



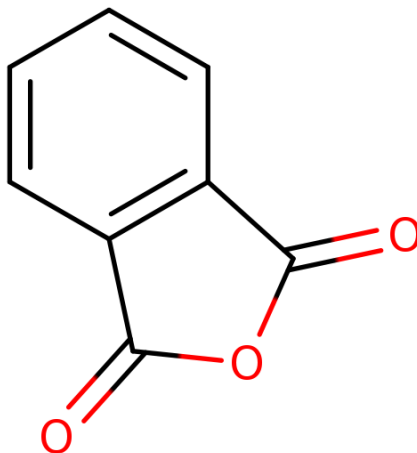
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# Draft Environmental Media and General Population Exposure for Phthalic Anhydride

## Technical Support Document for the Draft Risk Evaluation

CASRN 85-44-9



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## 108 KEY ABBREVIATIONS AND ACRONYMS

109	7Q10	Lowest 7-day flow in a 10-year period
110	ADC	Average daily concentration

111	ADD	Average daily dose
112	ADME	Absorption, distribution, metabolism, and excretion
113	ADR	Acute dose rate
114	AERMOD	American Meteorological Society (AMS)/EPA Regulatory Model
115	BAF	Bioaccumulation factor
116	BCF	Bioconcentration factor
117	BSAF	Biota-sediment accumulation factor
118	BW	Body weight
119	CASRN	Chemical Abstracts Service Registry Number
120	CFR	Code of Federal Regulations
121	COU	Condition of use
122	DFAC	Diffusion factor
123	DMR	Discharge monitoring report
124	DWT	Removal during drinking water treatment (%)
125	ECHO	Enforcement and Compliance History Online Database
126	ED	Exposure duration
127	EF	Exposure frequency
128	E-FAST	Exposure and Fate Assessment Screening Tool
129	ET	Exposure time
130	EROM	Enhanced runoff method
131	GC/MS	Gas chromatography/mass spectrometry
132	IIOAC	Integrated indoor-outdoor air calculator
133	EPA	Environmental Protection Agency (U.S.)
134	HM	Harmonic mean
135	HSWA	Hazardous and Solid Waste Amendments
136	IIOAC	Integrated Indoor/Outdoor Air Calculator (IIOAC) Model
137	K <sub>oc</sub>	Organic carbon:water partition coefficient
138	K <sub>p</sub>	Dermal permeability coefficient
139	LADD	Lifetime average daily dose
140	NHANES	National Health and Nutrition Examination Survey
141	NPDES	National Pollutant Discharge Elimination System
142	OES	Occupational exposure scenario
143	OW	Office of Water (EPA)
144	POTW	Publicly owned treatment works
145	PSC	Point Source Calculator
146	RD	Release days
147	RCRA	Resource Conservation and Recovery Act
148	SWC	Surface water concentration
149	TMF	Trophic magnification factor
150	TSCA	Toxic Substances Control Act
151	TSD	Technical support document
152	TRI	Toxic release inventory
153	STORET	STorage and RETrieval Dashboard
154	UIW	Underground Injection Wells
155	USDW	Underground source of drinking water
156	U.S.	United States
157	UV	Ultraviolet
158	VVWM	Variable Volume Water Model
159	WQP	Water Quality Portal

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## SUMMARY

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This technical support document (TSD) is part of the *Draft Risk Evaluation for Phthalic Anhydride* conducted under the Toxic Substances Control Act (TSCA) (see also public docket, [EPA-HQ-OPPT-2018-0459](#)). In the natural environment, phthalic anhydride (CASRN 85-44-9) rapidly hydrolyzes in contact with surface water or atmospheric moisture, forming 1,2-benzenedicarboxylic acid, also known as *ortho* (*o*)-phthalic acid. The reaction is facilitated by the anhydride's high reactivity with water and typically occurs quickly. The hydrolysis half-life is estimated to be between 30 to 90 seconds in surface water, depending on pH, with complete hydrolysis in approximately 8 minutes in simulated seawater or physiological fluids ([U.S. EPA, 2026d](#)). The rate of hydrolysis in the atmosphere is influenced by factors such as humidity, temperature, and other atmospheric components, with higher humidity accelerating the process. Although specific quantitative rates of atmospheric hydrolysis are not commonly detailed, the reaction is generally assumed to occur on the order of minutes, limiting the persistence of phthalic anhydride in its original form. Consequently, this assessment focused on exposure to *o*-phthalic acid, considering data from both chemicals.

The U.S. Environmental Protection Agency (EPA or the Agency) evaluated the reasonably available information for various environmental media concentrations and using previously peer-reviewed screening-level approaches to estimate exposure through different exposure pathways for the general population. This draft assessment employs a screening-level approach with more refined quantitative analyses, selected based on the evaluated population and the relevant exposure routes and pathways. Screening-level approaches enable timely assessments and conserve resources by focusing efforts on chemicals, uses, locations, populations, or exposure pathways and routes with the highest potential exposures. This draft TSD details the exposure analysis supporting the risk evaluation conclusions for phthalic anhydride conditions of use (COUs) under TSCA, focusing on scenarios with the upper-bound exposure estimates for the general population. It considers available monitoring data as well as modeled exposure estimates. These upper-bound exposure scenarios serve as screening-level analyses, and the resulting estimations are expected to be higher than exposure across all COUs in the draft risk evaluation. The key points are summarized below:

