronic exposures for aquatic vertebrates and algae from direct discharge to surface water. Of the 38 COUs assessed, EPA expects that environmental releases from the 11 consumer COUs will be negligible and are not expected to exceed hazard to ecological receptors (see Section 5.3.3). For the 27 other COUs, EPA quantitatively assessed

risk to aquatic organisms and used a screening assessment to evaluate risk to terrestrial organisms. The Agency is preliminarily determining that BBP is unlikely to result in risk to soil invertebrates, terrestrial mammals, and terrestrial plants.

Using either monitoring data or generic scenarios to model surface water exposure data, EPA was able to calculate 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 not risk of injury to the environment that would not 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. Additionally, if a chronic RQ is 1 or greater, the Agency evaluates whether the chronic RQ is 1 or greater for 21 days or more for aquatic species based on the exposure period of the hazard toxicity tests before making a determination of unreasonable risk.

As shown in Section 5.3.3, risk to aquatic organisms from surface water exposure was evaluated under 27 COUs. Risk to aquatic organisms was characterized by comparing hazard thresholds (COCs) for aquatic organisms to modeled surface water exposures due to (1) DMR data for OESs mapped to COUs with facility-specific data; (2) modeled data from generic scenarios of water releases for OESs mapped to COUs with water releases, but no facility-specific data; and (3) modeled data from generic scenarios of water releases from OESs mapped to COUs with multimedia releases that did not distinguish among wastewater, incineration, or landfill. These are discussed below.

Based on the DMR data for OESs with facility-specific data, EPA is preliminarily determining that out of the 10 COUs assessed with DMR data, 1 COU (Disposal) significantly contributes to unreasonable risk to the environment due to chronic risk to aquatic vertebrates (RQ = 5.26).

Based on the use of modeled data from generic scenarios of water releases, but no facility-specific data with refinements, EPA is preliminarily determining that out of eight COUs assessed, two COUs—(1) Processing – incorporation into formulation, mixture, or reaction product – plasticizers (custom compounding of purchased resin; plastic material and resin manufacturing; rubber manufacturing; adhesive manufacturing; paints and coatings manufacturing; ink, toner, and colorant manufacturing); and (2) Processing – incorporation into articles – plasticizers (adhesive manufacturing; fabric, textile, apparel, and leather products manufacturing; building and construction materials manufacturing; plastics product manufacturing; rubber product manufacturing; transportation equipment manufacturing)—significantly contribute to unreasonable risk to the environment due to risk to aquatic organisms. For these two COUs, EPA is preliminarily determining that the first (Processing – incorporation into formulation, mixture, or reaction product – plasticizers...) significantly contributes to unreasonable risk to the environment due to chronic risk to aquatic vertebrates (RQ = 31.79) and acute (4-day) risk to algae (RQ = 2.88). The second COU (Processing – incorporation into articles – plasticizers...) significantly contributes to unreasonable risk to the environment due to chronic risk to aquatic vertebrates (RQ = 1.92).

Based on the modeled data from generic scenarios of water releases from OESs with multimedia releases that did not distinguish among wastewater, incineration, or landfill, EPA is preliminarily determining that out of the two COUs assessed, one COU (Manufacturing – domestic manufacturing) significantly contributes to unreasonable risk to the due to chronic risk to aquatic vertebrates (RQ = 24.2) and acute (4-day) risk to algae (RQ = 2.19).

EPA did not calculate RQs for seven COUs but expects surface water exposure for aquatic organisms for those COUs to be negligible and is preliminarily determining they do not significantly contribute to a finding of unreasonable risk to the environment, including distribution in commerce.

6.2.1 Populations and Exposures EPA Assessed for the Environment

EPA evaluated risk for both aquatic and terrestrial receptors. For aquatic organisms, the Agency evaluated exposures via surface water and sediment (including pore water). For the water pathway, BBP in water releases is expected to predominantly partition into sediment. For terrestrial organisms, the Agency has qualitatively evaluated exposures via air deposition to soil, biosolids, and landfills due to high-quality physical and chemical property data suggesting that BBP will have low persistence potential and mobility in soils. Additionally, the Agency has qualitatively evaluated terrestrial organism exposures from trophic transfer of BBP from soil and surface water.

EPA conducted a screening assessment for sediment exposures of BBP to aquatic vertebrates and invertebrates and has preliminarily determined that under all COUs assessed this pathway does not contribute to the unreasonable risk to the environment. Groundwater concentrations resulting from releases to the landfill or to agricultural lands via biosolids applications were not quantified but were discussed qualitatively.

For terrestrial mammals, the Agency does not expect exposure to BBP via air, land, or dietary pathways for any COUs assessed to contribute to unreasonable risk to the environment.

EPA's confidence in the aquatic exposure assessment ranges from slight (the RQs calculated using the estimated high-end surface water concentrations) to moderate (the RQs calculated using the central tendency surface water concentrations). Additional information about EPA's confidence in the aquatic, terrestrial, and trophic transfer exposure assessments is noted in Table 5-4 of this risk evaluation.

6.2.2 Summary of Environmental Effects

EPA has preliminarily determined that four COUs assessed quantitatively significantly contribute to the unreasonable risk to the environment based on reduced reproduction due to chronic BBP exposure for aquatic vertebrate species and reduced population growth for aquatic algae. The four COUs are (1) Manufacturing – domestic manufacturing, (2) Processing – incorporation into formulation, mixture, or reaction product – plasticizers (custom compounding of purchased resin; plastic material and resin manufacturing; rubber manufacturing; adhesive manufacturing; paints and coatings manufacturing; ink, toner, and colorant manufacturing), (3) Processing – incorporation into articles – plasticizers (adhesive manufacturing; fabric, textile, apparel, and leather products manufacturing; building and construction materials manufacturing; plastics product manufacturing; rubber product manufacturing; transportation equipment manufacturing), and (4) Disposal. Concentrations of concern (COCs) were derived for acute and chronic exposures to aquatic organisms. A 4-day BBP exposure study was used as the basis for the COC for algae.

No evidence of hazard effects of BBP in the sediment was available to derive sediment exposure or sediment pore water COCs. However, estimations from the water column concentration were used to calculate a sediment-dwelling animal hazard threshold based on the 48-hour LC50 for the midge *Chironomus tentans* (U.S. EPA, 2025p). The sediment exposure assessment was performed by comparing the calculated sediment hazard threshold to the highest sediment value modeled from the highest releasing OES and using the high-end releases, no wastewater treatment, and slowest stream flow modeled estimates. Using this method resulted in an RQ below 1 and EPA is preliminarily

determining that exposure to BBP through sediment does not present unreasonable risk to the environment.

A hazard threshold for soil invertebrates was not derived because in the single identified study, mortality was not observed at any experimental BBP concentration. That study has a data quality rating of medium. A hazard threshold for BBP exposure to terrestrial plants was not derived because four high- or medium-quality rated studies did not find BBP effects on plant growth. EPA is preliminarily determining that BBP is unlikely to result in risk to soil invertebrates and terrestrial plants.

BBP is not readily found (or if found, is in relatively low concentrations) in organism tissues, and has low bioaccumulation and biomagnification potential in aquatic and terrestrial organisms. EPA does not expect BBP to persist in surface water, groundwater, or air, and the Agency qualitatively considered the risk of BBP trophically transferring through food webs (U.S. EPA, 2025p). EPA used the high-end estimate of BBP in soil (0.01 mg/kg), the dietary mammal hazard threshold, and the low bioaccumulation potential of BBP (U.S. EPA, 2025p) to determine the likelihood of BBP transferring from biosolids to soil and through food webs to reach the terrestrial mammal threshold value of 311 mg/kg-bw-day. Using the upper bound of BBP's water solubility or the highest modeled surface water concentration to determine concentrations in fish, the values are less than the terrestrial mammal threshold value of 311 mg/kg-bw-day over 130 days. EPA is preliminarily determining that the trophic transfer pathway does not present unreasonable risk to the environment.

EPA has robust confidence that BBP has acute and chronic effects on aquatic vertebrates and invertebrates in the environment. The Agency has robust confidence that BBP reduced the 4-day population growth of algae in the environment. Additional information about EPA's confidence in the aquatic, terrestrial, and trophic transfer hazard assessments is provided in Table 5-4 of this draft risk evaluation.

6.2.3 Basis for Unreasonable Risk to the Environment

Based on the risk evaluation for BBP—including the risk estimates, the environmental effects of BBP, the exposures, physical and chemical properties of BBP, and consideration of uncertainties—EPA has preliminarily determined that four COUs: (1) Manufacturing – domestic manufacturing; (2) Processing – incorporation into formulation, mixture, or reaction product – plasticizers (custom compounding of purchased resin; plastic material and resin manufacturing; rubber manufacturing; adhesive manufacturing; paints and coatings manufacturing; ink, toner, and colorant manufacturing); and (3) Processing – incorporation into article – plasticizers (adhesive manufacturing; fabric, textile, apparel, and leather products manufacturing; building and construction materials manufacturing; plastics product manufacturing; rubber product manufacturing; transportation equipment manufacturing; and (4) Disposal, significantly contribute to unreasonable risk to the environment for BBP due to surface water exposure. The Agency evaluated the surface water exposure pathway for 27 COUs. Consistent with EPA's determination of unreasonable risk to human health, the RQ is not treated as a bright-line and other risk-based factors may be considered (*e.g.*, confidence in the hazard and exposure characterization, duration, magnitude, uncertainty) for purposes of making an unreasonable risk determination.

EPA quantitatively characterized the environmental risk to the surface water pathway because wastewater releases are expected to result in water concentrations of BBP that affect aquatic organism survival or reproduction. The Agency evaluated the effect of BBP exposure through surface water releases to aquatic vertebrates, invertebrates, and algae. In evaluating BBP surface water concentrations, modeled BBP concentrations in surface water were assessed quantitatively using generic scenarios. Risk to aquatic organisms was characterized by comparing hazard thresholds (COCs) for aquatic organisms

to modeled surface water exposures due to (1) DMR data for OESs mapped to COUs with facility-specific data; (2) modeled data from generic scenarios of water releases for OESs mapped to COUs with water releases, but no facility-specific data; and (3) modeled data from generic scenarios of water releases from OESs mapped to COUs with multimedia releases that did not distinguish among wastewater, incineration, or landfill.

EPA is preliminary determining that the Disposal COU contributes to the unreasonable risk to the environment. Risk to aquatic organisms was characterized by comparing hazard thresholds (COCs) for aquatic organisms to DMR-derived modeled surface water exposures from 10 COUs. The RQs were calculated using modeled surface water concentrations estimated from 95th percentile releases from two POTWs. RQs exceeded the benchmark of 1 for the Disposal COU with an RQ of 5.26 for chronic exposure to aquatic vertebrates. These scenarios represent 2 of 28 reporting facilities for this COU and may not be representative of the COU in general. EPA has robust confidence in this risk characterization, because of robust confidence in the chronic vertebrate hazard COCs, as well as robust confidence in the exposure concentrations due to modeling with DMR data.

To determine risk to aquatic organisms from surface water exposure using generic scenarios of water releases for OES mapped to COUs with water releases, but no facility-specific data, EPA conducted a first-tier screening assessment that considered the highest exposures across all COUs of a high-end (95th percentile) release from the Processing – PVC plastic compounding, no wastewater treatment, and slowest flow scenario (Table 5-2). However, in some instances, the surface water estimates resulted in numbers that exceeded the limit of water solubility of BBP. EPA has slight confidence in the first-tier screening assessment that considered the highest exposures across all COUs of a high-end (95th percentile) release from the Processing – PVC plastic compounding, with no wastewater treatment, and using the slowest flow scenario (Table 5-2 and Appendix G). Because of this uncertainty and slight confidence in the results of the screening approach, EPA considered the scenarios with median (central tendency) release, wastewater treatment removal, and faster stream flows in a second-tier refined assessment that provided estimates of surface water concentrations with higher confidence.

The central tendency release volume represents a more typical release rather than a high-end (conservative) release. Modeled surface water concentrations approximating measured BBP concentrations (2.65 µg/L) occurred in the scenarios with central tendency (median) release volumes, medium and fast flows, and with wastewater treatment removal, representing potentially realistic water bodies, resulting in an increased confidence of the modeled estimates. Thus, EPA has moderate confidence that combinations of release, flow, and wastewater treatment in generic scenarios represent a BBP COU release that result in relevant and reliable water concentrations and evaluated risk to aquatic organisms through surface water exposure to BBP for eight COUs using this approach.

Based on the central tendency risk estimates with treatment and a medium flow rate of P75 (250,573 m³/day) associated with two COUs, EPA is preliminarily determining that BBP presents unreasonable risk to the environment driven by the (1) Processing – incorporation into formulation, mixture, or reaction product – plasticizer (custom compounding of purchased resin; plastic material and resin manufacturing; rubber manufacturing; adhesive manufacturing; paints and coatings manufacturing; ink, toner, and colorant manufacturing) COU; and the (2) Processing – incorporation into article – plasticizer (adhesive manufacturing; fabric, textile, apparel, and leather products manufacturing; building and construction materials manufacturing; plastics product manufacturing; rubber product manufacturing; transportation equipment manufacturing) COU. The first COU (Processing – incorporation into formulation, mixture, or reaction product – plasticizer...) had an RQ of 31.79 for chronic BBP exposure to aquatic vertebrates. In addition, an RQ of 2.88 was calculated based on comparing the release

estimate to a COC in algae that showed a significant reduction in population growth after a 4-day exposure to BBP. The second COU (Processing – incorporation into article – plasticizer...) had an RQ of 1.92 for chronic BBP exposure to aquatic vertebrates. The determination of unreasonable risk to the environment for this COU is based on the modeled surface water concentration, the robust confidence in the chronic COC derived from zebrafish, and the prediction that the concentration of BBP in surface water would exceed the COC for approximately 230 days a year.

EPA is preliminarily determining that three COUs do not contribute to unreasonable risk to the environment. The central tendency 7Q10, P75 with wastewater treatment resulted in RQs greater than 1 for three COUs. For the Industrial use – other uses – hydraulic fluids; Industrial use – other uses, automotive products, other than fluids; and Commercial use – other uses – automotive products, other than fluids COUs, the chronic vertebrate RQs were 39 due to chronic exposure of BBP to vertebrates, RQs were 1.18 due to chronic BBP exposure to invertebrates, and RQs were 3.53 due BBP exposure to algae. However, for these exposures the days of exceedance did not extend beyond the length of experimental exposures (21-days for chronic aquatic vertebrate COCs and 4-days algae COCs).

EPA is preliminary determining that Manufacturing – domestic manufacture contributes to the unreasonable risk to the environment. EPA used modeled data from generic scenarios of water releases from OESs mapped to COUs with multimedia releases that did not distinguish among wastewater, incineration, or landfill to determine risk to aquatic organisms from surface water exposure to BPP. The Agency could not determine the release of BBP to water for two COUs—(1) Manufacturing – domestic manufacturing, and (2) Commercial use – other uses – laboratory chemicals—and used a conservative assumption of 100 percent release to water in the generic scenarios modeled. For every modeled scenario of releases for Commercial use – other uses – laboratory chemicals, the RQs values were less than the benchmark of 1 for all aquatic organisms. For the COU, Manufacturing – domestic manufacturing, RQs exceeded the benchmark of 1 for every generic scenario modeled and therefore EPA used release reports of water releases for other phthalates, including DEHP ([U.S. EPA, 2025aa](#)), to refine the analysis. Initial inspection of 60 percent water release from Manufacturing resulted in daily release estimates (339.6 kg/site-day and 181.8 kg/site-day) that were greater than the range of daily releases from OESs with definitive water releases (*i.e.*, greater than the maximum of 122 kg/site-day). These high-end releases resulted in an unrealistic surface water concentration (3,070 µg/L) that is greater than the BBP limit of solubility (2,690 µg/L), leading to slight confidence in these scenarios.

EPA further refined the analysis using a more conservative release estimate of 10 percent of the total BBP Manufacturing release, the generic scenario with the central tendency releases, 7Q10 P75 flow rate, and 62 percent wastewater removal. The analysis resulted in a surface water concentration of 45.98 µg/L, and the concentration was compared to the COCs. The RQ exceeded the benchmark of 1 with an RQ of 24.2 for chronic (21-day) exposure to aquatic vertebrates with 269 days of exceedance in a year. The RQ for the 4-day exposure to algae was 2.19. The realistic release wastewater treatment and flow scenarios combined with evidence of water release obtained from DEHP resulted in the Agency having moderate confidence in the resulting predicted surface water concentrations. EPA has moderate overall confidence in this risk characterization because of robust confidence in the chronic vertebrate hazard COC but moderate confidence in the exposure concentrations due to generic scenario modeling. Therefore, EPA is preliminarily determining that Manufacturing – domestic manufacture contributes to the unreasonable risk to the environment.

EPA modeled maximum BBP exposure to sediment. EPA compared the highest environmental media concentration to an estimated hazard threshold value that resulted in an RQ less than 1 (0.85). As this screening assessment represented the worst cases scenario, no further refinement was performed. EPA is

preliminarily determining that exposure to BBP in sediment is not a pathway of environmental concern. See Section 5.3.3 of this risk evaluation for more details. EPA has moderate confidence in this risk assessment as shown in Table 5-4.

For terrestrial organisms, EPA modeled maximum fugitive and stack releases to air and subsequent deposition to soil. The Agency compared the highest exposure estimates, along with available evidence of no inhalation hazard or hazard to soil-dwelling organisms, resulting in EPA preliminarily determining that risk from exposure to BBP in air or subsequent deposition to soil from air are not pathways of environmental concern for BBP.

EPA expects BBP to be transported in sealed containers from import sites to downstream processing and use sites or for final disposal. The Agency expects under standard operating procedures, along with the expectation that BBP would be transported in a closed system, that there is negligible potential for releases except during a release incident. Therefore, EPA expects that environmental releases from distribution in commerce are unlikely to occur and not expected to exceed hazard to ecological receptors.

EPA evaluated the down-the-drain releases of BBP for consumer COUs qualitatively. Although the Agency acknowledges that there may be BBP releases to the environment via the cleaning and disposal of adhesives, sealants, paints, coatings, and cleaning and furnishing care products, these products were not quantitatively assessed due to limited reasonably available information on source attribution of the consumer COUs (see Section 3.1.4). However, the consideration of the physical and chemical properties of BBP allows the Agency to conduct a qualitative assessment. No studies were identified that reported the concentration of BBP in landfills or in the surrounding areas in the United States, but BBP was identified in sludge in wastewater plants in China, Canada, and the United States. BBP is expected to have a high affinity for particulate and organic media that would 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 BBP will migrate from landfills via groundwater infiltration. Nevertheless, nearby surface waters may be susceptible to BBP contamination via surface water runoff if it is not captured before mixing with surface water. However, EPA expects that environmental releases of BBP from consumer disposal will be negligible and are not expected to exceed hazard to ecological receptors (see Section 5.3.4).

The Agency has robust confidence in the terrestrial risk assessment. EPA has robust confidence that BBP has low potential for trophic transfer through food webs and would not result in unreasonable risk. The Agency's overall environmental risk characterization confidence levels were varied and are summarized in Table 5-4.

6.3 Additional Information Regarding the Basis of the Unreasonable Risk Determination

Table 6-1 and Table 6-2 summarize the basis for this preliminary unreasonable risk determination of injury to human health and the environment presented in this BBP draft risk evaluation. In the occupational (Table 6-1), bold text indicates that an MOE is below the benchmark value and highlighting indicates that the risk estimate was used to support a preliminary determination of unreasonable risk for the corresponding COU. Table 6-1 also identifies the duration of exposure (*e.g.*, acute, intermediate, or chronic duration) and the exposure route to the population. As explained in Section 6.1, for this preliminary unreasonable risk determination, EPA has considered the effects of BBP to human health, including PESS, as well as a range of risk estimates as appropriate, risk related factors, and the confidence in the analysis. In the environment Table 6-2, the shaded cells indicate an

6503 RQ exceeding 1. The table identifies the media of release and the risk characterization. See Sections 4.3,
6504 4.4, and 5.3 for a summary of risk estimates.