- EPA assessed environmental concentrations of *o*-phthalic acid in air, water, and land (soil, biosolids, and groundwater) for the environmental exposure and general population exposure assessments.
  - For the land pathway, based on the physical and chemical properties and environmental fate data, EPA determined that *o*-phthalic acid is likely to exhibit high mobility in soils; however, its low persistence potential in soils and groundwater limit its potential for transport in groundwater systems. Therefore, groundwater concentrations resulting from releases from the landfill or to agricultural lands via biosolids applications were not quantified but are discussed qualitatively.
  - For the water pathway, *o*-phthalic acid is expected to remain in solution and is not expected to partition into sediment. EPA's screening analysis utilized conservative model inputs and upper-bound modeled surface water concentrations to assess chronic human exposure. This approach and the results give the Agency high confidence that the estimated exposures are conservative.
  - For the air pathway, *o*-phthalic acid in air releases is expected to predominantly be deposited into the soil compartments where it is not expected to persist. EPA's screening analysis utilized conservative model inputs and upper-bound modeled outdoor air and soil concentrations from air deposition to soil of *o*-phthalic acid to assess chronic human

exposure via inhalation and incidental soil ingestion. This approach and the results give EPA high confidence that estimated exposures are conservative.

- No acute exposure scenarios were quantified or summarized in this assessment because no acute hazard was identified for *o*-phthalic acid.
- Screening for cancer was not conducted because EPA's review of the weight of evidence for the carcinogenicity of phthalic anhydride, as described in the *Draft Human Health Hazard Assessment for Phthalic Anhydride* ([U.S. EPA, 2026c](#)), concluded that phthalic anhydride is *Not Likely to Be Carcinogenic to Humans*. The hazard profiles of *o*-phthalic acid and phthalic anhydride are the same (*i.e.*, low systemic toxicity through the oral route).
- *o*-Phthalic acid has a low bioaccumulation and biomagnification potential. Because *o*-phthalic acid has low potential for trophic transfer through food webs, EPA did not evaluate trophic transfer for this assessment.

## 1 ENVIRONMENTAL MEDIA CONCENTRATION OVERVIEW

Phthalic anhydride is commonly used in the production of plastics and other polymers for consumer, commercial, and industrial applications. It is expected to hydrolyze to *o*-phthalic acid in the presence of moisture as described in the *Draft Physical Chemistry and Fate and Transport Assessment for Phthalic Anhydride* ([U.S. EPA, 2026d](#)). For the purposes of this draft TSD, *o*-phthalic acid was assessed.

This draft TSD describes the use of reasonably available information to estimate environmental concentration of *o*-phthalic acid, the hydrolysis product of phthalic anhydride, in different environmental media as well as the use of the estimated concentrations to evaluate exposure to the general population. EPA evaluated the reasonably available information for releases of phthalic anhydride from facilities that use, manufacture, or process phthalic anhydride under industrial and/or commercial conditions of use (COUs) under TSCA as detailed in the *Draft Environmental Release and Occupational Exposure Assessment for Phthalic Anhydride* ([U.S. EPA, 2026b](#)). EPA relied on modeling to assess drinking water exposures (Section 5) and ambient air exposures (Section 6). When monitoring data were available, EPA also compared modeled concentrations to monitored concentrations. Based on fate parameters for phthalic anhydride and *o*-phthalic acid detailed in *Draft Physical Chemistry and Fate and Transport Assessment for Phthalic Anhydride* ([U.S. EPA, 2026d](#)), concentrations of *o*-phthalic acid in soil and groundwater resulting from releases to the land pathway (Section 3) were discussed qualitatively because *o*-phthalic acid is not expected to be persistent in soils or groundwater. Table 1-1 provides a crosswalk between COUs and occupational exposure scenarios (OESs); Table 1-2 shows the types of releases to the environment by OES.

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

Life Cycle Stage <sup>a</sup>	COU		OES <sup>d</sup>
	Category <sup>b</sup>	Subcategory <sup>c</sup>	
Manufacturing	Domestic manufacturing	Domestic manufacturing	Manufacturing
	Importing	Importing	Import and repackaging
Processing	Repackaging	Repackaging	Import and repackaging
	Processing as a reactant	Intermediate (all other basic organic chemical manufacturing; Paint and coating manufacturing; Flame retardant manufacturing)	Processing as a reactant
		Intermediate (plastic material and resin manufacturing; Plastic product manufacturing; Construction)	Plastic compounding
		Monomer (plastic material and resin manufacturing)	Plastic compounding
		Monomer (all other basic organic chemical manufacturing)	Processing as a reactant
		Ion exchange agent (all other basic organic chemical manufacturing)	Processing as a reactant
		Pigments (printing ink manufacturing)	Processing as a reactant
		Polymerization promoter in: (synthetic dye and pigment manufacturing)	Processing as a reactant

COU			OES <sup>d</sup>
Life Cycle Stage <sup>a</sup>	Category <sup>b</sup>	Subcategory <sup>c</sup>	
Processing		Plasticizer (plastics product manufacturing)	Plastic compounding; Plastic converting
		Plasticizer (adhesive manufacturing)	Processing as a reactant
	Incorporation into formulations, mixtures, or reaction products	Intermediate (all other basic organic chemical manufacturing; All other basic inorganic chemical manufacturing; Adhesive manufacturing; Lubricant and lubricant additive manufacturing)	Incorporation into formulations, mixtures, or reaction products
		Intermediate (plastic product manufacturing)	Plastic compounding; Plastic converting
		Monomer (plastic material and resin manufacturing)	Plastic compounding
		Plasticizers (plastic material and resin manufacturing)	Plastic compounding
		Plasticizers (paint and coating manufacturing)	Incorporation into formulations, mixtures, or reaction products
		Paint additives and coating additives not described by other categories (plastics material and resin manufacturing)	Plastic compounding
		Paint additives and coating additives not described by other categories (roofing and coating materials manufacturing; solid color stains)	Incorporation into formulations, mixtures, or reaction products
		Fillers (all other chemical product and preparation manufacturing)	Incorporation into formulations, mixtures, or reaction products (epoxy resin casting hardener)
		Dyes (synthetic dye and pigment manufacturing)	Incorporation into formulations, mixtures, or reaction products
		Retarder (rubber product manufacturing)	Incorporation into formulations, mixtures, or reaction products
		Flame retardant (plastics product manufacturing)	Plastic compounding; Plastic converting
		Binder (paint and coating manufacturing)	Incorporation into formulations, mixtures, or reaction products
		Hardener (paint and coating manufacturing; solvent-based paint; Adhesive manufacturing; Rubber product manufacturing; Power infrastructure utilities)	Incorporation into formulations, mixtures, or reaction products

COU			OES <sup>d</sup>
Life Cycle Stage <sup>a</sup>	Category <sup>b</sup>	Subcategory <sup>c</sup>	
Processing	Incorporation into formulations, mixtures, or reaction products	Solvent (paint and coating manufacturing)	Incorporation into formulations, mixtures, or reaction products
		Solvent (plastic material and resin manufacturing)	Plastic compounding
		Processing aid (paint and coating manufacturing; rubber product manufacturing)	Incorporation into formulations, mixtures, or reaction products
		Pre-catalyst manufacturing ( e.g., catalyst component for polyolefins production)	Incorporation into formulations, mixtures, or reaction products
		Polymerization promoter (all other basic organic chemical manufacturing)	Incorporation into formulations, mixtures, or reaction products
	Recycling	Recycling	Disposal and recycling
Disposal	Disposal	Disposal	Disposal and recycling
Distribution in commerce	Distribution in commerce	N/A	Distribution in commerce
Industrial use	Processing aids, specific to petroleum production	Hydraulic fracturing	Use of lubricants and functional fluids
	Adhesives and sealants	Adhesives and sealants	Application of paints, coatings, adhesives, and sealants (non-spray)
	Paints and coatings	Paints and coatings ( e.g., commercial and residential paint coatings, stains, exterior architectural and marine paints)	Application of paints, coatings, adhesives, and sealants (spray and non-spray)
	Building/construction materials not covered elsewhere	Construction and building materials covering large surface areas, including paper articles; Metal articles; Stone, plaster, cement, glass and ceramic articles	Fabrication or use of final products or articles
	Electrical and electronic products	Machinery, mechanical appliances, electrical/electronic articles	Application of paints, coatings, adhesives, and sealants (non-spray)
	Other	Laboratory chemicals	Use of laboratory chemicals
	Automotive and aerospace products	Transportation equipment manufacturing ( e.g., used in the body/exterior, interior, and electrical systems of a vehicle, wiring assemblies, seat and console assemblies, and lamp assemblies)	Application of paints, coatings, adhesives, and sealants (spray and non-spray)
		Acceptance testing of foams used on human-rated spaceflight vehicles	Use of laboratory chemicals

COU			OES <sup>d</sup>
Life Cycle Stage <sup>a</sup>	Category <sup>b</sup>	Subcategory <sup>c</sup>	
	Lubricants and greases	Lubricants and greases	Use of lubricants and functional fluids
	Water treatment products	Water filtration applications	Fabrication or use of final products or articles
Commercial use	Adhesives and sealants	Adhesives and sealants ( <i>e.g.</i> , hot-melt adhesives)	Application of paints, coatings, adhesives, and sealants (non-spray)
	Fillers	Hardener ( <i>e.g.</i> , epoxy hardener)	Incorporation into formulations, mixtures, or reaction products (epoxy resin casting hardener)
	Other	Laboratory chemicals	Use of laboratory chemicals
	Transportation equipment manufacturing	Transportation equipment manufacturing ( <i>e.g.</i> , used in the body/exterior, interior, and electrical systems of a vehicle, wiring assemblies, seat and console assemblies, and lamp assemblies)	Application of paints, coatings, adhesives, and sealants (spray and non-spray)
	Water treatment products	Water filtration applications	Fabrication or use of final products or articles
	Plastic and rubber products	Other articles with routine direct contact during normal use including rubber articles; plastic articles (hard)	Fabrication or use of final products or articles
	Furniture and furnishings not covered elsewhere	Oil treatment of wood, indoors	Application of paints, coatings, adhesives, and sealants (spray and non-spray)
	Paints and coatings	Paints and coatings ( <i>e.g.</i> , powder coatings, aerosol spray paints)	Application of paints, coatings, adhesives, and sealants (spray and non-spray)
	Construction	Construction and building materials ( <i>e.g.</i> , stone, plaster, cement, glass and ceramic articles; fabrics, textiles, and apparel covering large surface areas)	Fabrication or use of final products or articles
	Lubricants and greases	Lubricants and greases	Use of lubricants and functional fluids
	Machinery and electronics	Machinery, mechanical appliances, electronic/electronic articles	Application of paints, coatings, adhesives, and sealants (non-spray)

<sup>a</sup> Life Cycle Stage Use Definitions (40 CFR 711.3)

- “Industrial use” means use at a site at which 1 or more chemicals or mixtures are manufactured (including imported) or processed.
- “Commercial use” means the use of a chemical or a mixture containing a chemical (including as part of an article) in a commercial enterprise providing saleable goods or services.