6505 **Table 6-1. Supporting Basis for the Unreasonable Risk Determination for Human Health (Occupational COUs)**

Life Cycle Stage – Category	Subcategory	OES	Worker Population	Exposure Level	Inhalation Risk Estimates (Bench. MOE = 30) ^a			Acute Inhalation Exposure Risk Estimates with PPE (Bench. MOE = 30) ^b		Dermal Risk Estimates (Bench. MOE = 30) ^a			Acute Dermal Exposure Risk Estimates with PPE (Bench. MOE = 30) ^b		Cumulative Risk Estimates (Bench. MOE = 30) ^c
					Acute	Inter.	Chronic	MOE with PPE	APF	Acute	Inter.	Chronic	MOE with PPE	APF	Acute
Manufacturing – Domestic manufacturing	Domestic manufacturing	Manufacturing	Average Adult Worker	CT	960	1,309	1,402	–	–	7	9	10	–	–	–
				HE	210	286	306	–	–	3	5	5	–	–	–
			Female of Reproductive Age	CT	869	1,185	1,269	–	–	8	10	11	38	PF 5	–
				CT ^d	292	–	–	–	–	2.5	–	–	–	–	2.5
				HE	190	259	277	–	–	4	5	6	38	PF 10	–
				HE ^d	64	–	–	–	–	1.3	–	–	–	–	1.2
			ONU	CT	960	1,309	1,402	–	–	–	–	–	–	–	–
Manufacturing – Importing	Importing	Import and repackaging (solid)	Average Adult Worker	CT	1,455	1,983	2,552	–	–	2,015	2,748	3,536	–	–	–
				HE	64	87	93	–	–	1,008	1,374	1,471	–	–	–
			Female of Reproductive Age	CT	1,317	1,796	2,311	–	–	2,193	2,990	3,848	–	–	–
				CT ^d	443	–	–	–	–	738	–	–	–	–	165
Processing – Repackaging	Repackaging		Female of Reproductive Age	HE	58	79	85	–	–	1,096	1,495	1,601	–	–	–
				HE ^d	19	–	–	–	–	369	–	–	–	–	18
Manufacturing – Importing	Importing	Import and repackaging (liquid)	Average Adult Worker	CT	960	1,309	1,685	–	–	7	9	12	–	–	–
				HE	210	286	306	–	–	3	5	5	–	–	–
			Female of Reproductive Age	CT	869	1,185	1,525	–	–	8	10	13	38	PF5	–
				CT ^d	292	–	–	–	–	2.5	–	–	–	–	2.5
Processing – Repackaging	Repackaging		Female of Reproductive Age	HE	190	259	277	–	–	4	5	6	38	PF 10	–
				HE ^d	64	–	–	–	–	1.3	–	–	–	–	1.2
Processing – Repackaging	Repackaging	ONU	CT	960	1,309	1,685	–	–	–	–	–	–	–	–	

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Life Cycle Stage – Category	Subcategory	OES	Worker Population	Exposure Level	Inhalation Risk Estimates (Bench. MOE = 30) ^a			Acute Inhalation Exposure Risk Estimates with PPE (Bench. MOE = 30) ^b		Dermal Risk Estimates (Bench. MOE = 30) ^a			Acute Dermal Exposure Risk Estimates with PPE (Bench. MOE = 30) ^b		Cumulative Risk Estimates (Bench. MOE = 30) ^c
					Acute	Inter.	Chronic	MOE with PPE	APF	Acute	Inter.	Chronic	MOE with PPE	APF	Acute
Processing – Incorporation into formulation, mixture, or reaction product	Plasticizer in: – Adhesive manufacturing	Incorporation into adhesives and sealants (solid)	Average Adult Worker	CT	286	390	417	–	–	2,015	2,748	2,942	–	–	–
				HE	27	37	40	–	–	1,008	1,374	1,471	–	–	–
			Female of Reproductive Age	CT	259	353	378	–	–	2,193	2,990	3,201	–	–	–
				CT ^d	84	–	–	–	–	738	–	–	–	–	65
				HE	25	34	36	248	APF 10	1,096	1,495	1,601	–	–	–
				HE ^d	8.4	–	–	–	–	369	–	–	–	–	8.0
			ONU	CT ^e	286	390	417	–	–	2,015	2,748	2,942	–	–	–
Processing – Incorporation into formulation, mixture, or reaction product	Plasticizer in: – Adhesive manufacturing	Incorporation into adhesives and sealants (liquid)	Average Adult Worker	CT	1,920	2,618	2,803	–	–	7	9	10	–	–	–
				HE	960	1,309	1,402	–	–	3	5	5	–	–	–
			Female of Reproductive Age	CT	1,738	2,370	2,538	–	–	8	10	11	38	PF5	–
				CT ^d	585	–	–	–	–	2.5	–	–	–	–	2.5
				HE	869	1,185	1,269	–	–	4	5	6	38	PF 10	–
				HE ^d	292	–	–	–	–	1.3	–	–	–	–	1.3
			ONU	CT ^e	1,920	2,618	2,803	–	–	–	–	–	–	–	–
Processing – Incorporation into formulation, mixture, or reaction product	Plasticizer in: – Paint and coating manufacturing	Incorporation into paints and coatings (liquid)	Average Adult Worker	CT	1,920	2,618	2,803	–	–	7	9	10	–	–	–
				HE	960	1,309	1,402	–	–	3	5	5	–	–	–
			Female of Reproductive Age	CT	1,738	2,370	2,538	–	–	8	10	11	38	PF5	–
				CT ^d	585	–	–	–	–	2.5	–	–	–	–	2.5
				HE	869	1,185	1,269	–	–	4	5	6	38	PF 10	–
				HE ^d	292	–	–	–	–	1.3	–	–	–	–	1.3
			ONU	CT ^e	1,920	2,618	2,803	–	–	–	–	–	–	–	–
Processing – Incorporation into formulation, mixture, or reaction product	Plasticizer in: – Ink, toner, and colorant manufacturing	Incorporation into other formulations, mixtures, or reaction products (liquid)	Average Adult Worker	CT	1,920	2,618	2,803	–	–	7	9	10	–	–	–
				HE	960	1,309	1,402	–	–	3	5	5	–	–	–
			Female of Reproductive Age	CT	1,738	2,370	2,538	–	–	8	10	11	38	PF5	–
				CT ^d	585	–	–	–	–	2.5	–	–	–	–	2.5
				HE	869	1,185	1,269	–	–	4	5	6	38	PF 10	–
				HE ^d	292	–	–	–	–	1.3	–	–	–	–	1.3
			ONU	CT ^e	1,920	2,618	2,803	–	–	–	–	–	–	–	–
Processing – Incorporation into formulation, mixture, or reaction product	Laboratory chemical manufacturing	Incorporation into other formulations, mixtures, or reaction products (liquid)	Average Adult Worker	CT	1,920	2,618	2,803	–	–	7	9	10	–	–	–
				HE	960	1,309	1,402	–	–	3	5	5	–	–	–
			Female of Reproductive Age	CT	1,738	2,370	2,538	–	–	8	10	11	38	PF5	–
				CT ^d	585	–	–	–	–	2.5	–	–	–	–	2.5
				HE	869	1,185	1,269	–	–	4	5	6	38	PF 10	–
				HE ^d	292	–	–	–	–	1.3	–	–	–	–	1.3
			ONU	CT ^e	1,920	2,618	2,803	–	–	–	–	–	–	–	–

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Life Cycle Stage – Category	Subcategory	OES	Worker Population	Exposure Level	Inhalation Risk Estimates (Bench. MOE = 30) ^a			Acute Inhalation Exposure Risk Estimates with PPE (Bench. MOE = 30) ^b		Dermal Risk Estimates (Bench. MOE = 30) ^a			Acute Dermal Exposure Risk Estimates with PPE (Bench. MOE = 30) ^b		Cumulative Risk Estimates (Bench. MOE = 30) ^c
					Acute	Inter.	Chronic	MOE with PPE	APF	Acute	Inter.	Chronic	MOE with PPE	APF	Acute
Processing – Incorporation into formulation, mixture, or reaction product	Plasticizers (custom compounding of purchased resin; plastic material and resin manufacturing)	PVC plastics compounding	Average Adult Worker	CT	134	183	220	–	–	7	9	11	–	–	–
				HE	22	30	32	–	–	3	5	5	–	–	–
			Female of Reproductive Age	CT	122	166	199	–	–	8	10	12	38	PF5	–
				CT ^d	41	–	–	–	–	2.5	–	–	–	–	2.4
				HE	20	27	29	197	APF 10	4	5	6	38	PF 10	–
				HE ^d	6.6	–	–	–	–	1.3	–	–	–	–	1.1
			ONU	CT ^e	134	183	220	–	–	2,015	2,748	3,299	–	–	–
Processing – Incorporation into formulation, mixture, or reaction product	Plasticizers (custom compounding of purchased resin; resin manufacturing; rubber manufacturing)	Non-PVC plastics compounding	Average Adult Worker	CT	134	183	210	–	–	7	9	11	–	–	–
				HE	22	30	32	–	–	3	5	5	–	–	–
			Female of Reproductive Age	CT	122	166	190	–	–	8	10	12	38	PF 5	–
				CT ^d	41	–	–	–	–	2.5	–	–	–	–	2.4
				HE	20	27	29	197	APF 10	4	5	6	38	PF 10	–
Industrial Use – Other uses	Castings		ONU	CT ^e	134	183	210	–	–	2,015	2,748	3,143	–	–	–
Commercial Use – Other uses	Castings														
Processing – Incorporation into articles	Plasticizers (adhesive manufacturing; fabric, textile, apparel, and leather products manufacturing; building and construction materials manufacturing; plastics product manufacturing; rubber product manufacturing; transportation equipment manufacturing)	PVC plastics converting	Average Adult Worker	CT	134	183	224	–	–	2,015	2,748	3,359	–	–	–
				HE	22	30	32	–	–	1,008	1,374	1,471	–	–	–
			Female of Reproductive Age	CT	122	166	203	–	–	2,193	2,990	3,654	–	–	–
				CT ^d	41	–	–	–	–	738	–	–	–	–	35
				HE	20	27	29	197	APF 10	1,096	1,495	1,601	–	–	–
				HE ^d	6.6	–	–	–	–	369	–	–	–	–	6.4
			ONU	CT ^e	134	183	224	–	–	2,015	2,748	3,359	–	–	–

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Life Cycle Stage – Category	Subcategory	OES	Worker Population	Exposure Level	Inhalation Risk Estimates (Bench. MOE = 30) ^a			Acute Inhalation Exposure Risk Estimates with PPE (Bench. MOE = 30) ^b		Dermal Risk Estimates (Bench. MOE = 30) ^a			Acute Dermal Exposure Risk Estimates with PPE (Bench. MOE = 30) ^b		Cumulative Risk Estimates (Bench. MOE = 30) ^c
					Acute	Inter.	Chronic	MOE with PPE	APF	Acute	Inter.	Chronic	MOE with PPE	APF	Acute
Processing – Incorporation into article	Plasticizers (adhesive manufacturing; fabric, textile, apparel, and leather products manufacturing; building and construction materials manufacturing; plastics product manufacturing; rubber product manufacturing; transportation equipment manufacturing)	Non-PVC materials converting	Average Adult Worker	CT	134	183	224	–	–	2,015	2,748	3,359	–	–	–
				HE	22	30	32	–	–	1,008	1,374	1,471	–	–	–
			Female of Reproductive Age	CT	122	166	203	–	–	2,193	2,990	3,654	–	–	–
				CT ^d	41	–	–	–	–	738	–	–	–	–	35
				HE	20	27	29	197	APF 10	1,096	1,495	1,601	–	–	–
				HE ^d	7	–	–	–	–	369	–	–	–	–	6.4
Industrial Use – Other uses	Castings	Non-PVC materials converting	ONU	CT ^e	134	183	224	–	–	2,015	2,748	3,359	–	–	–
Commercial Use – Other uses	Castings														
Industrial Use – Construction, paint, electrical, and metal products	Adhesives and sealants	Application of Adhesives and Sealants	Average Adult Worker	CT	38,400	52,364	60,414	–	–	7	9	11	–	–	–
				HE	19,200	26,182	28,032	–	–	3	5	5	–	–	–
Female of Reproductive Age	CT		34,764	47,405	54,693	–	–	8	10	12	38	PF5	–		
	CT ^d		11,699	–	–	–	–	2.5	–	–	–	–	2.5		
	HE		17,382	23,703	25,378	–	–	4	5	6	38	PF 10	–		
Commercial Use – Construction, paint, electrical, and metal products	Adhesives and sealants		Female of Reproductive Age	HE ^d	5,850	–	–	–	–	1.3	–	–	–	–	1.3
		ONU		CT ^e	38,400	52,364	60,414	–	–	–	–	–	–	–	–

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Life Cycle Stage – Category	Subcategory	OES	Worker Population	Exposure Level	Inhalation Risk Estimates (Bench. MOE = 30) ^a			Acute Inhalation Exposure Risk Estimates with PPE (Bench. MOE = 30) ^b		Dermal Risk Estimates (Bench. MOE = 30) ^a			Acute Dermal Exposure Risk Estimates with PPE (Bench. MOE = 30) ^b		Cumulative Risk Estimates (Bench. MOE = 30) ^c
					Acute	Inter.	Chronic	MOE with PPE	APF	Acute	Inter.	Chronic	MOE with PPE	APF	Acute
Industrial Use – Construction, paint, electrical, and metal products	Paints and coatings	Application of paints and coatings	Average Adult Worker	CT	47	64	69	–	–	7	9	10	–	–	–
				HE	4	6	6	–	–	3	5	5	–	–	–
Female of Reproductive Age	CT		43	58	62	–	–	8	10	11	38	PF5	–		
	CT ^d		14	–	–	–	–	2.5	–	–	–	–	2.2		
	HE		4	5	6	39	APF 10	4	5	6	38	PF 10	–		
	HE ^d		1.3	–	–	–	–	1.3	–	–	–	–	0.6		
Commercial Use – Construction, paint, electrical, and metal products	Paints and coatings		ONU	CT ^e	47	64	69	–	–	7	9	10	–	–	–
Commercial Use – Packaging, paper, plastic, hobby products	Ink, toner and colorant products														
Industrial Use – Other uses	Hydraulic fluids	Use of lubricants and functional fluids	Average Adult Worker	CT	38,400	576,000	7,008,000	–	–	7	104	1,269	–	–	–
	HE			19,200	144,000	1,752,000	–	–	3	26	317	–	–	–	
	Automotive products, fluids		Female of Reproductive Age	CT	34,764	521,460	6,344,430	–	–	8	114	1,381	38	PF5	–
				CT ^d	11,699	–	–	–	–	2.5	–	–	–	–	2.5
				HE	17,382	130,365	1,586,108	–	–	4	28	345	38	PF 10	–
				HE ^d	5,850	–	–	–	–	1.3	–	–	–	–	1.3
Commercial Use – Other uses	Automotive products, fluids		ONU	CT ^e	38,400	576,000	7,008,000	–	–	–	–	–	–	–	–

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Life Cycle Stage – Category	Subcategory	OES	Worker Population	Exposure Level	Inhalation Risk Estimates (Bench. MOE = 30) ^a			Acute Inhalation Exposure Risk Estimates with PPE (Bench. MOE = 30) ^b		Dermal Risk Estimates (Bench. MOE = 30) ^a			Acute Dermal Exposure Risk Estimates with PPE (Bench. MOE = 30) ^b		Cumulative Risk Estimates (Bench. MOE = 30) ^c
					Acute	Inter.	Chronic	MOE with PPE	APF	Acute	Inter.	Chronic	MOE with PPE	APF	Acute
Commercial Use – Other uses	Laboratory chemicals	Use of laboratory chemicals – solid	Average Adult Worker	CT	168,421	229,665	261,590	–	–	2,015	2,748	3,130	–	–	–
				HE	11,852	16,162	17,304	–	–	1,008	1,374	1,471	–	–	–
			Female of Reproductive Age	CT	152,474	207,919	236,821	–	–	2,193	2,990	3,406	–	–	–
				CT ^d	51,313	–	–	–	–	738	–	–	–	–	261
				HE	10,730	14,631	15,665	–	–	1,096	1,495	1,601	–	–	–
				HE ^d	3,611	–	–	–	–	369	–	–	–	–	184
			ONU	CT ^e	168,421	229,665	261,590	–	–	2,015	2,748	3,130	–	–	–
Commercial Use – Other uses	Laboratory chemicals	Use of laboratory chemicals – liquid	Average Adult Worker	CT	960	1,309	1,491	–	–	128	175	199	–	–	–
				HE	210	286	306	–	–	43	58	62	–	–	–
			Female of Reproductive Age	CT	869	1,185	1,350	–	–	139	190	217	–	–	–
				CT ^d	292	–	–	–	–	47	–	–	–	–	37
				HE	190	259	277	–	–	46	63	68	–	–	–
				HE ^d	64	–	–	–	–	16	–	–	–	–	12
			ONU	CT ^e	960	1,309	1,491	–	–	–	–	–	–	–	–

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Life Cycle Stage – Category	Subcategory	OES	Worker Population	Exposure Level	Inhalation Risk Estimates (Bench. MOE = 30) ^a			Acute Inhalation Exposure Risk Estimates with PPE (Bench. MOE = 30) ^b		Dermal Risk Estimates (Bench. MOE = 30) ^a			Acute Dermal Exposure Risk Estimates with PPE (Bench. MOE = 30) ^b		Cumulative Risk Estimates (Bench. MOE = 30) ^c
					Acute	Inter.	Chronic	MOE with PPE	APF	Acute	Inter.	Chronic	MOE with PPE	APF	Acute
Industrial Use – Other uses	Automotive articles	Fabrication of final product from articles	Average Adult Worker	CT	1,067	1,455	1,557	–	–	2,015	2,748	2,942	–	–	–
Commercial Use – Furnishing, cleaning, treatment/care products	Floor coverings; Construction and building materials covering large surface areas including stone, plaster, cement, glass and ceramic articles; fabrics, textiles, and apparel			HE	119	162	173	–	–	1,008	1,374	1,471	–	–	–
	Fabric, textile, and leather products														
Commercial Use – Packaging, paper, plastic, hobby products	Packaging (excluding food packaging) and other articles with routine direct contact during normal use, rubber articles; plastic articles (hard); plastic articles (soft)		Female of Reproductive Age	CT	966	1,317	1,410	–	–	2,193	2,990	3,201	–	–	–
	Toys, playground, and sporting equipment			CT ^d	325	–	–	–	–	738	–	–	–	–	145
Commercial Use – Other uses	Automotive articles			HE	107	146	157	–	–	1,096	1,495	1,601	–	–	–
				HE ^d	36	–	–	–	–	369	–	–	–	–	30
			ONU	CT ^e	1,067	1,455	1,557	–	–	2,015	2,748	2,942	–	–	–

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Life Cycle Stage – Category	Subcategory	OES	Worker Population	Exposure Level	Inhalation Risk Estimates (Bench. MOE = 30) ^a			Acute Inhalation Exposure Risk Estimates with PPE (Bench. MOE = 30) ^b		Dermal Risk Estimates (Bench. MOE = 30) ^a			Acute Dermal Exposure Risk Estimates with PPE (Bench. MOE = 30) ^b		Cumulative Risk Estimates (Bench. MOE = 30) ^c
					Acute	Inter.	Chronic	MOE with PPE	APF	Acute	Inter.	Chronic	MOE with PPE	APF	Acute
Processing – Recycling	Recycling	Recycling	Average Adult Worker	CT	889	1,212	1,298	–	–	2,015	2,748	2,942	–	–	–
				HE	61	83	89	–	–	1,008	1,374	1,471	–	–	–
			Female of Reproductive Age	CT	805	1,097	1,175	–	–	2,193	2,990	3,201	–	–	–
				<i>CT^d</i>	271	–	–	–	–	738	–	–	–	–	133
				HE	55	75	81	–	–	1,096	1,495	1,601	–	–	–
				<i>HE^d</i>	19	–	–	–	–	369	–	–	–	–	17
			ONU	CT ^e	889	1,212	1,298	–	–	2,015	2,748	2,942	–	–	–
Disposal	Disposal	Waste handling, treatment and disposal	Average Adult Worker	CT	889	1,212	1,298	–	–	2,015	2,748	2,942	–	–	–
				HE	61	83	89	–	–	1,008	1,374	1,471	–	–	–
			Female of Reproductive Age	CT	805	1,097	1,175	–	–	2,193	2,990	3,201	–	–	–
				<i>CT^d</i>	271	–	–	–	–	738	–	–	–	–	133
				HE	55	75	81	–	–	1,096	1,495	1,601	–	–	–
				<i>HE^d</i>	19	–	–	–	–	369	–	–	–	–	17
			ONU	CT ^e	889	1,212	1,298	–	–	2,015	2,748	2,942	–	–	–

APF = assigned protection factor; Bench. = benchmark; CT = central tendency; HE = high-end; MOE = margin of exposure; OES = occupational exposure scenario; PPE = personal protective equipment
^a Risk estimates are from Table 4-17 from the individual BBP analysis or from Table 4-22 in the cumulative analysis. The italicized risk estimates are from Table 4-22. The risk estimates in the bolded cells indicate that the number is below benchmark, and the highlighted cell indicates the risk estimate was used to support an unreasonable risk determination for the corresponding COU.

^b Risk estimates are from Table 4-15.

^c The acute cumulative MOE is derived by summing inhalation exposure from each individual BBP COU with dermal exposure from the same BBP COU and the cumulative non-attributable exposure to phthalates DEHP, DBP, BBP, DIBP, and DINP. Non-attributable cumulative exposure was estimated from NHANES urinary biomonitoring data using reverse dosimetry. All exposure estimates were (1) scaled by relative potency, (2) expressed in index chemical (*i.e.*, DBP) equivalents, (3) summed to calculate cumulative exposure in index chemical equivalents, and then (4) compared to the index chemical POD (*i.e.*, HED of 2.1 mg/kg-day) to calculate the cumulative MOE.

^d Risk estimates are from Table 4-22 in Section 4.4.4. Inhalation and dermal risk estimates are expressed in DBP equivalents.

^e In absence of ONU exposure data, EPA used worker data as analogous data for ONU exposure. The inhalation MOEs for ONUs are equal to worker central tendency exposures MOEs. Dermal exposures to ONUs are represented only a single hand (or 1 side of 2 hands) and used half the mean values for 2-hand surface areas (*i.e.*, 535 cm²).

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Table 6-2. Supporting Basis for the Unreasonable Risk Determination for the Environment (Occupational COUs)

COU Life Cycle	COU Category	COU Subcategory	Release Media ^a	Surface Water Concentration (µg/L) ^b	Receptor	RQ ^e – Acute	RQ ^e – Chronic	RQ ^e – Other
Manufacturing	Domestic manufacturing	Domestic manufacturing	Multimedia (10% water release assumption)	46	Aquatic Invertebrates	0.23	0.74	–
					Aquatic Vertebrates	0.23	24.2	–
					Algae	–	–	2.19
	Importing	Importing	Water (DMR data)	1.15	Aquatic Invertebrates	0.01	0.02	–
					Aquatic Vertebrates	0.01	0.61	–
					Algae	–	–	0.05
Processing	Repackaging	Repackaging	Water (DMR data)	1.15	Aquatic Invertebrates	0.01	0.02	–
					Aquatic Vertebrates	0.01	0.61	–
					Algae	–	–	0.05
	Incorporation into formulation, mixture, or reaction product	Plasticizers (custom compounding of purchased resin; plastic material and resin manufacturing; rubber manufacturing; adhesive manufacturing; paints and coatings manufacturing; ink, toner, and colorant manufacturing) ^c	Water (Generic Scenario)	60.4	Aquatic Invertebrates	0.31	0.96	–
					Aquatic Vertebrates	0.31	31.79	–
					Algae	–	–	2.88
		Laboratory chemical manufacturing	Water (DMR data)	0.11	Aquatic Invertebrates	<0.01	<0.01	–
					Aquatic Vertebrates	<0.01	5.94E–02	–
					Algae	–	–	0.01
	Incorporation into articles	Plasticizers (custom compounding of purchased resin; plastic material and resin manufacturing; rubber manufacturing; adhesive manufacturing; paints and coatings manufacturing; ink, toner, and colorant manufacturing)	Water (Generic Scenario)	3.65	Aquatic Invertebrates	0.02	0.06	–
					Aquatic Vertebrates	0.02	1.92	–
					Algae	–	–	0.17
	Recycling	Recycling	Water (Generic Scenario)	1.18E–02	Aquatic Invertebrates	2.23E–02	<0.01	–
					Aquatic Vertebrates	2.23E–02	<0.01	–
					Algae	–	–	<0.01

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COU Life Cycle	COU Category	COU Subcategory	Release Media ^a	Surface Water Concentration (µg/L) ^b	Receptor	RQ ^e – Acute	RQ ^e – Chronic	RQ ^e – Other
Distribution	Distribution in commerce	Distribution in commerce	Water	Qualitative Assessment: Water exposures expected to be negligible				
Industrial Use	Construction, paint, electrical, and metal products	Paints and coatings	Water (DMR data)	2.45E-02	Aquatic Invertebrates	<0.01	<0.01	—
					Aquatic Vertebrates	<0.01	1.29E-02	—
					Algae	—	—	<0.01
		Adhesives and sealants	Water (DMR data)	2.45E-02	Aquatic Invertebrates	<0.01	<0.01	—
					Aquatic Vertebrates	<0.01	1.29E-02	—
					Algae	—	—	<0.01
	Packaging, paper, plastic, hobby products	Ink, toner and colorant products	Water (DMR data)	2.45E-02	Aquatic Invertebrates	<0.01	<0.01	—
					Aquatic Vertebrates	<0.01	1.29E-02	—
					Algae	—	—	<0.01
	Other uses	Hydraulic fluids	Water (Generic Scenario)	74.10	Aquatic Invertebrates	0.38	39^d	—
					Aquatic Vertebrates	0.38	1.18^d	—
					Algae	—	—	3.53^d
		Castings	Water (Generic Scenario)	9.27E-02	Aquatic Invertebrates	<0.01	<0.01	—
					Aquatic Vertebrates	<0.01	0.05	—
					Algae	—	—	<0.01
		Automotive products, fluids	Water (Generic Scenario)	74.10	Aquatic Invertebrates	0.38	1.18^d	—
					Aquatic Vertebrates	0.38	39^d	—
					Algae	—	—	3.53^d
		Automotive articles	No release data	Water exposures expected to be negligible				

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July 2025

COU Life Cycle	COU Category	COU Subcategory	Release Media ^a	Surface Water Concentration (µg/L) ^b	Receptor	RQ ^e – Acute	RQ ^e – Chronic	RQ ^e – Other						
Commercial Use	Construction, paint, electrical, and metal products	Paints and coatings	Water (DMR data)	2.45E-02	Aquatic Invertebrates	<0.01	<0.01	–						
					Aquatic Vertebrates	<0.01	1.29E-02	–						
					Algae	–	–	<0.01						
		Adhesives and sealants	Water (DMR data)	2.45E-02	Aquatic Invertebrates	<0.01	<0.01	–						
					Aquatic Vertebrates	<0.01	1.29E-02	–						
					Algae	–	–	<0.01						
	Furnishing, cleaning, treatment/care products	Floor coverings; Construction and building materials covering large surface areas including stone, plaster, cement, glass and ceramic articles; fabrics, textiles, and apparel	No release data	Water exposures expected to be negligible										
		Fabric, textile, and leather products												
	Packaging, paper, plastic, hobby products	Packaging (excluding food packaging) and other articles with routine direct contact during normal use, rubber articles; plastic articles (hard); plastic articles (soft)	No release data	Water exposures expected to be negligible										
		Inks, toner and colorant products							Water (DMR data)	2.45E-02	Aquatic Invertebrates	<0.01	<0.01	–
											Aquatic Vertebrates	<0.01	1.29E-02	–
											Algae	–	–	<0.01
		Toys, playground, and sporting equipment	No release data	Water exposures expected to be negligible										
	Other uses	Laboratory chemical	Multimedia	9.99E-03	Aquatic Invertebrates	<0.01	<0.01	–						
					Aquatic Vertebrates	<0.01	<0.01	–						
					Algae	–	–	<0.01						
		Castings	Water (Generic Scenario)	9.27E-02	Aquatic Invertebrates	<0.01	<0.01	–						
					Aquatic Vertebrates	<0.01	0.05	–						
					Algae	–	–	<0.01						

PUBLIC RELEASE DRAFT
July 2025

COU Life Cycle	COU Category	COU Subcategory	Release Media ^a	Surface Water Concentration (µg/L) ^b	Receptor	RQ ^e – Acute	RQ ^e – Chronic	RQ ^e – Other
Commercial Use	Other uses	Automotive products, fluids	Water (Generic Scenario)	74.10	Aquatic Invertebrates	0.38	1.18	–
					Aquatic Vertebrates	0.38	39	–
					Algae	–	–	3.53
		Automotive articles	No release data	Water exposures expected to be negligible				
Disposal	Disposal	Disposal	Water (DMR data)	10	Aquatic Invertebrates	0.05	0.16	–
					Aquatic Vertebrates	0.05	5.26	–
					Algae	–	–	0.48

RQ = risk quotient

^a The type of release information is listed; generic scenarios, multimedia, and DMR data information is presented in Section 5.3.2 and Appendix G.

^b Quantitative assessments of water exposures reported from second-tier assessment using predicted exposure concentrations from generic scenarios of surface water concentrations using median release volumes, 62% wastewater removal, and 7Q10 P75 (250,573 m³/day) stream flows. For the Manufacturing – domestic manufacturing COU, a 10% water release assumption was used to model surface water concentration. DMR data assessments used the 95th percentile daily release statistic for POTWs (disposal COU), or one value (all other COUs).

^c The OES with the highest RQ is listed for this COU. Other OESs applicable to this COU were Formulation into adhesives and sealants; Formulation into paints and coatings; Incorporation into other formulation, mixture or reaction products; and Non-PVC material compounding.

^d For these exposures, the days of exceedance did not extend beyond the length of experimental exposures (21-days for chronic aquatic vertebrate COCs and 4-days algae COCs), so the values preliminarily do not contribute to the unreasonable risk of injury to the environment.

^e RQs based on acute animal (197 µg/L), chronic vertebrate (1.9 µg/L), chronic invertebrate (62.6 µg/L), and algae (21 µg/L) concentrations of concern ([U.S. EPA, 2025p](#)). EPA has robust confidence in the quality, consistency, strength and precision, and relevance of the studies used in determining these COCs.

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APPENDICES

Appendix A KEY ABBREVIATIONS AND ACRONYMS

7377	7Q10	Lowest 7-day average flow that occurs (on average) once every 10 years
7378	30Q5	Lowest 30-day average flow that occurs (on average) once every 5 years
7379	ADD	Average daily dose
7380	ADC	Average daily concentration
7381	AGD	Anogenital distance
7382	APDR	Acute potential dose rate
7383	BAF	Bioaccumulation factor
7384	BBP	Butyl benzyl phthalate
7385	BCF	Bioconcentration factor
7386	BLS	Bureau of Labor Statistics (U.S.)
7387	CASRN	Chemical Abstracts Service Registry Number
7388	CBI	Confidential business information
7389	CDC	Centers for Disease Control and Prevention (U.S.)
7390	CDR	Chemical Data Reporting
7391	CEHD	Chemical Exposure Health Data
7392	CEM	Consumer Exposure Model
7393	CFR	Code of Federal Regulations
7394	ChV	Chronic value
7395	COC	Concentration of concern
7396	CPSC	Consumer Product Safety Commission (U.S.)
7397	CRA	Cumulative risk assessment
7398	DBP	Dibutyl phthalate
7399	DCHP	Dicyclohexyl phthalate
7400	DEHP	Diethylhexyl phthalate
7401	DIBP	Diisobutyl phthalate
7402	DIDP	Diisodecyl phthalate
7403	DINP	Dicyclohexyl phthalate
7404	DIY	Do-it-yourself
7405	ECJRC	European Commission's Joint Research Centre
7406	EPA	Environmental Protection Agency (U.S.)
7407	ESD	Emission scenario document
7408	EU	European Union
7409	FDA	Food and Drug Administration (U.S.)
7410	GS	Generic scenario
7411	K _{OC}	Soil organic carbon: water partitioning coefficient
7412	K _{OW}	Octanol: water partition coefficient
7413	HEC	Human equivalent concentration
7414	HED	Human equivalent dose
7415	IADD	Intermediate average daily dose
7416	IIOAC	Integrated Indoor-Outdoor Air Calculator (Model)
7417	IR	Ingestion rate
7418	LCD	Life cycle diagram
7419	LOEC	Lowest-observed-effect concentration
7420	LOAEL	Lowest-observed-adverse-effect level
7421	LOD	Limit of detection

7422	Log K _{oc}	Logarithmic organic carbon: water partition coefficient
7423	Log K _{ow}	Logarithmic octanol: water partition coefficient
7424	MBP	Monobutyl phthalate
7425	MBzP	Monobenzyl phthalate
7426	MOA	Mode of action
7427	MOE	Margin of exposure
7428	NAICS	North American Industry Classification System
7429	NHANES	National Health and Nutrition Examination Survey
7430	NICNAS	National Industrial Chemicals Notification and Assessment Scheme
7431	NOEL	No-observed-effect level
7432	NOAEL	No-observed-adverse-effect level
7433	NPDES	National Pollutant Discharge Elimination System
7434	OCSPP	Office of Chemical Safety and Pollution Prevention (EPA)
7435	OECD	Organisation for Economic Co-operation and Development
7436	OEL	Occupational exposure limits
7437	OES	Occupational exposure scenario
7438	OEV	Occupational exposure value
7439	ONU	Occupational non-user
7440	OPPT	Office of Pollution Prevention and Toxics (EPA)
7441	OSHA	Occupational Safety and Health Administration
7442	PBZ	Personal breathing zone
7443	PESS	Potentially exposed or susceptible subpopulations
7444	PND	Postnatal day
7445	PNOR	Particulates not otherwise regulated
7446	POD	Point of departure
7447	PSC	Point Source Calculator tool (for VVWM)
7448	PV	Production volume
7449	PVC	Polyvinyl chloride
7450	RPF	Relative potency factor
7451	RQ	Risk quotient
7452	SACC	Science Advisory Committee on Chemicals
7453	SDS	Safety data sheet
7454	SOC	Standard occupational classification
7455	SpERC	Specific emission release category
7456	SSD	Species sensitivity distribution
7457	SWC	Surface water concentration
7458	TRI	Toxic Release Inventory
7459	TRV	Toxicity reference value
7460	TSCA	Toxic Substances Control Act
7461	TSD	Technical support document
7462	TWA	Time-weighted average
7463	UF	Uncertainty factor
7464	U.S.	United States
7465	VVWM	Variable Volume Water Model
7466	WWTP	Wastewater treatment plant

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 three and one-half years after the date of enactment (June 22, 2016) of the Frank R. Lautenberg Chemical Safety for the 21st Century Act.	BBP 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 BBP as a high-priority substance constitutes the initiation of the risk evaluation on the chemical.
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.	BBP manufacturing (including importing), processing, and use information is reported under the CDR rule (85 FR 20122, April 9, 2020).
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.	BBP 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).
TSCA – section 8(e)	Manufacturers (including importers), processors, and distributors must immediately notify EPA if they obtain information that supports the conclusion that a chemical substance or mixture presents a substantial risk of injury to health or the environment.	Eleven risk reports received for BBP (received: 1992–2009). One worker exposure submission was received in 2007. U.S. EPA, ChemView, Accessed April 9, 2019).
TSCA – section 4	Provides EPA with authority to issue rules, enforceable consent agreements, and orders requiring manufacturers (including importers) and processors to test chemical substances and mixtures.	Ten chemical data submissions from test rules received for BBP: one acute aquatic plant toxicity studies, five acute toxicity studies, two chronic aquatic toxicity studies, one bioaccumulation potential report, one persistence report. (U.S. EPA, ChemView, Accessed April 9, 2019).
Emergency Planning and Community Right-To-Know Act (EPCRA) – section 313	Requires annual reporting from facilities in specific industry sectors that employ 10 or more full-time equivalent employees and that manufacture, process or otherwise use a TRI-listed chemical in quantities above threshold levels. A facility that meets reporting	BBP was on the original TRI chemical list in 1987 and was delisted in calendar year 1994 (40 CFR 372). The last reporting year was 1993.

	requirements must submit a reporting form for each chemical for which it triggered reporting, providing data across a variety of categories, including activities and uses of the chemical, releases and other waste management (<i>e.g.</i> , quantities recycled, treated, combusted) and pollution prevention activities (under section 6607 of the Pollution Prevention Act). These data include on- and off-site data as well as multimedia data (<i>i.e.</i> , air, land, and water).	
Clean Water Act (CWA) – section 304(a)(1)	Requires EPA to develop and publish ambient water quality criteria (AWQC) reflecting the latest scientific knowledge on the effects on human health that can be expected from the presence of pollutants in any body of water.	In 2015, EPA published updated AWQC for BBP, including a recommendation of 0.1 µg/L for “Human Health for the consumption of Water + Organism” and 0.1 µg/L for “Human Health for the consumption of Organism Only” for states and authorized Tribes to consider when adopting criteria into their water quality standards. This criterion is based on carcinogenicity of 10 ⁻⁶ risk. (Docket ID: EPA-HQ-OW-2014-0135-0213)
CWA – sections 301, 304, 306, 307 and 402	CWA section 307(a) establishes 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 401.15. The “priority pollutants” specified by those families are listed in 40 CFR 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 judgement basis in 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 and sets regulatory requirements based on the performance of that technology.	Phthalate esters are designated as a toxic pollutant under section 307(a)(1) of the CWA and as such are subject to effluent limitations (40 CFR 401.15). Butyl benzyl phthalate is listed as a “priority pollutant” in 40 CFR 423 Appendix A . Under CWA section 304, BBP is included in the list of total toxic organics (TTO) (40 CFR 413.02(i)).
Resource Conservation and Recovery Act (RCRA) – section 3001	Directs EPA to develop and promulgate criteria for identifying the characteristics of hazardous waste, and for listing hazardous waste, taking into account toxicity, persistence, and degradability in nature, potential for accumulation in tissue and other related factors such as flammability, corrosiveness, and other hazardous characteristics.	BBP is listed as a hazardous constituent in Appendix VIII of Part 261 – Hazardous Constituents RCRA (40 CFR 261).
Comprehensive Environmental Response, Compensation and	Authorizes EPA to promulgate regulations designating as hazardous substances those substances which, when released into the environment, may present substantial danger to the public health or	BBP is a hazardous substance under CERCLA. Releases of BBP in excess of 100 lb must be reported (40 CFR 302.4).

Liability Act (CERCLA) – sections 102(a) and 103	welfare or the environment. EPA must also promulgate regulations establishing the quantity of any hazardous substance the release of which must be reported under section 103. Section 103 requires persons in charge of vessels or facilities to report to the National Response Center if they have knowledge of a release of a hazardous substance above the reportable quantity threshold.	
Superfund Amendments and Reauthorization Act (SARA)	Requires the Agency to revise the hazardous ranking system and update the National Priorities List (NPL) of hazardous waste sites, increases state and citizen involvement in the superfund program and provides new enforcement authorities and settlement tools.	BBP is listed on SARA, an amendment to CERCLA and the CERCLA Priority List of Hazardous Substances. This list includes substances most commonly found at facilities on the CERCLA NPL that have been deemed to pose the greatest threat to public health.
Other federal statutes/regulations		
Consumer Product Safety Improvement Act of 2008 (CPSIA)	Under section 108 of CPSIA, the U.S. 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%.	The use of BBP at concentrations greater than 0.1% is limited in toys and child care articles (16 CFR 1307).
Federal Hazardous Materials Transportation Act (HMTA)	Section 5103 of the Act directs the Secretary of Transportation to: • Designate material (including an explosive, radioactive material, infectious substance, flammable or combustible liquid, solid or gas, toxic, oxidizing or corrosive material, and compressed gas) as hazardous when the Secretary determines that transporting the material in commerce may pose an unreasonable risk to health and safety or property. • Issue regulations for the safe transportation, including security, of hazardous material in intrastate, interstate and foreign commerce.	BBP is listed as a hazardous material with regard to transportation and is subject to regulations prescribing requirements applicable to the shipment and transportation of listed hazardous materials. Its reportable quantity is 100 lb (49 CFR 172.1, Appendix A, Table 1)

B.2 State Laws and Regulations

Table_Apx B-2. State Laws and Regulations

State Actions	Description of Action
State Air Regulations	Allowable Ambient Levels Rhode Island (Air Pollution Regulation No. 22) 700 µg/m ³ in 24 hours.
State Drinking Water Standards and Guidelines	Florida (Fla. Admin. Code R. Chap. 62-550), Michigan (Mich. Admin. Code r.299.44 and r.299.49, 2017).
State Right-to-Know Acts	Massachusetts (105 Code Mass. Regs. § 670.000 Appendix A), New Jersey (8:59 N.J. Admin. Code § 9.1) and Pennsylvania (P.L. 734, No. 159 and 34 Pa. Code § 323).