COU			OES <sup>d</sup>
Life Cycle Stage <sup>a</sup>	Category <sup>b</sup>	Subcategory <sup>c</sup>	
<ul style="list-style-type: none"><li>– “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.</li><li>– 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 Toxic Substances Control Act section 6(a)(5) to reach both.</li></ul>			
<sup>b</sup> These categories of conditions of use (COUs) appear in the life cycle diagram, reflect Chemical Data Reporting rule (CDR) codes, and broadly represent COUs of phthalic anhydride in industrial and/or commercial settings.			
<sup>c</sup> These subcategories represent more specific activities within the life cycle stage and category of the COU of phthalic anhydride.			
<sup>d</sup> An OES (occupational exposure scenario) is based on a set of facts, assumptions, and inferences that describe how releases and exposures take place within an occupational COU. The occurrence of releases/exposures may be similar across multiple conditions of use (multiple COUs mapped to single OES), or there may be several ways in which releases/exposures take place for a given condition of use (single COU mapped to multiple OESs).			

**Table 1-2. Type of Release to the Environment by Occupational Exposure Scenario**

OES <sup>a</sup>	Type of Discharge <sup>b</sup> , Air Emission <sup>c</sup> , or Disposal <sup>d</sup>
Manufacturing	Stack air
	Fugitive air
	Land
Import and repackaging	Stack air
	Fugitive air
	Wastewater
Processing as a reactant	Stack air
	Fugitive air
	Wastewater
	Land
Incorporation into formulations, mixtures, or reaction products	Stack air
	Fugitive air
	Wastewater
	Land
Plastic compounding	Stack air
	Fugitive air
	Wastewater
	Land

OES <sup>a</sup>	Type of Discharge <sup>b</sup> , Air Emission <sup>c</sup> , or Disposal <sup>d</sup>
Plastic converting	Stack air
	Fugitive air
	Wastewater
	Land
Application of paints, coatings, adhesives, and sealants	Stack air
	Fugitive air
	Land
Use of laboratory chemicals	Stack air
	Fugitive air
	Wastewater
	Land
Use of lubricants and functional fluids	No identified releases <sup>e</sup>
Fabrication or final use of products or articles	No identified releases <sup>e</sup>
Disposal and recycling	Stack air
	Fugitive air
	Wastewater
	Land
<sup>a</sup> Table 1-1 provides the crosswalk of OESs to COUs. Discharge types and related OES were derived from US EPA's Toxics Release Inventory ( <a href="#">U.S. EPA, 2026b</a> ) <sup>b</sup> Direct discharge to surface water; indirect discharge to non-POTW (publicly owned treatment works); indirect discharge to POTW. Details on wastewater release streams for each facility are presented in the <i>Draft Environmental Release and Occupational Exposure Assessment for Phthalic Anhydride</i> ( <a href="#">U.S. EPA, 2026b</a> ). <sup>c</sup> Emissions via fugitive air or stack air, or treatment via incineration <sup>d</sup> Land releases were reported to on-site underground class 1 wells, on-site and off-site underground injection, on-site and off-site Resource Conservation and Recovery Act (RCRA) subtitle C landfills, off-site landfills, other off-site land disposal, off-site surface impoundments, and transfers to off-site waste brokers. <sup>e</sup> EPA did not quantitatively assess environmental releases for this OES due to the lack of readily available process-specific and phthalic anhydride-specific data	

Releases from all OESs were considered, but EPA focused on estimating upper-bound concentrations of phthalic anhydride from the largest reported releases of phthalic anhydride by media for its screening-level assessment of environmental and general population exposures. This means that EPA considered the concentration of phthalic anhydride as *o*-phthalic acid in each environmental media resulting from the OES that had the highest release compared to the other OES. The OES resulting in the highest environmental concentration of *o*-phthalic acid varied by environmental media is shown in Table 1-2. Additionally, EPA relied on its fate assessment (*Draft Physical Chemistry and Fate and Transport Assessment for Phthalic Anhydride* ([U.S. EPA, 2026d](#))) to inform which environmental pathways are expected to have exposures to the general population.

Under normal environmental conditions, phthalic anhydride is expected to be hydrolyzed into *o*-phthalic acid on the order of minutes ([NCBI, 2020](#)). Therefore, EPA focused on the environmental exposure of *o*-phthalic acid as it is the main transformation product of phthalic anhydride released into the

environment. Based on the fate parameters of *o*-phthalic acid, (e.g., Henry's Law constant, log  $K_{oc}$  [Organic carbon:water partition coefficient], water solubility, fugacity modeling), EPA anticipates *o*-phthalic acid will be predominantly in water. However, because phthalic anhydride is released to the ambient air from industrial facilities and processes, inhalation of phthalic anhydride as *o*-phthalic acid as well as deposition to soil and water via ambient air are possible transport and exposure pathways. EPA quantitatively assessed concentrations of *o*-phthalic acid in surface water and ambient air, and deposition from ambient air to soil. Soil and groundwater concentrations of *o*-phthalic acid from land application of biosolids and other land pathways were not quantitatively assessed as *o*-phthalic acid is expected to have limited persistence potential in soil and groundwater. Concentrations of *o*-phthalic acid in sediments were not quantitatively assessed because *o*-phthalic acid is expected to remain in solution and not sorb to sediments.