Chemicals of High Concern to Children	Several states have adopted reporting laws for chemicals in children's products containing BBP, including Maine (38 MRSA Chapter 16-D), Minnesota (Toxic Free Kids Act Minn. Stat. 116.9401 to 116.9407), Oregon (Toxic-Free Kids Act, Senate Bill 478, 2015), Vermont (18 V.S.A § 1776) and Washington State (Wash. Admin. Code 173-334-130).
Other	California listed BBP on Proposition 65 on December 2, 2005, due to developmental toxicity. (Cal Code Regs. Title 27, § 27001). BBP is listed as a Candidate Chemical under California's Safer Consumer Products Program (Health and Safety Code § 25252 and 25253). California issued a Health Hazard Alert for BBP (Hazard Evaluation System and Information Service, 2016). BBP is on the MA Toxic Use Reduction Act (TURA) list of 2019 (300 CMR 41.00).

B.3 International Laws and Regulations

Table_Apx B-3. Regulatory Actions by other Governments, Tribes, and International Agreements

Country/Tribe/ Organization	Requirements and Restrictions
Canada	BBP is on the Domestic Substances List (Government of Canada. Managing substances in the environment. Substances search, Accessed April 28, 2020). BBP is on Canada's National Pollutant Release Inventory (NPRI). Reportable to NPRI if manufactured, processed or otherwise used at quantities >10 tons (Government of Canada. National Pollutant Release Inventory, Accessed April 16, 2019).
European Union	In February 2011, BBP was added to Annex XIV of Registration, Evaluation, Authorisation and Restriction of Chemicals (REACH) (Authorisation List) with a sunset date of February 2015. (European Chemicals Agency (ECHA) database , Accessed April 16, 2019).
Australia	BBP is subject to secondary notifications when importing or manufacturing the chemical in Australia. BBP was assessed under Human Health Tier II of the Inventory Multi-Tiered Assessment and Prioritisation (IMAP) as part of the C4-6 side chain transitional phthalates. Uses reported include as a plasticiser for PVC consumer products (including gumboots, toys – secondary plasticizer, play and exercise balls), in adhesives, textile printing inks, automotive refinishing, road-marking paints, light industrial, wood coatings and building products (NICNAS, 2017). In addition, BBP was assessed under Environment Tier II of IMAP as part of the phthalate esters. In 2015, BBP was also assessed as a Priority Existing Chemical (Assessment Report No. 40) (National Industrial Chemicals Notification and Assessment Scheme (NICNAS). Chemical inventory , Accessed April 3, 2019).

Japan	BBP is regulated in Japan under the following legislation: • Act on the Evaluation of Chemical Substances and Regulation of Their Manufacture, etc. (Chemical Substances Control Law; CSCL) • Act on Confirmation, etc. of Release Amounts of Specific Chemical Substances in the Environment and Promotion of Improvements to the Management Thereof • Air Pollution Control Act • (National Institute of Technology and Evaluation [NITE] Chemical Risk Information Platform [CHRIP], Accessed April 11, 2019).
Austria, Denmark, Germany, New Zealand, Norway, South Africa, Poland, Sweden, Switzerland, United Kingdom	Occupational exposure limits for BBP (CASRN 85-68-7) (GESTIS International limit values for chemical agents (Occupational exposure limits, OELs) database, (Accessed February 14, 2025). Norway has an 8-hour limit of 1 mg/m³. Austria, Denmark, and Sweden have an 8-hour limit of 3 mg/m³. New Zealand, Poland, South Africa, and the United Kingdom have an 8-hour limit of 5 mg/m³. Switzerland has an 8-hour limit of 10 mg/m³. Germany an 8-hour limit of 20 mg/m³.

B.4 Assessment History

Table_Apx B-4. Assessment History of BBP

Authoring Organization	Publication
U.S. EPA publications	
Office of Research and Development, U.S. Environmental Protection Agency	<i>Provisional Peer Reviewed Toxicity Values for Butyl Benzyl Phthalate</i> (U.S. EPA, 2002b) Integrated Risk Information System (IRIS) assessment for butyl benzyl phthalate (BBP) (U.S. EPA, 1993)
Other U.S.-based organizations	
National Toxicology Program Center for Evaluation of Risks to Human Reproduction (NTP-CERHR)	<i>NTP-CERHR Monograph on the Potential Human Reproductive and Developmental Effects of Butyl Benzyl Phthalate (BBP)</i> (NTP, 2003)
Office of Environmental Health Hazard Assessment (OEHHA), California Environmental Protection Agency	<i>Evidence on the Carcinogenicity of Butyl Benzyl Phthalate</i> (OEHHA, 2013) Reproductive Toxicity: Maximum Allowable Dose Level for Butyl Benzyl Phthalate (Oral) (OEHHA, 2012)
U.S. Consumer Product Safety Commission (CPSC)	<i>Estimated Phthalate Exposure and Risk to Women of Reproductive Age as Assessed Using 2013/2014 NHANES Biomonitoring Data</i> (CPSC, 2017) <i>Exposure Assessment: Composition, Production, and Use of Phthalates</i> (CPSC, 2015b)

Authoring Organization	Publication
	<i>Chronic Hazard Panel on Phthalates and Phthalate Alternatives Final Report (with Appendices)</i> (CPSC, 2014) Toxicity Review of Benzyl-n-Butyl Phthalate (CPSC, 2010a)
International	
Australian Government, National Industrial Chemicals Notification and Assessment Scheme (NICNAS)	<i>Priority existing chemical assessment report no. 40: Butyl benzyl phthalate</i> (NICNAS, 2015) C4-6 side chain transitional phthalates: Human health tier II assessment (NICNAS, 2016) Phthalate esters: Environment tier II assessment (NICNAS, 2019)
European Union, European Chemicals Agency (ECHA)	Annex to the Background document to the Opinion on the Annex XV dossier proposing restrictions on four phthalates (DEHP, BBP, DBP, DIBP) (ECHA, 2017a) Opinion on an Annex XV dossier proposing restrictions on four phthalates (DEHP, BBP, DBP, DIBP) (ECHA, 2017b) Committee for Risk Assessment (RAC) Committee for Socio-economic Analysis (SEAC): Background document to the Opinion on the Annex XV dossier proposing restrictions on four phthalates (ECHA, 2012a) Committee for Risk Assessment (RAC) Opinion on an Annex XV dossier proposing restrictions on four phthalates (ECHA, 2012b)
European Food Safety Authority (EFSA)	Update of the risk assessment of di-butylphthalate (DBP), butyl-benzyl-phthalate (BBP), bis(2-ethylhexyl)phthalate (DEHP), di-isononylphthalate (DINP) and di-isodecylphthalate (DIDP) for use in food contact materials (EFSA, 2019)
Government of Canada, Environment Canada, Health Canada	Canadian environmental protection act priority substances list assessment report: Butylbenzylphthalate (EC/HC, 2000) Proposed approach for cumulative risk assessment of certain phthalates under the Chemicals Management Plan (EC/HC, 2015a) Proposed approach for cumulative risk assessment of certain phthalates under the Chemicals Management Plan (Health Canada, 2020)

Authoring Organization	Publication
International Agency for Research on Cancer (IARC)	<i>Some chemicals that cause tumours of the kidney or urinary bladder in rodents and some other substances: Butyl Benzyl Phthalate (IARC, 1999)</i>

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Appendix C LIST OF TECHNICAL SUPPORT DOCUMENTS

This appendix includes a list and citations for all supplemental documents included in the draft risk evaluation for BBP.

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.

Draft Systematic Review Protocol for Butyl Benzyl Phthalate (BBP) ([U.S. EPA, 2025ac](#)) – 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 Draft Risk Evaluation for BBP 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 “BBP Systematic Review Protocol.”

Draft Data Quality Evaluation and Data Extraction Information for Physical and Chemical Properties for Butyl Benzyl Phthalate (BBP) ([U.S. EPA, 2025k](#)) – Provides a compilation of tables for the data extraction and data quality evaluation information for BBP. 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 “BBP Data Quality Evaluation and Data Extraction Information for Physical and Chemical Properties.”

Draft Data Quality Evaluation and Data Extraction Information for Environmental Fate and Transport for Butyl Benzyl Phthalate (BBP) ([U.S. EPA, 2025i](#)) – Provides a compilation of tables for the data extraction and data quality evaluation information for BBP. 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 “BBP Data Quality Evaluation and Data Extraction Information for Environmental Fate and Transport.”

Draft Data Quality Evaluation and Data Extraction Information for Environmental Release and Occupational Exposure for Butyl Benzyl Phthalate (BBP) ([U.S. EPA, 2025j](#)) – Provides a compilation of tables for the data extraction and data quality evaluation information for BBP. 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 “BBP Data Quality Evaluation and Data Extraction Information for Environmental Release and Occupational Exposure.”

Draft Data Quality Evaluation Information for General Population, Consumer, and Environmental Exposure for Butyl Benzyl Phthalate (BBP) ([U.S. EPA, 2025m](#)) – Provides a compilation of tables for the data quality evaluation information for BBP. 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 “BBP Data Quality Evaluation Information for General Population, Consumer, and Environmental Exposure.”

Draft Data Extraction Information for General Population, Consumer, and Environmental Exposure for Butyl Benzyl Phthalate (BBP) ([U.S. EPA, 2025h](#)) – Provides a compilation of tables for the data extraction for BBP. 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 “BBP Data Extraction Information for General Population, Consumer, and Environmental Exposure.”

Draft Data Quality Evaluation Information for Human Health Hazard Epidemiology for Butyl Benzyl Phthalate (BBP) ([U.S. EPA, 2025o](#)) – Provides a compilation of tables for the data quality evaluation information for BBP. 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 “BBP Data Quality Evaluation Information for Human Health Hazard Epidemiology.”

Draft Data Quality Evaluation Information for Human Health Hazard Animal Toxicology for Butyl Benzyl Phthalate (BBP) ([U.S. EPA, 2025n](#)) – Provides a compilation of tables for the data quality evaluation information for BBP. 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 “BBP Data Quality Evaluation Information for Human Health Hazard Animal Toxicology.”

Draft Data Quality Evaluation Information for Environmental Hazard for Butyl Benzyl Phthalate (BBP) ([U.S. EPA, 2025l](#)) – Provides a compilation of tables for the data quality evaluation information for BBP. 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 “BBP Data Quality Evaluation Information for Environmental Hazard.”

Draft Data Extraction Information for Environmental Hazard and Human Health Hazard Animal Toxicology and Epidemiology for Butyl Benzyl Phthalate (BBP) ([U.S. EPA, 2025g](#)) – Provides a compilation of tables for the data extraction for BBP. 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 “BBP Data Extraction Information for Environmental Hazard and Human Health Hazard Animal Toxicology and Epidemiology.”

Associated **Technical Support Documents (TSDs)** – Provide additional details and information on exposure, hazard, and risk assessments.

Draft Physical Chemistry and Fate and Transport Assessment for Butyl Benzyl Phthalate (BBP) ([U.S. EPA, 2025z](#))

Draft Environmental Release and Occupational Exposure Assessment for Butyl Benzyl Phthalate (BBP) ([U.S. EPA, 2025t](#))

Draft Consumer and Indoor Exposure Assessment for Butyl Benzyl Phthalate (BBP) ([U.S. EPA, 2025d](#))

Draft Environmental Media and General Population and Environmental Exposure Assessment for Butyl Benzyl Phthalate (BBP) ([U.S. EPA, 2025r](#))

Draft Environmental Hazard Assessment for Butyl Benzyl Phthalate (BBP) ([U.S. EPA, 2025p](#))

Draft Non-Cancer Human Health Hazard Assessment for Butyl Benzyl Phthalate (BBP) ([U.S. EPA, 2025v](#))

Draft 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, 2025c](#))

Draft Consumer Risk Calculator for Butyl Benzyl Phthalate (BBP) ([U.S. EPA, 2025f](#))

Draft Consumer Exposure Analysis for Butyl Benzyl Phthalate (BBP) ([U.S. EPA, 2025e](#))

Draft Risk Calculator for Occupational Exposures for Butyl Benzyl Phthalate (BBP) ([U.S. EPA, 2025y](#))

Draft Fish Ingestion Risk Calculator for Butyl Benzyl Phthalate (BBP) ([U.S. EPA, 2025u](#))

Draft Surface Water Human Exposure Risk Calculator for Butyl Benzyl Phthalate (BBP) ([U.S. EPA, 2025ab](#))

Draft Ambient Air Exposure Assessment for Butyl Benzyl Phthalate (BBP) ([U.S. EPA, 2025b](#))

Draft Occupational and Consumer Cumulative Risk Calculator for Butyl Benzyl Phthalate (BBP) ([U.S. EPA, 2025x](#))

Draft 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, 2024b](#)).

Revised Draft 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, 2025ad](#)).

Draft Summary of Facility Release Data for Di(2-ethylhexyl) Phthalate (DEHP), Dibutyl Phthalate (DBP), and Butyl Benzyl Phthalate (BBP) ([U.S. EPA, 2024g](#)).

Appendix D UPDATES TO THE BBP CONDITIONS OF USE TABLE

After the final scope ([U.S. EPA, 2020c](#)), EPA received updated submissions from the 2020 CDR cycle. In addition to new submissions received under CDR, the use and processing codes changed for the 2020 CDR cycle ([U.S. EPA, 2020a](#)). Therefore, EPA amended the description of certain BBP COUs based on those new submissions and new reporting name codes. Also, EPA received information from stakeholders about uses of BBP. For cases where COUs were consolidated under a category, if the category was not present in the scope, the nomenclature was taken directly from the 2020 CDR cycle codes and categories. Table_Apx D-1 summarizes the changes to the COUs based on the new codes in the 2020 CDR cycle and any other additional information reasonably available to EPA since the publication of the final scope document in 2020.

Table_Apx D-1. Changes to Categories and Subcategories of COUs Based on CDR and Stakeholder Engagement

Life Cycle Stage and Category in the Final Scope Document	Subcategory in the Final Scope Document	Occurred Change	Revised COU in the 2025 Draft Risk Evaluation
Manufacture – Domestic manufacturing	Domestic manufacturing	Changed life stage by adding an “ing”	Manufacturing – domestic manufacturing
Manufacture – Import	Import	Changed category and subcategory by adding an “ing”	Manufacturing – importing
Processing – Incorporating into formulation, mixture or reaction product	Fillers (<i>e.g.</i> , in custom compound of purchased resin)	Changed category by removing “ing” and replacing with “incorporation” to be consistent with 2020 CDR codes Removed fillers and “<i>e.g.</i>, in” ^a Replaced fillers with plasticizers based on outreach with stakeholder ^a Added “plastic and resin manufacturing” and “rubber manufacturing” industrial sectors to better represent the sectors involved in non-PVC and PVC compounding Consolidated the industrial sectors under the “Processing – incorporation into formulation, mixture, or reaction product – plasticizers” to avoid redundancy with an existing COU in the scope	Processing – incorporation into formulation, mixture or reaction product – plasticizers (custom compounding of purchased resin; plastic material and resin manufacturing; rubber manufacturing; adhesive manufacturing; basic inorganic chemical manufacturing; paints and coatings manufacturing; ink, toner, and colorant manufacturing)
Processing – Incorporating into formulation, mixture or reaction product	Plasticizers (<i>e.g.</i> , in adhesive manufacturing; all other basic inorganic chemical manufacturing; paints and coatings manufacturing; printing ink manufacturing)	Changed category by removing “ing” and replacing with incorporation to be consistent with 2020 CDR codes Changed “printing ink manufacturing” to “ink, toner, and colorant manufacturing” to better describe the manufacturing	Processing – incorporation into formulation, mixture or reaction product – plasticizers (custom compounding of purchased resin; plastic material and resin manufacturing; rubber manufacturing; adhesive manufacturing; ; paints and coatings manufacturing; ink,

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Life Cycle Stage and Category in the Final Scope Document	Subcategory in the Final Scope Document	Occurred Change	Revised COU in the 2025 Draft Risk Evaluation
		of all products from this sector that contain BBP Consolidated “all other basic inorganic manufacturing” under other industrial sectors listed because the Agency could not find information that BBP was used in this industrial sector Removed “<i>e.g.</i>, in” to be more specific about the industrial sectors	toner, and colorant manufacturing)
Processing – Incorporating into formulation, mixture or reaction product	Biocide carrier manufacturing	^a Removed COUs based on the review of information from a stakeholder, the product that uses BBP as a biocide carrier is “not available for sale in the E.U. or North America” (Earthjustice, 2019). The Agency does not have any information that the product or any similar product containing BBP is manufactured in the United States.	N/A
Processing – Incorporating into articles	Plasticizers (<i>e.g.</i> , in asphalt paving, roofing, and coating materials manufacturing; fabric, textile, and leather products not covered elsewhere manufacturing; floor coverings manufacturing; plastics product manufacturing; rubber product manufacturing; textiles, apparel, and leather manufacturing; transportation equipment manufacturing)	Changed category by removing “ing” and replacing with incorporation” Removed “<i>e.g.</i>, in;” “not covered elsewhere” from “fabric, textile, and leather products not covered elsewhere manufacturing;” Added “adhesive manufacturing” based on a 2020 CDR submission Consolidated “asphalt paving, roofing, and coating materials manufacturing” and “floor coverings” into “building and construction materials manufacturing” and consolidated “textiles, apparel, and leather manufacturing” with “fabric, textile, and leather product manufacturing”	Processing – incorporation into article – plasticizers (adhesive manufacturing; fabric, textile, and leather products manufacturing; building and construction materials manufacturing; plastics product manufacturing; rubber product manufacturing; transportation equipment manufacturing)
Industrial Use – Adhesives and sealants	Adhesives and sealants	^a Consolidated under the “Construction, paint, electrical, and metal products” category	Industrial use – construction, paint, electrical, and metal products – adhesives and sealants
Industrial Use – Automotive, fuel, agriculture, outdoor use products	Automotive care products	Updated category to “Other uses” to be consistent with 2020 CDR categories	Industrial use – other uses – automotive articles

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Life Cycle Stage and Category in the Final Scope Document	Subcategory in the Final Scope Document	Occurred Change	Revised COU in the 2025 Draft Risk Evaluation
		Consolidated “automotive care products” into “automotive articles;” based on stakeholder comments, this title is a more accurate representation of the use (MEMA, 2019)	
N/A	N/A	Added “Industrial use – other uses – automotive products, fluids” based on received stakeholder comments (MEMA, 2019)	Industrial use – other uses – automotive products, fluids
Industrial Use – Castings	Castings	Changed the category “Castings” to “Other uses” to be consistent with 2020 CDR categories	Industrial use – other uses – castings
Industrial Use – Construction, paint, electrical, and metal products	Building/construction not covered elsewhere	Consolidated under “Industrial use – construction, paint, electrical, and metal products – adhesives and sealants” because the identified product was best represented under that COU (DAP Products, 2024)	Industrial use – construction, paint, electrical, and metal products – adhesives and sealants
Industrial Use – Floor coverings	Floor coverings	Consolidated under “Processing – incorporation into articles – building and construction materials manufacturing” to better represent this use	Processing – incorporation into articles – plasticizers (adhesive manufacturing; fabric, textile, apparel, and leather products manufacturing; building and construction materials manufacturing; plastics product manufacturing; rubber product manufacturing; transportation equipment manufacturing
Industrial Use – Furnishing, cleaning, treatment/care products	Fabric, textile, and leather products not covered elsewhere	Consolidated under “Processing – incorporation into articles – fabric, textile, and leather products manufacturing” to better represent this use	Processing – incorporation into articles – plasticizers (adhesive manufacturing; fabric, textile, apparel, and leather products manufacturing; building and construction materials manufacturing; plastics product manufacturing; rubber product manufacturing; transportation equipment manufacturing
Industrial Use – Ink, toner, and colorant products	Ink, toner, and colorant products	^a Consolidated under “Packaging, paper, plastic, hobby products” category to match the 2020 CDR codes	Industrial use – packaging, paper, plastic, hobby products – ink, toner, and colorant products
Industrial Use – Paints and coatings	Paints and coatings	^a Consolidated under “Construction, paint, electrical, and metal products” category to match the 2020 CDR codes	Industrial use – construction, paint, electrical, and metal products – paints and coatings
Industrial Use – Plastic and rubber products not covered elsewhere	Plastic and rubber products not covered elsewhere	Consolidated under “Processing – incorporation into article – plasticizers” to better represent this use	Processing – incorporation into articles – plasticizers (adhesive manufacturing; fabric, textile, apparel, and leather products

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Life Cycle Stage and Category in the Final Scope Document	Subcategory in the Final Scope Document	Occurred Change	Revised COU in the 2025 Draft Risk Evaluation
			manufacturing; building and construction materials manufacturing; plastics product manufacturing; rubber product manufacturing; transportation equipment manufacturing
Industrial Use – Other uses	Chemical intermediate	^a Consolidated under “Processing – incorporation into formulation – plasticizers”	Processing – incorporation into formulation, mixture or reaction product – plasticizers (custom compounding of purchased resin; plastic material and resin manufacturing; rubber manufacturing; adhesive manufacturing; paints and coatings manufacturing; ink, toner, and colorant manufacturing)
Industrial Use – Other uses	Laboratory chemical	Consolidated under “Commercial use – other uses – laboratory chemicals” because the COU is better described as a commercial use	Commercial use – other uses – laboratory chemicals
Industrial Use – Other uses	Plastic and rubber products not covered elsewhere (<i>e.g.</i> , component of compound (resin) used to cast models)	Consolidated under “Industrial use – other uses – castings” because the two COUs are considered redundant based on stakeholder comment (NASA, 2020)	Industrial use – other uses – castings
Commercial Use – Adhesives and sealants	Adhesives and sealants	^a Consolidated under “Construction, paint, electrical, and metal products” category to match 2020 CDR codes	Commercial use – construction, paint, electrical, and metal products – adhesives and sealants
Commercial Use – Automotive, fuel, agriculture, outdoor use products	Automotive care products	Changed category to “Other uses” to be consistent with 2020 CDR categories Consolidated “automotive care products” into “automotive articles;” based on stakeholder comments, this title is a more accurate representation of the use (MEMA, 2019)	Commercial use – other uses – automotive articles
N/A	N/A	Added “Commercial use – other uses – automotive products, fluids” based on received stakeholder comments (MEMA, 2019 ; Armored AutoGroup Inc., 2015)	Commercial use – other uses – automotive products, fluids
Commercial Use – Castings	Castings	Changed the category “Castings” to “Other uses” to be consistent with 2020 CDR categories	Commercial use – other uses – castings

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Life Cycle Stage and Category in the Final Scope Document	Subcategory in the Final Scope Document	Occurred Change	Revised COU in the 2025 Draft Risk Evaluation
Commercial Use – Construction, paint, electrical, and metal products	Building/construction not covered elsewhere	Consolidated under “Commercial use – construction, paint, electrical, and metal products – adhesives and sealants” because the product identified was better represented by this COU (DAP Products, 2024)	Commercial use – construction, paint, electrical, and metal products – adhesives and sealants
Commercial Use – Floor coverings	Floor coverings	^a Consolidated under the “Furnishing, cleaning, treatment/care products” category to match 2020 CDR codes ^a Changed subcategory to match the reporting codes in the 2020 CDR cycle	Commercial use – furnishing, cleaning, treatment/care products – floor coverings; construction and building materials covering large surface areas including stone, plaster, cement, glass and ceramic articles; fabrics, textiles, and apparel
Commercial Use – Furnishing, cleaning, treatment/care products	Fabric, textile, and leather products not covered elsewhere	Removed “not covered elsewhere”	Commercial uses – furnishing, cleaning, treatment/care products – fabric, textile, and leather products
Commercial Use – Ink, toner, and colorant products	Ink, toner, and colorant products	^a Consolidated under “Packaging, paper, plastic, hobby products” to match 2020 CDR codes	Commercial use – packaging, paper, plastic, hobby products – ink, toner, and colorant products
Commercial Use – Paints and coatings	Paints and coatings	^a Consolidated under category to “Construction, paint, electrical, and metal products” category to match 2020 CDR codes	Commercial use – construction, paint, electrical, and metal products – paints and coatings
Commercial Use – Plastic and rubber products not covered elsewhere	Plastic and rubber products not covered elsewhere	^a Consolidated under “Packaging, paper, plastic, hobby products” to match the 2020 CDR codes ^a Changed the subcategory to match the 2020 CDR codes	Commercial use – packaging, paper, plastic, hobby products – packaging (excluding food packaging) and other articles with routine direct contact during normal use, rubber articles; plastic articles (hard); plastic articles (soft) (as plasticizer)
N/A	N/A	^a Added “Commercial use – packaging, paper, plastic, hobby products -toys, playground, and sporting equipment” based on additional information that BBP is present in artificial turf (U.S. EPA, 2024j , k , 2019e , f)	Commercial use – packaging, paper, plastic, hobby products – toys, playground, and sporting equipment
Commercial Use – Other uses	Chemical intermediate	^a Consolidated under “Processing – incorporation into formulation – plasticizers”	Processing – incorporation into formulation, mixture or reaction product – plasticizers (custom compounding of purchased resin; plastic material and resin manufacturing; rubber manufacturing; adhesive manufacturing; paints and coatings manufacturing; ink, toner, and colorant manufacturing)

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Life Cycle Stage and Category in the Final Scope Document	Subcategory in the Final Scope Document	Occurred Change	Revised COU in the 2025 Draft Risk Evaluation
Commercial Use – Other uses	Plastic and rubber products not covered elsewhere (<i>e.g.</i> , component of compound (resin) used to cast models)	Consolidated under “Industrial use – other uses – castings” based on stakeholder comment (NASA, 2020)	Industrial use – other uses – castings
Consumer Use – Adhesives and sealants	Adhesives and sealants	^a Consolidated under “Construction, paint, electrical, and metal products” category to match the 2020 CDR codes	Consumer use – construction, paint, electrical, and metal products – adhesives and sealants
Consumer Use – Automotive, fuel, agriculture, outdoor use products	Automotive care products	Updated category to “Other uses” Consolidated “automotive care products” into “automotive articles;” based on stakeholder comment, this title is a more accurate representation of the use (MEMA, 2019)	Consumer use – other uses – automotive articles
N/A	N/A	Added consumer use – other uses – automotive products, fluids based on identified products (U.S. EPA, 2020c ; Armored AutoGroup Inc., 2015)	Consumer use – other uses – automotive products, fluids
Consumer Use – Construction, paint, electrical, and metal products	Building/construction not covered elsewhere	Consolidated under “Consumers use – construction, paint, electrical, and metal products – adhesives and sealants” because no products were identified by EPA	Consumers use – construction, paint, electrical, and metal products – adhesives and sealants
Consumer Use – Floor coverings	Floor coverings	^a Consolidated under the “Furnishing, cleaning, treatment/care products” category to match 2020 CDR codes ^a Changed subcategory to match the 2020 CDR cycle codes	Consumer use – furnishing, cleaning, treatment/care products – construction and building materials covering large surface areas including stone, plaster, cement, glass and ceramic articles; fabrics, textiles, and apparel
Consumer Use – Furnishing, cleaning, treatment/care products	Fabric, textile, and leather products not covered elsewhere	Removed “not covered elsewhere”	Consumer use – furnishing, cleaning, treatment/care products – fabric, textile, and leather products
Consumer Use – Packaging, paper, plastic, hobby products	Arts, crafts, and hobby materials Toys, playground, and sporting equipment Ink, toner, and colorant products	Separated each its own subcategory to better describe the use	Consumer use – packaging, paper, plastic, hobby products – arts, crafts, and hobby materials
Consumer Use – Packaging, paper, plastic, hobby products	Arts, crafts, and hobby materials	Separated each its own subcategory to better describe the use	Consumer use – packaging, paper, plastic, hobby products – toys, playground, and sporting equipment

Life Cycle Stage and Category in the Final Scope Document	Subcategory in the Final Scope Document	Occurred Change	Revised COU in the 2025 Draft Risk Evaluation
	Toys, playground, and sporting equipment Ink, toner, and colorant products		
Consumer use – Packaging, paper, plastic, hobby products	Arts, crafts, and hobby materials Toys, playground, and sporting equipment Ink, toner, and colorant products	Separated each into its own subcategory to better describe the use	Consumer Use – packaging, paper, plastic, hobby products – ink, toner, and colorant products
Consumer use – Paints and coatings	Paints and coatings	Consolidated under “Construction, paint, electrical, and metal products” category to match the 2020 CDR codes	Consumer use – construction, paint, electrical, and metal products – paints and coatings
Consumer use – Plastic and rubber products not covered elsewhere	Plastic and rubber products not covered elsewhere	^a Consolidated under “Packaging, paper, plastic, hobby products” to match the 2020 CDR codes ^a Changed the subcategory to match the 2020 CDR codes	Consumer use – packaging, paper, plastic, hobby products – packaging (excluding food packaging) and other articles with routine direct contact during normal use, rubber articles; plastic articles (hard); plastic articles (soft) (as plasticizer)
N/A	N/A	^a Added category and subcategory based on additional information (Sipe et al., 2023).	Consumers use – other uses – novelty articles
^a Indicates further explanation of the occurred change is provided below this table.			

In addition, EPA is including further detail about edits to the following COUs, which are already summarized in Table_Apx D-1:

- In the 2016 CDR cycle, one company reported the use of BBP as a filler in *Processing – incorporation into formulation, mixture, or reaction product – custom compounding of purchased resin* ([U.S. EPA, 2019b](#)). However, the usual function of ortho-phthalates is as a plasticizer in plastic compounding. A plasticizer is defined by American Society for Testing and Materials (ASTM-D-883), as “substance incorporated in a material to increase its workability, flexibility, or distensibility,” which contrasts with a function of a filler ([ASTM, 2023](#)). Upon outreach with the stakeholder, they clarified that the function of BBP in custom compounding of purchased resin is to increase flexibility and improve impact resistance, which is consistent with the role of a plasticizer ([U.S. EPA, 2025a](#)). Therefore, EPA consolidated this COU under “*Processing – incorporation into formulation, mixture, or reaction product – plasticizer*” to better match the functional use as clarified by the stakeholder.
- To describe the upstream process prior to incorporation into article, the industrial sector “*Plastic and resin manufacturing*” was added to the “*Processing – incorporation into formulation, mixture, or reaction product– plasticizer*” COU. “*Processing – incorporation into article – plastic product manufacturing*” was reported in the 2016 and 2020 CDR cycles ([U.S. EPA, 2020a, 2019b](#)).

- 7654 • Based on additional information EPA identified, BBP is found in tire crumb rubber
7655 characterization and a stakeholder comment that BBP is found in silicone rubber coated
7656 fiberglass used in aerospace applications, the industrial sector “*rubber manufacturing*” was
7657 added to the “*Processing – incorporation into formulation, mixture, or reaction product –*
7658 *plasticizer*” COU ([U.S. EPA, 2024j](#), [k](#); [AIA, 2019](#); [U.S. EPA, 2019e](#), [f](#)).
7659
- 7660 • “*Processing – incorporation into formulation, mixture, or reaction product – biocide carrier*
7661 *manufacturing*” was removed because EPA did not find any evidence that these types of
7662 products containing BBP are manufactured in the United States. However, if the Agency
7663 receives information that there is manufacturing of BBP-containing biocides in the United States,
7664 EPA will consider the processing of BBP prior to incorporation with the biocide to be a
7665 condition of use.
7666
- 7667 • “*Adhesive and sealant*” and “*paints and coatings*” subcategories were consolidated under
7668 the “*Construction, paint, electrical, and metal products*” category for the industrial, commercial,
7669 and consumer life stages to better align with the 2020 CDR cycle nomenclature and with
7670 products identified. EPA received CDR submissions for these subcategories under the
7671 “*Construction, paint, electrical, and metal products*” category. EPA is using the “*Construction,*
7672 *paint, electrical, and metal products*” nomenclature to better describe the uses, since the broader
7673 category better represents the variety of applications of the identified products.
7674
- 7675 • “*Ink, toner, and colorant products*” and “*packaging (excluding food packaging) and other*
7676 *articles with routine direct contact during normal use, rubber articles; plastic articles (hard);*
7677 *plastic articles (soft) (as plasticizer)*” subcategories were consolidated under the “*Packaging,*
7678 *paper, plastic, hobby products*” category to better align with the 2020 CDR cycle nomenclature
7679 and with other phthalates designated as high-priority substances or that have undergone
7680 manufacture requested risk evaluation.
7681
- 7682 • “*Floor coverings; Construction and building materials covering large surface areas including*
7683 *stone, plaster, cement, glass and ceramic articles; fabrics, textiles, and apparel*” subcategories
7684 was consolidated under the “*Furnishing, cleaning, treatment/care products*” category for the
7685 commercial and consumer life cycle stages to better align with the 2020 CDR cycle
7686 nomenclature and to better describe the types of articles and products covered under this COU
7687 ([EPAB, 2020](#); [Quikrete, 2019a](#)). This change also aligns BBP COUs with the nomenclature used
7688 for the COUs for other phthalates designated as high-priority substances or that have undergone
7689 manufacture requested risk evaluation.
7690
- 7691 • “*Industrial Use – other uses – intermediate and commercial use – other uses – intermediates*”
7692 was consolidated with “*processing – incorporation into formulation, mixture, or reaction*
7693 *product– plasticizer*” because upon further investigation, the Agency determined that these two
7694 COUs were redundant. The term “intermediate” is used here to describe the intermediate step in
7695 plastic product/article production where a PVC plastic or non-PVC resin is formed prior to
7696 conversion to the final article.
7697
- 7698 • “*Commercial Use – toys, playground, and sporting equipment*” was added to the draft risk
7699 evaluation based on Agency investigation into the characterization of recycled rubber tire crumb
7700 containing BBP that is used to build synthetic turf playing fields and playground. EPA is
7701 therefore adding it during the development of the draft risk evaluation to ensure that it is assessed

appropriately given the evidence the Agency has cited on BBP being used in these types of products ([U.S. EPA, 2024j](#), [k](#), [2019e](#), [f](#)).

- “*Consumer use – novelty articles*” was added to the draft risk evaluation based on Agency investigation into the use of various phthalates in adult sex toys (*i.e.*, novelty products). EPA therefore adding it during the development of the draft risk evaluation to ensure that it is assessed appropriately given the evidence the Agency has cited on BBP being used in these types of articles ([Sipe et al., 2023](#)).

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 the last two CDR cycles for BBP (CASRN 85-68-7), and the COU descriptions reflect what the Agency identified as the best fit for that submission. 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 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 the CDR reports that are referenced; that is, “plastic 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 manufacturing means to manufacture or produce BBP within the United States. For purposes of the draft BBP risk evaluation, this includes the extraction of BBP from a previously existing chemical substance or complex combination of chemical substances and loading and repackaging (but not transport) associated with the manufacturing, production, or import of BBP.

BBP is typically manufactured through reaction of the monobutyl ester of phthalic acid with benzyl alcohol or by reaction with benzyl chloride in the presence of an acid catalyst in solution ([U.S. EPA, 2020c](#)). The monobutyl ester can be produced through reaction of phthalic anhydride with n-butyl alcohol, before reaction with benzyl chloride or benzyl alcohol to produce butyl benzyl phthalate ([CPSC, 2015b](#)). This COU includes this typical manufacturing process and any other similar manufacturing processes of BBP.

Examples of CDR Submissions

According to the 2016 CDR cycle, three companies submitted activity data for 2015. Two of these companies stated that they imported BBP in 2015 and the remaining company’s 2015 manufacture or import activity is claimed as CBI ([U.S. EPA, 2019b](#)). According to the 2020 CDR cycle, there is only one manufacturer of BBP (CASRN 85-68-7) in the United States ([U.S. EPA, 2020a](#)). BBP is manufactured as a liquid.

E.2 Manufacturing – Importing

Import refers to the import of BBP into the customs territory of the United States. This condition of use includes loading/unloading and repackaging (but not transport) associated with the import of BBP. In general, chemicals may be imported into the United States in bulk via water, air, land, and intermodal shipments. According to 2016 and 2020 CDR cycle data, BBP is imported into the United States in liquid and wet solid form ([U.S. EPA, 2019b](#)) including liquids, pellets, or large crystals ([U.S. EPA, 2020a](#)).

Examples of CDR Submissions

According to the 2020 CDR cycle, two companies import BBP (CASRN 85-68-7) into the United States ([U.S. EPA, 2020a](#)). According to the 2016 CDR cycle, three companies submitted activity data for 2015 ([U.S. EPA, 2019b](#)). Two of these companies stated that they imported BBP in 2015 while the remaining company’s 2015 manufacture or import activity is claimed as CBI ([U.S. EPA, 2019b](#)).

E.3 Processing – Incorporation into Formulation, Mixture, or Reaction Product – Plasticizers (Custom Compounding of Purchased Resin; Plastic Material and Resin Manufacturing; Rubber Manufacturing; Adhesive Manufacturing; Paints and Coatings Manufacturing; Ink, Toner, and Colorant Manufacturing)

This COU refers to the preparation of a product; that is, the incorporation of BBP 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. A plasticizer provides flexibility to non-PVC and PVC plastic materials. In manufacturing of plastic material and resin through non-PVC and PVC compounding, BBP is blended into polymers. Compounding involves the mixing of the polymer with the plasticizer and other chemicals 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 transferring 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. BBP is used as a plasticizer incorporated into rubber during rubber manufacturing, which could be used in various rubber products or articles ([U.S. EPA, 2024j](#), [k](#); [AIA, 2019](#); [U.S. EPA, 2019e](#), [f](#)).

BBP is also used in the formulation of adhesives and sealants, paints and coatings, and inks, toners, and colorants ([U.S. EPA, 2020c](#)).

Examples of CDR Submissions

Although Processing – incorporation into formulation, mixture, or reaction product of plastic material and resin manufacturing were not reported during the 2016 and 2020 CDR cycles, Processing – incorporation into article – plastic product manufacturing was reported during the 2016 and 2020 CDR cycles. Therefore, this COU best describes the upstream resin manufacturing and compounding process before it is shaped into plastic products or articles ([U.S. EPA, 2020a](#), [2019b](#)). In the 2016 CDR cycle, there was one report of Processing – incorporation into formulation, mixture, or reaction product of the use of BBP as a filler in custom compounding of purchased resin ([U.S. EPA, 2019b](#)). However, upon outreach with the company, they clarified that BBP’s function in this use is as a plasticizer ([U.S. EPA, 2025a](#)). The reported use as a filler is therefore best represented by this COU.

E.4 Processing – Incorporation into Formulation, Mixture, or Reaction Product – Laboratory Chemical Manufacturing

Processing to incorporate BBP into a formulation, mixture, or reaction product refers to the addition of a chemical substance, after its manufacture, to a product or product mixture for distribution in commerce. In this case, BBP is added to a mixture of chemical substances used as a reference standard in analytical methods for monitoring chemical substances in aqueous and solid samples ([AccuStandard, 2023](#); [SPEX CertiPrep, 2023](#)). It is also used to produce reference standards used in analytical methods to determine the amount of BPP in articles (*i.e.*, childcare articles or toys) ([SPEX CertiPrep, 2024](#), [2021](#)).

The processing use for laboratory chemical manufacturing was not reported during the 2016 or 2020 CDR cycles.

E.5 Processing – Incorporation into Articles – Plasticizers (Adhesive Manufacturing; Fabric, Textile, Apparel, and Leather Products Manufacturing; Building and Construction Materials Manufacturing; Plastics Product Manufacturing; Rubber Product Manufacturing; Transportation Equipment Manufacturing;)

This COU refers to the preparation of an article; that is, the incorporation of BBP into articles, meaning BBP becomes a component of the article, after its manufacture, for distribution in commerce. In this case, BBP is present in a raw material such as rubber or plastic that contains a mixture of plasticizer, fillers, and other additives. This COU refers to the manufacturing of PVC and non-PVC articles using those raw materials. The raw material is converted by processes such as calendaring, extrusion, injection molding, and plastisol spread coating ([ACC, 2020b](#)). This COU encompasses the step that occurs immediately after PVC compounding, where the compounded resin is sent to an extruder that shapes and sizes the plastic into an article or pellet to be used in downstream processing at PVC or non-PVC conversion sites ([U.S. EPA, 2021c](#)).

In the manufacture of coated textiles, such as synthetic leather, plastisol can be applied to a solid backing to produce a textile used in industrial, commercial, and consumer settings (<https://www.vestolit.com/products/artificial-leather/>).