Exposure of phthalic anhydride as *o*-phthalic acid from groundwater, biosolids, and landfills were not quantified. EPA performed a qualitative assessment for these land exposure scenarios (Section 3). EPA did not conduct a quantitative assessment for incidental oral and dermal exposures to *o*-phthalic acid in water through swimming because dermal and oral hazards were not identified for acute exposures to *o*-phthalic acid ([U.S. EPA, 2026c](#)). For chronic (within a year) exposures, EPA acknowledges that some populations (tribal and non-tribal) may swim in open bodies of water (e.g., rivers and lakes) regularly in warmer climates or intermittently during the warmer seasons in a year. However, physical and chemical properties of *o*-phthalic acid indicate that dermal absorption is not expected. Specifically, *o*-phthalic acid is expected to fully ionize at typical skin pH levels, 5.5, and therefore, EPA did not derive a chronic dermal hazard value for *o*-phthalic acid ([U.S. EPA, 2026c](#)). EPA also did not conduct a quantitative assessment for exposure through human milk ingestion because based on the physical and chemical properties of *o*-phthalic acid, it is highly water soluble, not lipophilic ( $\log K_{ow} = 0.73$ ), and has a low bioaccumulation (factor) potential ( $BAF = 1.32 \text{ L/kg}$ ). These properties indicate that *o*-phthalic acid does not readily accumulate in fatty tissues, such as those found in human milk. Therefore, EPA does not expect *o*-phthalic acid to be present or be expected to accumulate in human milk. The Agency qualitatively discusses the dietary pathway and fish ingestion as it is not expected to result in exposures to the general population since the chemical does not bioaccumulate and is not lipophilic. EPA did not conduct a quantitative analysis of *o*-phthalic acid trophic transfer, as *o*-phthalic acid is expected to have low bioaccumulation potential, no apparent biomagnification potential, and thus low potential for uptake overall. For further information on the bioaccumulation and biomagnification of phthalic anhydride/*o*-phthalic acid as well as other physical and chemical properties, please see the *Draft Physical Chemistry and Fate and Transport Assessment for Phthalic Anhydride* ([U.S. EPA, 2026d](#)).

When monitoring data were available, EPA compared modeled concentrations to monitored concentrations. No monitoring data for phthalic anhydride or *o*-phthalic acid in biosolids or landfills were available. Further description of the qualitative and quantitative assessments for each exposure pathway can be found in the sections linked in Table 2-1.

## 2 SCREENING-LEVEL ASSESSMENT OVERVIEW

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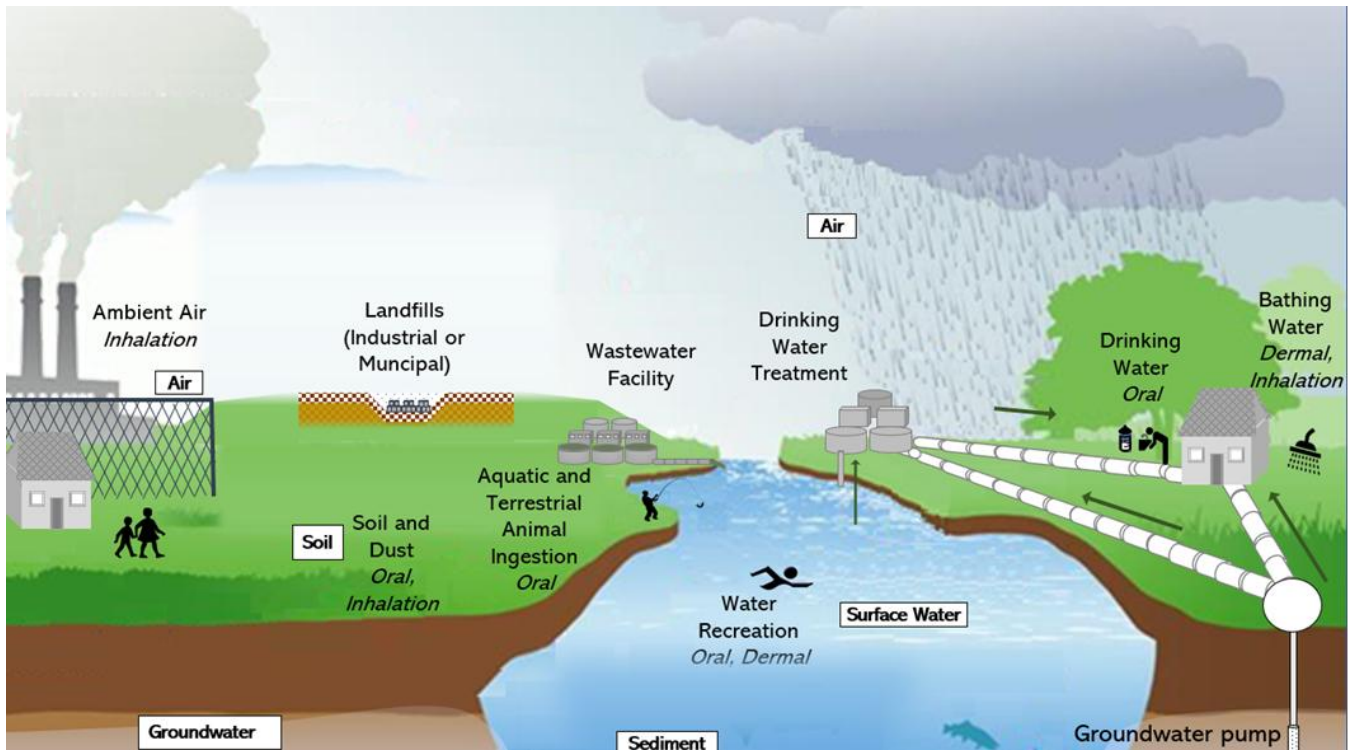
Due to the hydrolysis of phthalic anhydride to *o*-phthalic acid that is expected due to the presence of moisture in the environment, EPA assessed exposure to *o*-phthalic acid for the general population. EPA utilized a screening-level approach that relies on conservative assumptions including default input parameters for modeling environmental media concentrations to help to characterize exposure resulting from the upper-bound of the expected distribution. 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, 2019a](#)). This screening-level analysis also includes conservative assumptions in the hazard values associated with *o*-phthalic acid used for calculating the margin of exposure as described in Section 2.1.