BBP is incorporated as a general-purpose plasticizer PVC for vinyl floor tile ([EPAB, 2020](#)). BBP has been reported to be incorporated into parts used in aerospace and automobiles. However, it is not clear how many of these parts are manufactured in the United States vs. imported from other countries ([AIA, 2019](#); [MEMA, 2019](#)).

BBP can be used as a plasticizer to provide flexibility to toys. The Consumer Product Safety Improvement Act (CPSIA) of 2008 placed a prohibition on BBP that limited manufacturers' use of BBP in children's toys to 0.1 percent ([U.S. EPA, 2019a](#)). This COU includes the processing of BBP; that is, forming, shaping, or cutting articles containing BBP in toy manufacturing because toys could contain up to 0.1 percent of BBP. Additionally, BBP could be incorporated into playground equipment manufacturing due to its use as a plasticizer in PVC and non-PVC articles, which may be components of playground equipment. BBP is also reported to be in a component of tire crumb, which is used in playgrounds and playing fields. BBP may also be a part of other components in playing field based on results of federal research on exposure to chemicals in outdoor and indoor playing fields, see Federal Research Action Plan on Recycled Tire Crumb Used on Playing Fields and Playgrounds ([U.S. EPA, 2024j, k, 2019e, f](#)).

Examples of CDR Submissions

In the 2020 CDR cycle, there was one report of the processing of BBP into the incorporation into article for adhesive manufacturing and plastic product manufacturing ([U.S. EPA, 2020a](#)). In the 2016 CDR cycle, there was one report of the processing of BBP into the incorporation into article for adhesive manufacturing and plastic product manufacturing ([U.S. EPA, 2019b](#)).

E.6 Processing – Repackaging

Repackaging refers to the preparation of BBP for distribution in commerce in a different form, state, or quantity than originally received or stored by various industrial sectors, including laboratory chemicals manufacturing ([U.S. EPA, 2020e](#)). This includes the transferring of a chemical substance from a bulk container into smaller containers. 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.

The processing use of BBP in repackaging was not reported during the 2016 or 2020 CDR cycles.

E.7 Processing – Recycling

This COU refers to the process of treating generated waste streams (*i.e.*, which would otherwise be disposed of as waste) containing BBP that are collected, either on-site or at a third-party site, for commercial purposes. BBP is primarily recycled industrially in the form of BBP-containing PVC waste streams, including vinyl flooring, carpet tiles, and plastic mold and trim ([Lowe et al., 2021](#)). BBP has been found in virgin and recycled construction materials within the United States ([Lowe et al., 2021](#)).

The processing use of BBP in recycling was not reported during the 2016 or 2020 CDR cycles, and BBP is not reported to the TRI.

E.8 Distribution in Commerce

For purposes of assessment in this draft risk evaluation, distribution in commerce consists of the transportation associated with the moving of BBP or BBP-containing products and/or articles between sites manufacturing, processing or recycling BBP or BBP-containing products and/or articles to final use sites, or for final disposal of BBP or BBP-containing products and/or articles. More broadly under TSCA, “distribution in commerce” and “distribute in commerce” are defined under TSCA section 3(5).

E.9 Industrial Use – Construction, Paint, Electrical, and Metal Products – Paints and Coatings

This COU refers to BBP as it is used in various industrial sectors as a component of industrial paints and coatings. This is a use of BBP after it has already been incorporated into a paint or coating product or mixture, as opposed to when it is used upstream (*e.g.*, when BBP is processed into the paint or coating formulation). This COU also includes activities identified by the U.S. Department of Defense.

Examples of paints and coatings containing BBP that are intended for industrial use include coatings used to protect metal, concrete flooring, and walls from various weather conditions, exposure to various chemicals, and fire ([Stonhard, 2024](#); [Carboline, 2023](#), [2022a](#), [b](#), [c](#), [2021a](#), [b](#); [Dudick Inc., 2015](#); [Henry Company, 2015](#)). Depending on the product, paints and coatings containing BBP can be applied using airless spray, roller, brush, spray, trowel, or squeegee. This COU includes these typical paint and coating uses and any similar paint and coating use of BBP.

BBP has been identified within lacquer compounds, topcoats, and spray paint in aerospace applications ([AIA, 2019](#)).

The industrial use of BBP in paints and coatings was not reported during the 2016 or 2020 CDR cycles.

E.10 Industrial Use – Construction, Paint, Electrical, and Metal Products – Adhesives and Sealants

This COU refers to BBP as it is used in various industrial sectors as a component of adhesive or sealant mixtures. This is a use of BBP 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 BBP is processed into the adhesive and sealant formulation). This COU also includes activities identified by the U.S. Department of Defense.

BBP is a component of sealants used construction projects in industrial and commercial settings ([Protecto Wrap, 2020](#); [Permatite, 2015](#)). BBP is also a component in sealants used in automobile manufacturing as well as dielectric pastes used in aerospace applications ([AIA, 2019](#); [MEMA, 2019](#)).

The industrial use of BBP in adhesives and sealants was not reported during the 2016 or 2020 CDR cycles.

E.11 Industrial Use – Packaging, Paper, Plastic, Hobby Products – Ink, Toner, and Colorant Products

This COU refers to BBP as it is used in various industrial sectors as a component of inks, toner, and colorant products; that is, the use of BBP after it has already been incorporated into ink, toner, and colorant product as opposed to when it is used upstream (*e.g.*, when BBP is processed into the inks, toner, and colorant product).

According to the final scope document for BBP, printing inks consist of colorants (*e.g.*, pigments, dyes, toners) dispersed in a formulation to form a paste, liquid, or solid, which can be applied to a substrate's surface and dried ([U.S. EPA, 2020c](#)). BBP is present in a liquid pigment used to color resin systems for a variety of applications, such as castings and coatings ([BJB Enterprises, 2019](#)).

Industrial printing processes can be categorized as lithographic, flexographic, gravure, letterpress, screen printing or digital printing. 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. BBP could be used in formulation of screen-printing ink, typically referred to as plastisol inks. Plastisol inks consist of PVC particles and a plasticizer that allows the PVC to retain a liquid form during use. Plastisol can be used to produce finished goods such as t-shirts, sweatshirts, jackets, and tote bags ([Sharpprint, 2019](#)). 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](#)).

BBP is a component of inks used for industrial marking of many types of materials such as wood, paper, or plastic. Industrial marking is used to identify and personalize products made by companies and provide a method to trace various parts and products. An ink stamp containing BBP used for industrial marking has been identified ([Identity Group, 2017](#)).

The industrial use of inks, toners, and colorants was not reported during the 2016 or 2020 CDR cycles.

E.12 Industrial Use – Other Uses – Hydraulic Fluids

This COU refers to the use of BBP as a component of hydraulic fluids in the defense industry. This is the use of BBP after it has already been incorporated into a hydraulic fluid, as opposed to when it is used upstream (*e.g.*, when BBP is processed into the hydraulic fluid). This COU also includes activities identified by the U.S. Department of Defense.

A stakeholder recommended that EPA include the use of BBP in hydraulic fluid ([U.S. EPA, 2020d](#)). There is limited information and data other than the communication in support of this COU.

The industrial use of BBP in hydraulic fluids was not reported during the 2016 or 2020 CDR cycles.

E.13 Industrial Use – Other Uses – Castings

This COU refers to BBP as it is used in various industrial sectors as a component of industrial multi-component castings or the molds used for the casting process; that is, the use of BBP after it has already been incorporated into one of the components (*e.g.*, when BBP is processed into the component of the casting or molding). Castings are used for the design of models and structures for a variety of applications. The general process of casting involves mixing liquid components together, pouring them into a mold, and waiting the recommended amount of curing time. The components of the liquid materials can vary and depend on the application. Examples of materials are multi-component polyurethane resins and molten metals or metal alloys.

BBP is a component of compound (resin) used to cast models in aerospace applications ([NASA, 2020](#)). It is also a component of polyurethane resins used in commercial and industrial settings ([Smooth-On, 2023a, b, 2022](#); [BJB Enterprises, 2021b, c](#)) as well as in components of castings used for general purpose in industrial, and commercial, and consumer settings ([BJB Enterprises, 2022, 2021a](#)).

Examples of CDR Submissions

In the 2020 CDR cycle, one company reported the non-incorporative activity for the use of BBP as viscosity modifier in fabricated metal product manufacturing ([U.S. EPA, 2020a](#)).

E.14 Industrial Use – Other Uses – Automotive Products, Fluids

This COU refers to the use of BBP as it is used in the automobile manufacturing sector as a component in various automotive products, fluids. Meaning the use of fluids used by automakers during the manufacture of automobiles and used in the maintenance of industrial vehicles. BBP has been reported in automotive fluids such as solvents and lubricants ([MEMA, 2019](#)). This COU also includes activities identified by the U.S. Department of Defense.

The industrial use of automotive products, fluids, including solvents and lubricants, was not reported during the 2016 or 2020 CDR cycles.

E.15 Industrial Use – Other Uses – Automotive Articles

This COU refers to the use of BBP as it is used in the automobile manufacturing sector as a component in various automotive articles; that is, the use of BBP after it has already been incorporated into a plastic product or mixture and molded into a solid form—as opposed to when it is used upstream (*e.g.*, when BBP is processed into an article). Specifically, this COU refers to the assembly of automobiles using components that contain BBP. The use of BBP in numerous components in the exterior and interior of the vehicle has been reported. Some examples of parts that contain BBP are the body side/side quarter trim and ornamentation, air bags, electronic controls, radiator grille assemblies, and reading light assemblies ([MEMA, 2019](#)). This COU also includes activities identified by the U.S. Department of Defense.

BBP is reported to be found downstream in tire crumb applications for playgrounds and turf ([U.S. EPA, 2024j, k](#); [Armada et al., 2022](#); [U.S. EPA, 2019e, f](#)). Workers may be exposed to BBP when handling tires manufacture of automobiles.

The industrial use of BBP in automotive articles was not reported during the 2016 or 2020 CDR cycles.

E.16 Commercial Use – Construction, Paint, Electrical, and Metal Products – Paints and Coatings

This COU refers to the commercial use of BBP already incorporated as a plasticizer in paints and coatings, as opposed to upstream use of BBP (*e.g.*, when BBP is processed into the paints and coatings) or use in an industrial setting. This COU also includes activities identified by the U.S. Department of Defense.

These products would be purchased by commercial operations and applied by professional contractors in various commercial settings. Some of these products could be used for industrial applications and these industrial uses are covered in Appendix E.9; however, they would be available and used in smaller scale commercial settings for similar purposes (*e.g.*, corrosion and water protection on structural components, residential construction).

BBP is present in coatings used in industrial and commercial setting to protect a variety of surfaces from weathering, water, and fire ([Henry Company, 2015](#)). They can be applied using airless spray, trowel, or conventional spray. BBP is also found in coatings used to protect interior steelwork from fire ([Carboline, 2023, 2022a](#)). BBP is present in primers used prior to the coating of outdoor commercial settings to protect concrete and asphalt ([MBCC Group, 2021](#); [BASF, 2013](#)).

BBP is also found in touch up paints used for retouching cars that customers have already purchased ([Ford Motor Company, 2019](#)). It is also present in coatings to repair plumbing fixtures ([Multi-Tech Products Corp, 2015](#)) and is used in a spray on-applications, such as spray-on enamels used on a variety of surfaces ([Chase Products, 2015](#); [Henry, 2015a](#)). EPA notes that these products could also be available for consumer use and these consumers uses are covered by Appendix E.28.

Examples of CDR Submissions.

In the 2016 CDR cycle, there were two reports of the commercial use of BBP in paints and coatings ([U.S. EPA, 2019b](#)).

E.17 Commercial Use – Construction, Paint, Electrical, and Metal Products – Adhesives and Sealants

This COU refers to the commercial use of BBP in adhesives and sealants; that is, the use of BBP-containing adhesives and sealants in a commercial setting, such as a business or at a job site, as opposed to upstream use of BBP (*e.g.*, when BBP-containing products are used in the manufacturing of the construction products) or use in an industrial setting. This COU also includes activities identified by the U.S. Department of Defense.

BBP-containing sealants are used to seal a variety of construction materials used during the installation of interior and exterior components in industrial and commercial settings and the industrial use is covered under Appendix E.10 ([Protecto Wrap, 2020](#); [Tremco Sealants, 2019, 2018](#); [Henry, 2016, 2015b](#); [Permatite, 2015](#)). BBP-containing sealants can be used to protect concrete in commercial and consumer settings ([Rust-Oleum, 2017](#)).

Other BBP-containing adhesives and sealants are also used in the repair of roofs, blacktop, concrete, automobiles, sporting equipment, mortar, and stucco ([HB Fuller Co, 2023](#); [Quikrete, 2023a, b, c](#); [Home Depot, 2019](#); [Quikrete, 2019b](#)). These products can be applied using a caulking gun, trowel, or another mechanism to spread it on the surface. EPA notes that these products may be available for consumer use and this consumer use is covered under Appendix E.27.

Examples of CDR Submissions.

In the 2016 CDR cycle, one company reported the commercial and consumer use of BBP in adhesives and sealants, and one company reported the commercial use of BBP in adhesives and sealants ([U.S. EPA, 2019b](#)).

In the 2020 CDR cycle, one company reported the commercial use of BBP as a sealant (barrier) in one-component caulks. One company reported the commercial and consumer use of BBP as a plasticizer in fillers and putties ([U.S. EPA, 2020a](#)).

E.18 Commercial Use – Furnishing, Cleaning, Treatment/Care Products - Floor Coverings; Construction and Building Materials Covering Large Surface Areas Including Stone, Plaster, Cement, Glass and Ceramic Articles; Fabrics, Textiles, and Apparel

This COU refers to the commercial use of BBP already incorporated as a plasticizer in various floor coverings and construction and building materials. BBP is a general-purpose plasticizer used in the production of vinyl tiles and carpet tile ([EPAB, 2020](#)). EPA notes that this reporting code in the 2020 CDR cycle is intended to describe product/articles such as cement flooring, stone tile, mirrors, flooring or wall materials, carpets, rugs, and tapestries ceramic articles as well as fabrics, textiles, and apparel ([U.S. EPA, 2020a](#)). The Agency anticipates that these products would be used in commercial applications. This COU includes handling and installing the vinyl tiles and carpeting that already have BBP incorporated and may involve cutting and shaping the tiles and carpeting for installation. This COU also includes activities identified by the U.S. Department of Defense.

BBP is found in a liquid stucco, which is used as a cement-based finishing plaster ([Quikrete, 2019a](#)). The product requires the addition of water and mixing it before application using a trowel or spray.

Carpet tiles are the only articles that EPA has identified that use BBP in construction and would fall under fabrics, textiles, and apparel 2020 CDR code ([U.S. EPA, 2020a](#)). EPA notes that these articles may be available to consumers and such articles are covered under a consumer COU (see Appendix E.30).

Examples of CDR Submissions

In the 2016 CDR cycle, one company reported the commercial and consumer use of BBP in floor coverings ([U.S. EPA, 2019b](#)). In the 2020 CDR cycle, one company reported the commercial and consumer use of BBP in construction and building materials covering large surface areas, including stone, plaster, cement, glass and ceramic articles; fabrics, textiles, and apparel ([U.S. EPA, 2020a](#)).

E.19 Commercial Use – Furnishing, Cleaning, Treatment/Care Products – Fabric, Textile, and Leather Products

This COU refers to the commercial use of BBP already incorporated as a plasticizer in fabric, textile, and leather products and/or articles. EPA notes that the reporting code in the 2020 CDR cycle is intended to describe products applied to the surfaces of leather articles to impart desirable properties and products applied to the surfaces of textiles to impart water or stain resistances, flame resistance, but not dyes ([U.S. EPA, 2020a](#)). Examples of products and/or articles under this COU include synthetic leather materials in furniture materials, synthetic leather clothing, and accessory items such as belts and handbags. This COU includes cutting and shaping textiles and wearing BBP-containing textiles.

The National Library of Medicine 2019 database identified BBP as a plasticizer in PVC for vinyl leather and cloth coating ([NLM, 2015](#)).
The commercial use of BBP in fabric, textile, and leather products was not reported during the 2016 or 2020 CDR cycles.

E.20 Commercial Use – Packaging, Paper, Plastic, Hobby Products – Packaging (Excluding Food Packaging) and Other Articles with Routine Direct Contact During Normal Use, Including Rubber Articles; Plastic Articles (Hard); Plastic Articles (Soft)

This COU refers to the commercial use of BBP in various packaging, paper, plastic, and hobby articles. EPA notes that the CDR use code for packaging (excluding food packaging), including rubber articles; plastic articles (hard); plastic articles (soft)” includes examples such as phone covers, personal tablets covers, styrofoam packaging, and bubble wrap. In addition, the CDR use code for “other articles with routine direct contact during normal use including rubber articles; plastic articles (hard)” in the 2020 CDR cycle includes examples such as gloves, boots, clothing, rubber handles, gear levers, steering wheels, handles, pencils, and handheld device casings. Given the use of BBP as a general-purpose plasticizer for PVC and non-PVC applications, BBP has been noted to be in a variety of articles such as food conveyor belts, tarps, weather stripping and traffic cones ([EPAB, 2020](#)). It was reported that BBP is contained in printing wire assemblies used in aerospace applications ([AIA, 2019](#)). This COU also includes activities identified by the U.S. Department of Defense.

The type of articles being reported under this code are likely to be both commercial and consumer in nature. An example of commercial use covered by this COU is the final stages of assembly, such as assembly of a conveyor belt or the cutting of weather stripping for installation into a commercial building. The consumers articles are covered under a consumer COU (see also Appendix E.34).

The commercial use of packaging (excluding food packaging) and other articles with routine direct contact during normal use, including rubber articles; plastic articles (hard); plastic articles (soft) was not reported during the 2016 or 2020 CDR cycles.

E.21 Commercial Use – Packaging, Paper, Plastic, Hobby Products – Ink, Toner and Colorant Products

This COU refers to the commercial use of BBP in ink, toner, and colorant products. According to the *Final Scope of the Risk Evaluation for Butyl Benzyl Phthalate (BBP)*, printing inks consist 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’s surface and dried ([U.S. EPA, 2020c](#)). BBP is present in a liquid pigment used to color resin systems for a variety of applications, such as castings and coatings ([BJB Enterprises, 2019](#)).

Commercial printing may involve lithographic, flexographic, gravure and letterpress printing - all of which involve the transfer of images from printing plates to a substrate. Screen printing requires a mesh screen to transfer the ink to a substrate, whereas digital printing allows for the transfer of a digital image directly onto a substrate. BBP could be used in formulation of screen-printing ink, typically referred to as plastisol inks. Plastisol inks consist of PVC particles and a plasticizer that allows the PVC to retain a liquid form during use. Plastisol can be used to produce finished goods such as t-shirts, sweatshirts, jackets, and tote bags ([Sharprint, 2019](#)). Inkjet printing is the most common form of digital printing. It involves the application of small drops of ink onto a substrate, with direct contact between the ink nozzle and the substrate ([U.S. EPA, 2010](#)).

The commercial use of BBP in ink, toner and colorant products was not reported during the 2016 or 2020 CDR cycles.

E.22 Commercial Use – Packaging, Paper, Plastic, Hobby Products – Toys, Playground, and Sporting Equipment

This COU refers to the commercial use of BBP in toys, playground, and sporting equipment. The COU includes to the commercial installation, use, and maintenance of toys (such as in daycare or school environments by workers like teachers, teacher assistants, or providers), playgrounds, and sporting equipment (such as in a gym environment with fitness balls and plastisol-coated dumbbells) that contain BBP. This COU includes fabrication or assembly of toys, playground and sporting equipment articles for commercial and consumer applications, as well as during installation of sporting or playground equipment.

BBP can be used as a plasticizer to provide flexibility to toys. The CPSIA of 2008 placed a prohibition on BBP that limited manufacturers' use of BBP in children's toys to 0.1 percent ([U.S. EPA, 2019a](#)). Toys containing higher concentrations of BBP that were manufactured and/or processed prior to the CPSIA restriction in 2008 may still be in use ([U.S. EPA, 2020c](#)). BBP is also reported to be in a component of tire crumb, which is used in playgrounds and playing fields. BBP may also be a part of other components in playing field based on results of federal research on exposure to chemicals in outdoor and indoor playing fields ([U.S. EPA, 2024j](#), [k](#), [2019e](#), [f](#)). Exposure could occur during the installation of the field and during their use.

The commercial use of BBP in toys and playground and sporting equipment was not reported during the 2016 or 2020 CDR cycles.

E.23 Commercial Use – Other Uses – Laboratory Chemicals

This COU refers to the use of BBP in laboratory chemicals.

BBP can be used as a laboratory chemical, such as a chemical standard or reference material during analyses. Some laboratory chemical manufacturers identify use of BBP as a certified reference material and research chemical. The users of products under this category would be expected to apply these products in general laboratory use applications. Use of laboratory chemicals may involve handling BBP by hand-pouring or pipette and either adding to the appropriate labware in its pure form to be diluted later or added to dilute other chemicals already in the labware. EPA expects that laboratory BBP products are pure BBP in neat liquid form. The Agency notes that the same applications and methods used for quality control can be applied in industrial and commercial settings, and both are included in this COU. This COU also includes activities identified by the U.S. Department of Defense.

BBP has been reported as a laboratory chemical in applications such as analytical standards, research, equipment calibration, and sample preparation, and is also used in the analysis of extraterrestrial material samples ([NASA, 2020](#); [Bio SB Inc., 2019](#)). BBP is in a mixture of chemical substances used a reference standard in analytical methods monitoring chemical substances in aqueous and solid samples ([AccuStandard, 2023](#); [SPEX CertiPrep, 2023](#)). It is also added to produce reference standards used in analytical methods to determine the amount of BPP in articles (*i.e.*, childcare articles or toys) ([SPEX CertiPrep, 2024](#), [2021](#)).

The commercial use of BBP in laboratory chemicals was not reported during the 2016 or 2020 CDR cycles.

E.24 Commercial Use – Other Uses – Castings

This COU refers to BBP as it is used in various commercial sectors as a component of the casting resin or the molds used for the casting process; that is, the use of BBP after it has already been incorporated into one of the components (e.g., when BBP is processed into the component of the casting or molding) or used in an industrial setting. Castings are used for the design of models and structures for a variety of applications. The general process of casting involves mixing liquid components together, pouring them into a mold, and waiting the recommended amount of curing time. The components of the liquid materials can vary and depend on the application. Examples of materials are multi-component polyurethane resins and molten metals or metal alloys.

BBP is a component of polyurethane resins used in commercial and industrial settings ([Smooth-On, 2023a, b, 2022](#); [BJB Enterprises, 2021b, c](#)). BBP may also be a component of molds used to cast machinery and electrical/electronic articles ([U.S. EPA, 2020a](#)). BBP is also used in components of castings that are used for general-purpose in industrial, commercial, and consumer settings ([BJB Enterprises, 2022, 2021a](#)). The industrial use is covered under an industrial COU (see Appendix E.13) while the consumer use is covered under the consumer COU (see Appendix E.31).

Examples of CDR Submissions

In the 2020 CDR cycle, one company reported the commercial use of BBP in machinery, mechanical appliances, electrical/electronic articles ([U.S. EPA, 2020a](#)).

E.25 Commercial Use – Other Uses – Automotive Products, Fluids

This COU refers to the commercial use of BBP in automotive product fluids, which already have BBP incorporated into them. That is, the use of BBP-containing automotive product fluids in a commercial setting such as an automotive parts business or a worker driving a vehicle as opposed to upstream use of BBP (e.g., when BBP containing products are used in the manufacturing of the automotive) or use in an industrial setting. The industrial use is covered under Appendix E.14. This COU also includes activities identified by the U.S. Department of Defense.

According to the final scope, BBP is used in automotive cleaning formulations and power steering fluids ([U.S. EPA, 2020c](#); [Armored AutoGroup Inc., 2015](#)). It is also found in lubricants used to stop breaks from squealing ([Permatex, 2020](#)). EPA notes that these products are available to consumers. The consumer uses are covered under a consumer COU (see Appendix E.35).

The commercial use of BBP in automotive products, fluids, was not reported during the 2016 or 2020 CDR cycles.

E.26 Commercial Use – Other Uses – Automotive Articles

This COU refers to the commercial use of BBP in automotive articles, which already have BBP incorporated into them—that is, the use of BBP-containing automotive articles in a commercial setting, such as an automotive parts business or a worker using (driving) a vehicle, as opposed to upstream use of BBP (e.g., when BBP containing products are used in the manufacturing of the automotive) or use in an industrial setting. The industrial use is covered by the Appendix E.15.

The use of BBP in replacement parts within the exterior and interior of the vehicle has been reported. Some examples of parts containing BBP are the body side/side quarter trim and ornamentation, air bags, electronic controls, radiator grille assemblies, and reading light assemblies ([MEMA, 2019](#)).

It is assumed that tires contain BBP as BBP is reported to be found downstream in tire crumb applications for playgrounds and turf ([U.S. EPA, 2024j](#), [k](#); [Armada et al., 2022](#); [U.S. EPA, 2019e](#), [f](#)). Commercial users may be exposed to BBP when handling tires for replacement on automobiles or when performing maintenance and repair on automobiles.

The commercial use of automotive articles was not reported during the 2016 or 2020 CDR cycles.

E.27 Consumer Use – Construction, Paint, Electrical, and Metal Products – Paints and Coatings

This COU refers to the consumer use of BBP in paints and coatings.

BBP is found in touch up paints used for retouching cars that customers have already purchased ([Ford Motor Company, 2019](#)) and is also present in coatings to repair plumbing fixtures ([Multi-Tech Products Corp, 2015](#)). It is a spray-on application and is also present in spray-on enamels used on a variety of surfaces ([Chase Products, 2015](#); [Henry, 2015a](#)). EPA notes that these products could be used in commercial settings, and the commercial use is covered under Appendix E.16.

The consumer use of BBP in paints and coatings was not reported during the 2016 or 2020 CDR cycles.

E.28 Consumer Use – Construction, Paint, Electrical, and Metal Products – Adhesives and Sealants

This COU refers to the consumer use of BBP already incorporated in adhesives and sealants, including fillers and putties. The use of these types of products would occur in commercial applications and the commercial use is covered under Appendix E.17; however, EPA notes that this product are able to be sourced by DIY consumers through various online vendors.

BBP-containing sealants can be used to protect concrete in commercial and consumer settings ([Rust-Oleum, 2017](#)) and can be applied using a roller or pump sprayer. BBP-containing adhesives and sealants are also used to in the repair of roofs, blacktop, concrete, automotives, sporting equipment, mortar, and stucco ([HB Fuller Co, 2023](#); [Quikrete, 2023a](#), [b](#), [c](#); [Home Depot, 2019](#); [Quikrete, 2019b](#)). The products can be applied using a caulking gun, trowel, or another mechanism to spread it on the surface.

Examples of CDR Submissions

In the 2016 CDR cycle, one company reported the commercial and consumer use of BBP in adhesives and sealants ([U.S. EPA, 2019b](#)).

In the 2020 CDR cycle, one company reported the commercial use of BBP as a sealant (barrier) in one-component caulks. Another company reported the commercial and consumer use of BBP as a plasticizer in fillers and putties in the 2020 CDR cycle ([U.S. EPA, 2020a](#)).

E.29 Consumer Use – Furnishing, Cleaning, Treatment/Care Products – Fabrics, Textiles, and Leather Products

This COU refers to the consumer use of BBP already incorporated in fabric, textile, and leather products and/or articles. This COU includes wearing various apparel. EPA notes that the reporting code in the 2020 CDR cycle is intended to describe products applied to the surfaces of leather articles to impart desirable properties and products applied to the surfaces of textiles to impart water or stain resistances, flame resistance, but not dyes ([U.S. EPA, 2020a](#)). Given the use of BBP as a general-purpose plasticizer for PVC and non-PVC applications, BBP has been noted to be used as a plasticizer in PVC for viny

leather and cloth coating ([NLM, 2015](#)). Note that vinyl leather or faux leather is a type of leather finishing.

BBP has been identified in children's clothing items and accessories ([WSDE, 2023, 2020](#)). Exposure could also occur through the consumer use of synthetic leather furniture ([Danish EPA, 2010](#)) and automotive synthetic leather interiors.

The consumer use of BBP in fabrics, textiles, and leather products and/or articles was not reported during the 2016 or 2020 CDR cycles.

E.30 Consumer Use – Furnishing, Cleaning, Treatment/Care Products – Floor Coverings; Construction and Building Materials Covering Large Surface Areas Including Stone, Plaster, Cement, Glass and Ceramic Articles Fabrics, Textiles, and Apparel

This COU refers to the consumer use of BBP already incorporated in vinyl and carpet tiles ([EPAB, 2020](#)). EPA notes that this reporting code in the 2020 CDR cycle is intended to describe product/articles such as cement flooring, stone tile, mirrors, flooring or wall materials, carpets, rugs, and tapestries. Consumers generally use flooring containing BBP in an indoor environment and DIYers handle the construction materials (e.g., tiles, carpeting) that have BBP incorporated into the products, which may involve cutting and shaping the products for installation.

BBP is found in a liquid stucco, which is used as a cement-based finishing plaster ([Quikrete, 2019a](#)). The product requires the addition of water and mixing it before application using a trowel or spray.

Carpet tiles are the only articles that EPA has identified that use BBP in construction and would fall under fabrics, textiles, and apparel 2020 CDR code ([U.S. EPA, 2020a](#)).

Examples of CDR Submissions

In the 2016 CDR cycle, one company reported the commercial and consumer use of BBP in floor coverings ([U.S. EPA, 2019b](#)).

In the 2020 CDR cycle, one company reported the commercial and consumer use of BBP in construction and building materials covering large surface areas, including stone, plaster, cement, glass and ceramic articles, fabrics, textiles, and apparel ([U.S. EPA, 2020a](#)).

E.31 Consumer Use – Packaging, Paper, Plastic, Hobby Products – Arts, Crafts, and Hobby Materials

This COU refers to the consumer use of BBP in and in a two-component urethane crafting resin used in general purpose casting, which may involve prototyping, miniatures, models, and taxidermy. EPA expects that the majority of products used for casting that contain BBP would be commercial or industrial in nature and these uses are covered under Appendices E.24 and E.13; however, this COU also encompasses the use of some products by DIY consumers as many of the commercial products are available for consumer purchasers through various online vendors.

BBP is used in components of castings used for general purpose in consumer settings ([BJB Enterprises, 2022, 2021a](#)).

8294 The consumer use of arts, crafts, and hobby materials was not reported during the 2016 or 2020 CDR
8295 cycles.

8296 **E.32 Consumer Use – Packaging, Paper, Plastic, Hobby Products – Toys,**
8297 **Playground, and Sporting Equipment**

8298 This COU refers to the consumer use of BBP in toys, playground, and sporting equipment. The COU
8299 includes the consumer use or storage of toys, playgrounds, and sporting equipment that contain BBP in
8300 an indoor environment. The use also refers to the DIY building of home sporting equipment. BBP can
8301 be used as a plasticizer to provide flexibility to toys. The CPSIA of 2008 limited the manufacturer's use
8302 of BBP in children's toys to 0.1 percent ([U.S. EPA, 2019a](#)). Toys containing higher concentrations of
8303 BBP that were manufactured and/or processed prior to the CPSIA restriction in 2008 may still be in use
8304 ([U.S. EPA, 2020c](#)). BBP is also reported to be in a component of tire crumb, which is used in
8305 playgrounds and playing fields. BBP may also be a part of other components in playing field based on
8306 results of federal research on exposure to chemicals in outdoor and indoor playing fields ([U.S. EPA,](#)
8307 [2024j](#), [k](#), [2019e](#), [f](#)). Exposure could occur during the use of the fields.

8308
8309 The consumer use of toys, playground, and sporting equipment was not reported during the 2016 or
8310 2020 CDR cycles.

8311 **E.33 Consumer Use – Packaging, Paper, Plastic, Hobby Products – Ink,**
8312 **Toner, and Colorant Products**

8313 This COU refers to the consumer use of BBP in ink, toner, and colorant products. According to the final
8314 scoping document, printing inks consist of colorants (e.g., pigments, dyes and toners) dispersed in a
8315 formulation to form a paste, liquid, or solid that can be applied to a substrate's surface and dried ([U.S.](#)
8316 [EPA, 2020c](#)). Screen printing requires a mesh screen to transfer the ink to a substrate, whereas digital
8317 printing allows for the transfer of a digital image directly onto a substrate. Inkjet printing is the most
8318 common form of digital printing. It involves the application of small drops of ink onto a substrate with
8319 direct contact between the ink nozzle and the substrate ([U.S. EPA, 2010](#)).

8320
8321 EPA expects that most ink, toner, and colorant products containing BBP would be commercial or
8322 industrial in nature; however, it is possible that some products are used by do-it-yourself (DIY)
8323 consumers as many of the commercial products are available for consumer purchasers through various
8324 online vendors. The industrial use is covered under Appendix E.11 and the commercial under Appendix
8325 E.21. BBP is present in a liquid pigment used to color resin systems for a variety of applications such as
8326 castings and coatings ([BJB Enterprises, 2019](#)). EPA would expect that if consumer DIYers were to use
8327 these products they would apply them in the same fashion as commercial users, albeit on a smaller scale
8328 at their residences.

8329
8330 The consumer use of inks, toners, and colorants was not reported during the 2016 or 2020 CDR cycles.

8331 **E.34 Consumer Use – Packaging, Paper, Plastic, Hobby Products – Packaging**
8332 **(Excluding Food Packaging) and Other Articles with Routine Direct**
8333 **Contact During Normal Use, Including Rubber Articles; Plastic Articles**
8334 **(Hard); Plastic Articles (Soft)**

8335 This COU refers to the consumer use of BBP already incorporated in various packaging, paper, plastic,
8336 and hobby products. EPA notes that this reporting code in the 2020 CDR cycle is intended to describe
8337 articles such as phone covers, personal tablets covers, styrofoam packaging, and bubble wrap. Given the

use of BBP as a general-purpose plasticizer for PVC and non-PVC applications, BBP has been noted to be in a variety of articles such as food conveyor belts, tarps, weather stripping, and traffic cones ([EPAB, 2020](#)).

The type of products being reported under this code are likely to be both commercial and consumer in nature. This COU includes handling of BBP-containing packaging. The commercial articles are covered under a commercial COU (see Appendix E.20).

The consumer use of packaging (excluding food packaging) and other articles with routine direct contact during normal use—including rubber articles, plastic articles (hard), and plastic articles (soft)—was not reported during the 2016 or 2020 CDR cycles.

E.35 Consumer Use – Other Uses – Automotive Products, Fluids

This COU refers to the consumer use of BBP already incorporated in fluid automotive product.

According to the *Final Scope of the Risk Evaluation for Butyl Benzyl Phthalate* (BBP), BBP is used in automotive cleaning formulations and power steering fluids ([U.S. EPA, 2020c](#); [Armored AutoGroup Inc., 2015](#)). It is also found in lubricants used to stop breaks from squealing ([Permatex, 2020](#)).

The consumer use of automotive products, fluids was not reported during the 2016 or 2020 CDR cycles.

E.36 Consumer Use – Other Uses – Automotive Articles

This COU refers to the consumer use of BBP already incorporated in automotive articles. This COU includes the use of BBP-containing automotive articles in a consumer DIY setting or by consumers driving a vehicle.

According to a received comment, BBP is found in the reading lamp assembly, the instrument cluster located in the passenger compartment, closure panels/knee bolsters located in the passenger compartment, front seat springs, frame, tracks, and mechanisms that are adjusted manually by the passenger, and the body side/side quarter trim and ornamentation located in the passenger compartment ([MEMA, 2019](#)).

It is assumed that tires contain BBP, as BBP is reported to be found downstream in tire crumb applications for playgrounds and turf ([U.S. EPA, 2024j, k](#); [Armada et al., 2022](#); [U.S. EPA, 2019e, f](#)). Consumers may handle BBP-containing tires for replacement on automobiles.

The consumer use of automotive articles was not reported during the 2016 or 2020 CDR cycles.

E.37 Consumer Use – Other Uses – Novelty Articles

This COU refers to the consumer use of BBP in adult novelty products. This COU is describing adult sex toys that are available for consumer use in the United States. Although the U.S. Food and Drug Administration (FDA) classifies certain sex toys (such as vibrators) as obstetrical and gynecological therapeutic medical devices, many manufacturers label these products “for novelty use only” and are not subject to the FDA regulations ([Stabile, 2013](#)). This same study indicated tested concentrations of phthalates between 24 and 49 percent of the tested sex toys for creating a softer, more flexible plastic ([Stabile, 2013](#)). EPA assumed that the concentration of BBP in these products to be analogous to the overall content of the mix of phthalates tested and found in that study. Consumers could experience dermal and oral exposure to BBP using the products covered by this COU.

The consumer use of BBP in novelty articles was not reported during the 2016 or 2020 CDR cycles.

E.38 Disposal

For purposes of the draft BBP risk evaluation, this COU refers to the BBP in a waste stream that is collected from facilities and households and are unloaded at and treated or disposed at third-party sites. Each of the COUs of BBP can generate waste streams of the chemical. This COU also encompasses BBP contained in wastewater discharged by consumers or occupational users to a publicly owned treatment works (POTW) or other, non-POTW for treatment, as well as other wastes. BBP 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 BBP, plastic and rubber products, textiles, and transport containers). Disposal may also include destruction and removal by incineration. ([U.S. EPA, 2020c](#)). Additionally, BBP has been identified in *EPA's Hydraulic Fracturing for Oil and Gas: Impacts from the Hydraulic Fracturing Water Cycle on Drinking Water Resources in the United States*, December 2016 document to be a chemical reported to be detected in produced water, which is subsequently disposed ([U.S. EPA, 2016a](#)). Recycling of BBP and BBP-containing products is considered a different COU. Environmental releases from industrial sites are assessed in each COU of use and are not considered as part of the disposal COU.

Appendix F DRAFT OCCUPATIONAL EXPOSURE VALUE DERIVATION

EPA has calculated a draft 8-hour existing chemical occupational exposure value to summarize the occupational exposure scenario and sensitive health endpoints into a single value. This calculated draft value may be used to support risk management efforts for BBP under TSCA section 6(a), 15 U.S.C. § 2605. EPA calculated the draft value rounded to 3.1 mg/m³ for inhalation exposures to BBP 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.*, decreased anogenital distance [AGD] and related phthalate syndrome effects).

TSCA requires risk evaluations to be conducted without consideration of costs and other non-risk factors, and thus this draft occupational exposure value represents a risk-only number. If risk management for BBP follows the finalized risk evaluation, EPA may consider costs and other non-risk 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 draft occupational exposure value presented in this appendix based on additional consideration of exposures and non-risk factors consistent with TSCA section 6(c).

This calculated draft value for BBP represents the exposure concentration below which exposed workers and 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.*, decreased fetal testicular testosterone) and exposure duration (*i.e.*, acute) relative to benchmarks and a standard occupational scenario assumption of an 8-hour workday.

EPA expects that at the draft occupational exposure value of 0.25 ppm (3.1 mg/m³), 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 draft occupational exposure value. The Agency has not separately calculated a draft short-term (*i.e.*, 15-minute) occupational exposure value because EPA did not identify hazards for BBP associated with this very short duration.

The Occupational Safety and Health Administration (OSHA) has not set a permissible exposure limit (PEL) as an [8-hour TWA for BBP](#). EPA located several occupational exposure limits for BBP (CASRN 85-68-7) in other countries (<https://ilv.ifa.dguv.de/limitvalues/21276>). Identified 8-hour TWA values range from 1 mg/m³ in Norway to 20 mg/m³ in Germany. Additionally, EPA found that [New Zealand](#) and the [United Kingdom](#) have an established occupational exposure limit of 5 mg/m³ (8-hour TWA) in each country's code of regulation that is enforced by their respective country's worker safety and health agency.

F.1 Draft Occupational Exposure Value Calculations

This appendix presents the calculations used to estimate draft occupational exposure values using inputs derived in this draft risk evaluation. Multiple values are presented below for hazard endpoints based on different exposure durations. For BBP, the most sensitive occupational exposure value is based on non-cancer developmental effects and the resulting 8-hour TWA is rounded to 3.1 mg/m³.