Upper-bound exposure estimates used for screening-level analyses were defined as those associated with the industrial and commercial releases from a COU and OES that resulted in the highest environmental media concentrations. Additionally, individuals with the greatest intake rate of *o*-phthalic acid per body weight were considered to be those at the upper end of the exposure range. Taken together, these exposure estimates are conservative as they were determined using the highest environmental media concentrations and greatest intake rate of *o*-phthalic acid per kg of body weight. These exposure estimates are also conservative estimates that ensure that individuals will experience less exposure either due to lower intake rate or exposure to lower environmental media concentration. This is explained further in Section 2.1.

### 2.1 Estimating Upper-Bound Exposure

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As described in the *Draft Environmental Release and Occupational Exposure Assessment for Phthalic Anhydride* ([U.S. EPA, 2026b](#)) and summarized in Table 1-2 of this assessment, releases of phthalic anhydride are expected to occur to air, water, and land. Given the hydrolysis of phthalic anhydride to *o*-phthalic acid that is expected in the environment, this assessment focused on exposure to *o*-phthalic acid ([U.S. EPA, 2026d](#)). Figure 2-1 provides a graphical representation of where and in which media *o*-phthalic acid resulting from the hydrolysis of phthalic anhydride is expected to be found due to environmental releases and the corresponding route of exposure.



**Figure 2-1. Potential Human Exposure Pathways for the General Population**

The diagram presents the media (white text boxes) and routes of exposure (*italics for oral, inhalation, or dermal*) for the general population. Sources of drinking water from surface or water pipes are depicted with grey arrows.

For a screening-level analysis, upper-bound exposures were estimated for each exposure pathway assessed. EPA’s *Guidelines for Human Exposure Assessment* defined upper-bound 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” ([U.S. EPA, 2019a](#)).

Table 2-1 summarizes the upper-bound 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. Exposure scenarios were assessed quantitatively only when environmental media concentrations were quantified for the appropriate exposure scenario. Because *o*-phthalic acid environmental releases from biosolids, landfills and underground injection wells (and therefore, resulting soil concentrations) were not quantified, exposure from soil or groundwater resulting from *o*-phthalic acid release to the environment via biosolids, landfills or underground injection wells were not quantitatively assessed. Instead, the scenarios were assessed qualitatively for exposures potentially resulting from biosolids, landfills and underground injection wells. Additionally, the assessment focused solely on scenarios leading to chronic exposure.

348 **Table 2-1. Exposure Scenarios Assessed in Risk Screening for *o*-Phthalic Acid**

OES	Exposure Pathway	Exposure Route	Exposure Scenario	Lifestage	Analysis (Quantitative or Qualitative)
All	Biosolids	All considered qualitatively			Qualitative, Section 3.1
All	Landfills	All considered qualitatively			Qualitative, Section 3.2
All	Underground injection wells	All considered qualitatively			Qualitative, Section 3.3
Processing as a reactant	Drinking water	Oral	Ingestion of <i>o</i> -phthalic acid in drinking water	Adult, youth, and children	Quantitative, Section 5.1.1
Manufacturing	Ambient air	Inhalation	Inhalation of <i>o</i> -phthalic acid in ambient air resulting from industrial releases	All	Quantitative, (Section 6.1.3)
		Oral	Ingestion of <i>o</i> -phthalic acid onto soil as a result of air-to-soil deposition from industrial releases	Infants and children	Quantitative, (Section 6.1.3)

OES = occupational exposure scenario

349  
350 As part of the general population exposure assessment, EPA considered fenceline populations in  
351 proximity to releasing facilities as part of the ambient air exposure assessment by using pre-screening  
352 methodology described in EPA's *Draft TSCA Screening-level Approach for Assessing Ambient Air and*  
353 *Water Exposures to Fenceline Communities (Version 1.0)* ([U.S. EPA, 2022](#)). For other exposure  
354 pathways, EPA's screening method assessing upper-bound exposure scenarios used release data that  
355 reflect exposures expected to occur in proximity to releasing facilities, which would include fenceline  
356 populations.

357  
358 Modeled surface water concentrations (Section 4.1) were used to estimate oral drinking water exposures  
359 (5.1.1). Modeled ambient air concentrations (Section 6.1.3) were used to estimate inhalation exposures.  
360 Modeled air deposition rates onto soil (Section 6.1.3) were used to estimate incidental oral exposures via  
361 soil ingestion.

### 3 LAND PATHWAY

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Phthalates can be present in land pathways for several potential reasons. These include the amendment of soils with biosolids from wastewater treatment facilities containing phthalic anhydride/*o*-phthalic acid, contamination of soils and groundwater from leaking landfills, and from potential impacts to underlying groundwater from disposal of waste via injection well. EPA searched peer-reviewed literature, gray literature, and databases of environmental monitoring data identified during systematic review to obtain concentrations of *o*-phthalic acid in terrestrial land pathways (*i.e.*, biosolids, wastewater sludge, agricultural soils, and impacts to underlying groundwater from migration from landfills, landfill leachate, and/or injection wells).

This draft assessment of phthalic anhydride exposure as *o*-phthalic acid via land pathways is based on the fate and physical and chemical properties of *o*-phthalic acid—the hydrolysis product of phthalic anhydride. When possible, data from the existing literature were used to support the assessment.

#### 3.1 Biosolids and Potential Impacts to Underlying Soil and Groundwater

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The term “biosolids” refers to treated sludge that meets the EPA pollutant and pathogen requirements for land application and surface disposal and can be beneficially recycled (40 CFR Part 503) ([U.S. EPA, 1993](#)). Biosolids generated during the treatment of industrial and municipal wastewater may be applied to agricultural fields or pastures as fertilizer in either its dewatered form or as a water-biosolid slurry. Biosolids that are not applied to agricultural fields or pastures may be disposed of by incineration or landfill disposal. Landfill disposal will be discussed in further depth in Section 3.2. *o*-Phthalic acid may be introduced to biosolids by sorption to particulate or organic material during wastewater treatment. Wastewater treatment is expected to remove between 10 to 20% of *o*-phthalic acid via mainly biodegradation ([Kotowska et al., 2012](#)) even though higher removals have been seen in bench scale experiments ([Pirsaheb et al., 2009](#)). The STPWIN™ model in EPI Suite™ predicts less than 2% removal of *o*-phthalic acid in wastewater treatment via sorption to sludge ([U.S. EPA, 2017](#)). Based on its high water solubility and low sorption to solids, *o*-phthalic acid is not expected to partition to biosolids.

*o*-Phthalic acid present in soil through the application of biosolids or otherwise introduced to topsoil is expected to be mobile in water and may leach into groundwater due to the low tendency of *o*-phthalic acid to sorb to organic media and soil ( $\log K_{ow} = 0.73$ ;  $\log K_{oc} = 1.07$ ). Biodegradation of *o*-phthalic acid in groundwater is expected to have a half-life of days ([Fujita et al., 2005](#)). While the water solubility and low potential for sorption to organic carbon in soils of *o*-phthalic acid indicate that it is a likely candidate for transport in groundwater systems, the rapid aerobic biodegradation of *o*-phthalic acid in soils and groundwater indicate that it will biodegrade quickly in the subsurface environment. Therefore, *o*-phthalic is not a candidate for long-range transport in groundwater systems.

There are currently no U.S.-based studies reporting *o*-phthalic acid concentration in biosolids or in soil following land application. The limited measured data on concentrations of *o*-phthalic acid in biosolids or soils receiving biosolids creates some uncertainty. However, the predicted weak sorption to sludge, the high-quality biodegradation rates and physical and chemical properties suggest that *o*-phthalic acid will have limited persistence potential in soils receiving biosolids.

##### 3.1.1 Weight of Scientific Evidence Conclusions for Biosolids and Potential Impacts to Underlying Soil and Groundwater

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Although experimental data are limited, physical and chemical properties suggest that *o*-phthalic acid is expected to be weakly absorbed by biosolids and that *o*-phthalic acid present in biosolid-amended soils will likely not be absorbed by any plants or crops growing in the soil and soil-dwelling organisms are

not expected to readily accumulate *o*-phthalic acid through ingestion or absorption. Because *o*-phthalic acid is also likely to biodegrade rapidly in a subsurface environment, it is not a candidate for transport in groundwater systems.

## 3.2 Landfills and Potential Impacts to Underlying Groundwater

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Landfills are a potential source of chemicals in the environment. According to the EPA's Toxic Release Inventory (TRI) database, over 43 metric tons of phthalic anhydride were disposed of in landfills between 2019 and 2023. Phthalic anhydride can enter landfills through various waste streams, including industrial waste and municipal waste such as dewatered wastewater biosolids.

No studies were identified through systematic review determining the concentration of phthalic anhydride or *o*-phthalic acid in landfills or landfill leachate in the United States. Additionally, there are no studies reporting the presence of phthalic anhydride or *o*-phthalic acid in dewatered biosolids, which may be sent to landfills for disposal.

As note previously, phthalic anhydride is expected to be hydrolyzed into *o*-phthalic acid, which is expected to biodegrade in the upper aerobic portions of landfills. In the lower portions of the landfills, where anaerobic conditions are likely, biodegradation is expected to be slower ([Huang et al., 2013](#); [Jonsson et al., 2003](#)). In groundwater, *o*-phthalic acid is expected to biodegrade, with a half-life of days ([Tang et al., 2017](#); [Fujita et al., 2005](#)), suggesting that *o*-phthalic acid will not persist in groundwater.

### 3.2.1 Weight of Scientific Evidence Conclusions

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Information on the presence of *o*-phthalic acid in landfills is limited. Based on the biodegradation data for conditions relevant to landfills, there is robust confidence that *o*-phthalic acid will not be persistent in landfills. *o*-Phthalic acid is soluble in water and may possibly be present in landfill leachates and migrate through groundwater. However, biodegradation data shows that *o*-phthalic acid will biodegrade in soil and groundwater and thus is not expected to persist.