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Draft Acute Non-Cancer Occupational Exposure Value

The draft acute occupational exposure value (EV_{acute}) was calculated as the concentration at which the acute MOE would equal the benchmark MOE for acute occupational exposures using Equation_Apx F-1:

Equation_Apx F-1.

$$EV_{acute} = \frac{HEC_{acute}}{Benchmark\ MOE_{acute}} * \frac{AT_{HEC_{acute}}}{ED} * \frac{IR_{resting}}{IR_{workers}} =$$

$$\frac{5.0\ ppm}{30} * \frac{\frac{24h}{d}}{\frac{8h}{d}} * \frac{0.6125 \frac{m^3}{hr}}{1.25 \frac{m^3}{hr}} = 0.25\ ppm$$

$$EV_{acute} \left(\frac{mg}{m^3} \right) = \frac{EV\ ppm * MW}{Molar\ Volume} = \frac{0.25\ ppm * 312.37 \frac{g}{mol}}{24.45 \frac{L}{mol}} = 3.1 \frac{mg}{m^3}$$

Draft Intermediate Non-Cancer Occupational Exposure Value

The draft 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.

$$EV_{intermediate} = \frac{HEC_{intermediate}}{Benchmark\ MOE_{intermediate}} * \frac{AT_{HEC\ intermediate}}{ED * EF} * \frac{IR_{resting}}{IR_{workers}}$$

$$= \frac{5.0\ ppm}{30} * \frac{\frac{24h}{d} * 30d}{\frac{8h}{d} * 22d} * \frac{0.6125 \frac{m^3}{hr}}{1.25 \frac{m^3}{hr}} = 0.33\ ppm = 4.3 \frac{mg}{m^3}$$

Draft Chronic Non-Cancer Exposure Value

The draft 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.

$$EV_{chronic} = \frac{HEC_{chronic}}{Benchmark\ MOE_{chronic}} * \frac{AT_{HEC\ chronic}}{ED * EF * WY} * \frac{IR_{resting}}{IR_{workers}}$$

$$= \frac{5.0\ ppm}{30} * \frac{\frac{24h}{d} * \frac{365d}{y} * 40\ y}{\frac{8h}{d} * \frac{250d}{y} * 40\ y} * \frac{0.6125 \frac{m^3}{hr}}{1.25 \frac{m^3}{hr}} = 0.36\ ppm = 4.6 \frac{mg}{m^3}$$

Where:

AT_{hecate}

= Averaging time for the POD/HEC used for evaluating non-cancer

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8479		acute occupational risk based on study conditions and HEC
8480		adjustments (24 h/day).
8481	$AT_{HEC\text{intermediate}}$	= Averaging time for the POD/HEC used for evaluating non-cancer
8482		intermediate occupational risk based on study conditions and/or
8483		any HEC adjustments (24 h/day for 30 days).
8484	$AT_{HEC\text{chronic}}$	= Averaging time for the POD/HEC used for evaluating non-cancer
8485		chronic occupational risk based on study conditions and/or HEC
8486		adjustments (24 h/day for 365 days/year) and assuming the
8487		same number of years as the high-end working years (WY, 40
8488		years) for a worker.
8489	$Benchmark\ MOE_{acute}$	= Acute non-cancer benchmark margin of exposure, based on the
8490		total uncertainty factor of 30
8491	$Benchmark\ MOE_{intermediate}$	= Intermediate non-cancer benchmark margin of exposure, based on
8492		the total uncertainty factor of 30
8493	$Benchmark\ MOE_{chronic}$	= Chronic non-cancer benchmark margin of exposure, based on the
8494		total uncertainty factor of 30
8495	EV_{acute}	= Acute occupational exposure value
8496	$EV_{intermediate}$	= Intermediate occupational exposure value
8497	$EV_{chronic}$	= Chronic occupational exposure value
8498	ED	= Exposure duration (8 h/day)
8499	EF	= Exposure frequency (1 day for acute, 22 days for intermediate, and
8500		250 days/year for chronic and lifetime)
8501	HEC	= Human equivalent concentration for acute, intermediate, or chronic
8502		non-cancer occupational exposure scenarios
8503	IR	= Inhalation rate (default is 1.25 m ³ /h for workers and 0.6125 m ³ /h
8504		assumed from “resting” animals from toxicity studies)
8505	$Molar\ Volume$	= 24.45 L/mol, the volume of a mole of gas at 1 atm and 25 °C
8506	MW	= Molecular weight of BBP (312.37 g/mole)
8507	WY	= Working years per lifetime at the 95th percentile (40 years).
8508		
8509	<i>Unit conversion:</i>	
8510	1 ppm = 12.78 mg/m ³ (see equation associated with the EV_{acute} calculation)	

Appendix G Draft Environmental Water Exposure Risk Estimates

Table_Apx G-1. Risk Quotients for Aquatic Organism Hazards and Surface Water BBP Exposures from OESs with DMR Data of Water Releases

OES	Daily Release Statistic	SWC (µg/L) ^a	Risk Quotient ^b			
			Acute Animal	Chronic Vertebrate	Chronic Invertebrate	Algae
Waste handling, treatment and disposal – non-POTW ^c	95th percentile	8.16E-03	0.02	4.21E-03	0.06	0.19
Waste handling, treatment and disposal – non-POTW ^c	Median	2.70E-03	<0.01	1.42E-03	<0.01	<0.01
Waste handling, treatment, and disposal – POTW ^c	95th percentile	10	0.05	5.26	0.16	0.48
Waste handling, treatment, and disposal – POTW ^c	Median	0.14	<0.01	7.42E-02	<0.01	0.01
Incorporation into other formulations, mixtures, or reaction products	One value	0.11	<0.01	5.94E-02	<0.01	0.01
Import and repackaging	One value	1.15	0.01	0.61	0.02	0.05
Application of paints, coatings, adhesives, and sealants	One value	2.45E-02	<0.01	1.29E-02	<0.01	<0.01
COC = concentration of concern; SWC = surface water concentration						
^a Modeled surface water concentration of BBP resulting from DMR release data. EPA has robust confidence in SWCs derived from DMR data.						
^b RQs based on acute animal (197 µg/L), chronic vertebrate (1.9 µg/L), chronic invertebrate (62.6 µg/L), and algae (21 µg/L) COCs (U.S. EPA, 2025p). EPA has robust confidence in the quality, consistency, strength and precision, and relevance of the studies used in determining these COCs.						
^c The associated COU for this OES is Disposal.						

8517

Table_Apx G-2. Risk Quotients for Aquatic Organism Hazards and Generic Scenario Water BBP Exposures

Release ^a	Daily Release (kg/day)	Flow (m ³ /day)	WWT (%) ^b	SWC (µg/L) ^c	Risk Quotient ^d			
					Acute Animal	Chronic Vertebrate	Chronic Invertebrate	Algae
PVC plastic compounding								
Central tendency (median)	40	181,176 (7Q10, Median)	0	2,170	11.02	1,142	34.66	103.33
			62	824.6	4.19	434	13.17	39.27
		250,573 (7Q10, P75)	0	159	0.81	83.68	2.54	7.57
			62	60.4	0.31	31.79	0.96	2.88
		7,446,189 (7Q10, P90)	0	5.34	0.03	2.81	0.09	0.25
			62	2.03	0.01	1.07	0.03	0.01
High-end (95th percentile)	65.7	181,176 (7Q10, Median)	0	4,340 ^{e f}	22	2,284	69	207
			62	1,649	8.37	868	26.34	78.5
		250,573 (7Q10, P75)	0	319	1.62	168	5.10	15.2
			62	121	0.61	63.68	1.93	5.76
		7,446,189 (7Q10, P90)	0	10.7	0.05	5.63	0.17	0.51
			62	4.1	0.02	2.16	0.07	0.20
PVC plastic converting								
Central tendency (median)	2.41	181,176 (7Q10, Median)	0	131	0.66	68.94	2.09	6.23
			62	49.78	0.25	26.20	0.80	2.37
		250,573 (7Q10, P75)	0	9.6	0.05	5.05	0.15	0.46
			62	3.65	0.02	1.92	0.06	0.17
		7,446,189 (7Q10, P90)	0	0.32	<0.01	0.17	<0.01	0.02
			62	0.12	<0.01	0.06	<0.01	<0.01

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Release ^a	Daily Release (kg/day)	Flow (m ³ /day)	WWT (%) ^b	SWC (µg/L) ^c	Risk Quotient ^d			
					Acute Animal	Chronic Vertebrate	Chronic Invertebrate	Algae
High-end (95th percentile)	4.98	181,176 (7Q10, Median)	0	270	1.37	142.10	4.31	12.86
			62	102.60	0.52	54	1.64	4.89
		250,573 (7Q10, P75)	0	19.90	0.10	10.47	0.32	0.95
			62	7.56	0.04	3.98	0.12	0.36
		7,446,189 (7Q10, P90)	0	0.67	<0.01	0.35	0.01	0.03
			62	0.25	<0.01	0.13	<0.01	0.01
Non-PVC material compounding								
Central tendency (median)	5.92E-02	181,176 (7Q10, Median)	0	3.11	0.02	1.64	0.05	0.15
			62	1.18	<0.01	0.62	0.02	0.06
		250,573 (7Q10, P75)	0	2.29E-01	<0.01	0.12	<0.01	0.01
			62	8.7E-02	<0.01	0.05	<0.01	<0.01
		7,446,189 (7Q10, P90)	0	7.67E-03	<0.01	<0.01	<0.01	<0.01
			62	2.9E-03	<0.01	<0.01	<0.01	<0.01
High-end (95th percentile)	8.15E-02	181,176 (7Q10, Median)	0	4.42	0.02	2.32	0.07	0.21
			62	1.68	0.01	0.88	0.03	0.08
		250,573 (7Q10, P75)	0	0.33	<0.01	0.17	<0.01	0.02
			62	0.13	<0.01	0.07	<0.01	<0.01
		7,446,189 (7Q10, P90)	0	1.09E-02	<0.01	<0.01	<0.01	<0.01
			62	4.1E-03	<0.01	<0.01	<0.01	<0.01
Non-PVC material converting								
Central tendency (median)	6.13E-02	181,176 (7Q10, Median)	0	3.32	0.02	1.75	0.05	0.16
			62	1.26	<0.01	0.66	0.02	0.06
		250,573 (7Q10, P75)	0	2.44-01	<0.01	0.13	<0.01	<0.01
			62	9.27E-02	<0.01	0.05	<0.01	<0.01
		7,446,189 (7Q10, P90)	0	8.20E-03	<0.01	<0.01	<0.01	<0.01
			62	3.12E-03	<0.01	<0.01	<0.01	<0.01

PUBLIC RELEASE DRAFT
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Release ^a	Daily Release (kg/day)	Flow (m ³ /day)	WWT (%) ^b	SWC (µg/L) ^c	Risk Quotient ^d			
					Acute Animal	Chronic Vertebrate	Chronic Invertebrate	Algae
High-end (95th percentile)	9.09E-02	181,176 (7Q10, Median)	0	4.93	0.03	2.59	0.08	0.23
			62	1.87	<0.01	0.98	0.03	0.09
		250,573 (7Q10, P75)	0	3.62-01	<0.01	0.19	<0.01	0.02
			62	0.14	<0.01	0.07	<0.01	<0.01
		7,446,189 (7Q10, P90)	0	1.22E-02	<0.01	<0.01	<0.01	<0.01
			62	4.63E-03	<0.01	<0.01	<0.01	<0.01
Recycling								
Central tendency (median)	1.48E-02	181,176 (7Q10, Median)	0	4.21E-01	0.80	<0.01	0.42	0.01
			62	1.60E-01	0.30	<0.01	0.16	<0.01
		250,573 (7Q10, P75)	0	3.10E-02	5.88E-02	<0.01	<0.01	<0.01
			62	1.18E-02	2.23E-02	<0.01	<0.01	<0.01
		7,446,189 (7Q10, P90)	0	1.04E-03	1.97E-03	<0.01	<0.01	<0.01
			62	3.95E-04	7.49E-04	<0.01	<0.01	<0.01
High-end (95th percentile)	2.59E-02	181,176 (7Q10, Median)	0	7.39E-01	1.4	<0.01	0.74	0.02
			62	2.81E-01	0.53	<0.01	0.28	<0.01
		250,573 (7Q10, P75)	0	5.43E-02	0.10	<0.01	0.05	<0.01
			62	2.06E-02	3.80E-02	<0.01	<0.01	<0.01
		7,446,189 (7Q10, P90)	0	1.82E-03	9.09E-02	<0.01	<0.01	<0.01
			62	6.92E-04	3.45E-02	<0.01	<0.01	<0.01
Use of lubricants and functional fluids								
Central tendency (median)	48.9	181,176 (7Q10, Median)	0	2,650	13.45	1,394.74	42.33	126.19
			62	1,007	5.11 ^g	530	16.09 ^g	47.95 ^g
		250,573 (7Q10, P75)	0	195	0.99	102.63	3.12 ^g	9.29 ^g
			62	74.10	0.38	39 ^g	1.18 ^g	3.53 ^g
		7,446,189 (7Q10, P90)	0	6.54	0.03	3.44 ^g	0.10	0.31 ^g
			62	2.48	0.01	1.30 g	0.04	0.12

Release ^a	Daily Release (kg/day)	Flow (m ³ /day)	WWT (%) ^b	SWC (µg/L) ^c	Risk Quotient ^d			
					Acute Animal	Chronic Vertebrate	Chronic Invertebrate	Algae
High-end (95th percentile)	122	181,176 (7Q10, Median)	0	6,630 ^{e f}	33.65	3,489.47	105.91	315.71
			62	2,519	12.78 ^g	1,325.79	40.24 ^g	119.95 ^g
		250,573 (7Q10, P75)	0	487	2.47 ^g	256.32	7.78 ^g	23.19 ^g
			62	185.06	0.94	97.40 ^g	2.96 ^g	8.81 ^g
		7,446,189 (7Q10, P90)	0	16.4	0.08	8.63	0.26	0.78
			62	6.23	0.03	3.28	0.10	0.30

COC = concentration of concern; SWC = surface water concentration; WWT = wastewater treatment

^a Releases are modeled distributions.

^b Percentage of BBP removed by wastewater treatment.

^c Modeled surface water concentration of BBP resulting from generic scenarios. EPA has moderate confidence in SWCs below the BBP limit of water solubility estimated to be 2,690 µg/L ([U.S. EPA, 2025z](#)) and slight confidence in SWCs that exceed this limit of solubility (Section 5.3.6).

^d RQ based on acute animal (197 µg/L), chronic vertebrate (1.9 µg/L), chronic invertebrate (62.6 µg/L), and algae (21 µg/L) COCs ([U.S. EPA, 2025p](#)). EPA has robust confidence in the quality, consistency, strength and precision, and relevance of the studies used in determining these COCs.

^e Surface water concentration exceeds the BBP limit of water solubility estimated to be 2,690 µg/L ([U.S. EPA, 2025z](#)).

^f EPA has slight confidence in this water concentration because it exceeds the BBP limit of water solubility and it is three orders of magnitude greater than the maximum concentration reported in U.S. waterbodies (2.65 µg/L; ([U.S. EPA, 2025r](#))).

^g RQ values >1 and not bolded or shaded indicate that the days of exceedance did not extend beyond the length of experimental exposures (21-days for chronic COCs and 4-days for acute animal and algae COCs).

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Table_Apx G-3. Risk Quotients for Aquatic Organism Hazards and Surface Water BBP Exposures from OESs with Multimedia Releases Assuming Releases to Water

Release ^a	Daily Release (kg/day)	Flow (m ³ /day)	WWT (%) ^b	SWC (µg/L) ^c	Risk Quotient ^d			
					Acute Animal	Chronic Vertebrate	Chronic Invertebrate	Algae
Manufacturing – multimedia – 10% released to water								
Central tendency (median)	30.3	181,176 (7Q10, Median)	0	1646	83.6	866	263	784
			62	625.6	5.92	329	9.99	29.8
		250,573 (7Q10, P75)	0	121	0.61	63.7	1.93	5.76
			62	46	0.23	24.2	0.74	2.19
		7,446,189 (7Q10, P90)	0	4.06	0.02	2.14	0.06	0.19
			62	1.54	7.83E-03	0.81	0.02	0.07
High-end (95th percentile)	55.6	181,176 (7Q10, Median)	0	3,069 ^{e f}	15.6	1,620	49	146
			62	1,166	5.92	614	18.6	55.5
		250,573 (7Q10, P75)	0	225.6	1.15	119	3.6	10.7
			62	85.7	0.44	45.1	1.37	4.08
		7,446,189 (7Q10, P90)	0	7.57	0.04	3.98	0.12	0.36
			62	2.87	0.01	1.51	0.05	0.14
Use of laboratory chemicals – liquid – 100% released to water								
Central tendency (median)	6.59E-03	181,176 (7Q10, Median)	0	0.36	<0.01	0.19	<0.01	0.02
			62	0.14	<0.01	0.07	<0.01	<0.01
		250,573 (7Q10, P75)	0	2.63E-02	<0.01	<0.01	<0.01	<0.01
			62	9.99E-03	<0.01	<0.01	<0.01	<0.01
		7,446,189 (7Q10, P90)	0	8.82E-04	<0.01	<0.01	<0.01	<0.01
			62	3.35E-04	<0.01	<0.01	<0.01	<0.01

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Release ^a	Daily Release (kg/day)	Flow (m ³ /day)	WWT (%) ^b	SWC (µg/L) ^c	Risk Quotient ^d			
					Acute Animal	Chronic Vertebrate	Chronic Invertebrate	Algae
High-end (95th percentile)	2.20E-02	181,176 (7Q10, Median)	0	1.20	<0.01	0.63	0.02	0.06
			62	0.46	<0.01	0.24	<0.01	0.02
		250,573 (7Q10, P75)	0	0.09	<0.01	0.05	<0.01	<0.01
			62	3.42E-02	<0.01	<0.01	<0.01	<0.01
		7,446,189 (7Q10, P90)	0	2.95E-03	<0.01	<0.01	<0.01	<0.01
			62	1.12E-03	<0.01	<0.01	<0.01	<0.01
Use of laboratory chemicals – solid – 100% released to water								
Central tendency (median)	2.60E-03	181,176 (7Q10, Median)	0	0.14	<0.01	0.07	<0.01	<0.01
			62	0.05	<0.01	0.03	<0.01	<0.01
		250,573 (7Q10, P75)	0	1.03E-02	<0.01	<0.01	<0.01	<0.01
			62	3.91E-03	<0.01	<0.01	<0.01	<0.01
		7,446,189 (7Q10, P90)	0	3.47E-04	<0.01	<0.01	<0.01	<0.01
			62	1.31E-04	<0.01	<0.01	<0.01	<0.01
High-end (95th percentile)	2.38E-03	181,176 (7Q10, Median)	0	0.13	<0.01	0.07	<0.01	<0.01
			62	0.05	<0.01	0.03	<0.01	<0.01
		250,573 (7Q10, P75)	0	9.50E-03	<0.01	<0.01	<0.01	<0.01
			62	3.61E-03	<0.01	<0.01	<0.01	<0.01
		7,446,189 (7Q10, P90)	0	3.19E-04	<0.01	<0.01	<0.01	<0.01
			62	1.21E-04	<0.01	<0.01	<0.01	<0.01

COC = concentration of concern; SWC = surface water concentration; WWT = wastewater treatment

^a Releases are modeled distributions.

^b Percentage of BBP removed by wastewater treatment.

^c Modeled surface water concentration of BBP resulting from generic scenarios. EPA has moderate confidence in SWCs below the BBP limit of water solubility estimated to be 2,690 µg/L ([U.S. EPA, 2025z](#)) and slight confidence in SWCs that exceed this limit of solubility (Section 5.3.6).

^d RQs based on acute animal (197 µg/L), chronic vertebrate (1.9 µg/L), chronic invertebrate (62.6 µg/L), and algae (21 µg/L) concentrations of concern ([U.S. EPA, 2025p](#)). EPA has robust confidence in the quality, consistency, strength and precision, and relevance of the studies used in determining these COCs.

^e Surface water concentration exceeds the BBP limit of water solubility estimated to be 2,690 µg/L ([U.S. EPA, 2025z](#)).

Release ^a	Daily Release (kg/day)	Flow (m ³ /day)	WWT (%) ^b	SWC (µg/L) ^c	Risk Quotient ^d			
					Acute Animal	Chronic Vertebrate	Chronic Invertebrate	Algae
^f EPA has slight confidence in this water concentration because it exceeds the BBP limit of water solubility and it is three orders of magnitude greater than the maximum concentration reported in U.S. waterbodies (2.65 µg/L; (U.S. EPA, 2025r)). ^e The days of exceedance from modeling resulted in 269 days/year where RQs>1 and extended beyond the 21-day aquatic vertebrate exposure used to derive the COC.								

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