## 3.3 Underground Injection Wells and Potential Impacts to Underlying Groundwater

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According to EPA's TRI database, over 16 metric tons of phthalic anhydride were disposed of via underground injection to Class I Underground Injection Wells (UIWs) between 2019 and 2023 ([U.S. EPA, 2023](#)). EPA did not assess releases to the environment from Class I UIWs because EPA expects exposure from these wells to be negligible for reasons described below.

Underground injection to Class I Wells is a method of disposal for hazardous wastes. There are generally six different classes of UIWs and only Class I Wells may be permitted to receive hazardous waste ([U.S. EPA, 2008](#)). Wells typically consist of three or more concentric layers of pipe including surface casing, long string casing, and injection tubing. In addition, wells must be sited at locations with geologies that mitigate any movement of contaminants outside of a confined layer if there were a well failure. Extensive pre-siting geological tests confirm that the injection zone is of sufficient lateral extent and thickness and is sufficiently porous so that fluids injected through the well can enter the rock formation without extensive buildup of pressure or possible displacement of injected fluids outside of the intended zone. Class I UIWs are typically drilled thousands of feet below the lowermost underground source of drinking water (USDW) ([U.S. EPA, 2001](#)).

The Hazardous and Solid Waste Amendments (HSWA) to the RCRA added significant restrictions on the disposal of hazardous waste. Under these amendments, land disposal of hazardous wastes, which

includes Class I hazardous waste injection wells, is prohibited unless the waste has been treated to become non-hazardous or the disposer can demonstrate that the waste will remain where it has been placed for as long as it remains hazardous, which has been defined as 10,000 years by regulation ([U.S. EPA, 2001](#)).

Potential pathways through which injected fluids can migrate to underground sources of drinking water include failure of the well or improperly plugged or completed wells or other pathways near the well. Drinking water source contamination due to well failure is typically caused by leaks in the well tubing and casing or when injected fluid is forced upward between the well's outer casing and the well bore should the well lose mechanical integrity ([U.S. EPA, 2001](#)).

Well failures can be detected by continuous monitoring systems or mechanical integrity tests, at which point the wells would be shut-in until they are repaired. EPA's extensive technical requirements for Class I UIWs are designed to prevent contamination of underground sources of drinking water through these pathways ([U.S. EPA, 2001](#)).

Operators must conduct appropriate mechanical integrity tests yearly for hazardous wells and every 5 years for nonhazardous wells to ensure wells are fit for operation. It should be noted that the loss or failure of mechanical integrity does not necessarily mean that wastewater will escape the injection zone. This added security can be attributed to redundant safety systems to protect against loss of waste confinement. See <https://www.epa.gov/uic/class-i-industrial-and-municipal-waste-disposal-wells> (accessed February 2, 2026) for more details on class I UIWs.

### **3.3.1 Weight of Scientific Evidence Conclusions**

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Based on the low risk of failure of class I UIWs, as well as the expected low persistence of *o*-phthalic acid in a groundwater environment based on high-quality biodegradation data, EPA has robust confidence that *o*-phthalic acid will not persist in groundwater.

## 4 SURFACE WATER PATHWAY

EPA searched peer-reviewed literature, gray literature, and databases of environmental monitoring data to obtain concentrations of phthalic anhydride or *o*-phthalic acid in ambient surface water and aquatic sediments. Although the available monitoring data were limited, phthalic anhydride was measured in detectable concentrations in surface waters ([Guzzella and Sora, 1998](#)). In addition, industrial releases of phthalic anhydride, which hydrolyzes instantaneously to *o*-phthalic acid, directly to surface waters were reported to EPA via TRI databases ([U.S. EPA, 2026b](#)). EPA conducted modeling of estimated industrial releases to surface water to assess the expected resulting environmental media concentrations from Toxic Substances Control Act (TSCA) COUs presented in Table 1-1. Section 4.1 presents EPA modeled surface water concentrations. Section 4.2.1 includes a summary of monitoring concentrations for ambient surface water and sediment identified during the systematic review process.

### 4.1 Modeled Concentrations

#### 4.1.1 Modeling Approach for Estimating Concentrations in Surface Water

EPA conducted modeling using EPA's Variable Volume Water Model (VVWM) in Point Source Calculator (PSC) tool ([U.S. EPA, 2019b](#)) to estimate surface water concentrations of *o*-phthalic acid resulting from TSCA COU releases of phthalic anhydride. PSC inputs include physical and chemical properties of *o*-phthalic acid (*i.e.*,  $K_{ow}$ ,  $K_{oc}$ , water column half-life, photolysis half-life, hydrolysis half-life, and benthic half-life) and reported phthalic anhydride releases to water ([U.S. EPA, 2026b](#)), which are used to predict receiving water column concentrations.

Site-specific parameters influence how partitioning occurs over time. For example, the concentration of suspended sediments, water depth, and weather patterns all influence how a chemical may partition between compartments. However, physical and chemical properties of the chemical itself have a major influence on partitioning and half-lives in aqueous environments. *o*-Phthalic acid has a log  $K_{oc}$  of 1.07, indicating a low potential to sorb to suspended particles in the water column and settled sediment in the benthic environment ([U.S. EPA, 2026d](#)).

Physical and chemical, and environmental fate properties selected by EPA for this assessment were used as inputs to the PSC model (Table 4-1). Selected values are described in detail in *Draft Physical Chemistry and Fate and Transport Assessment for Phthalic Anhydride* ([U.S. EPA, 2026d](#)).

**Table 4-1. PSC Model Inputs (Chemical Parameters for Phthalic Anhydride as *o*-Phthalic Acid)**

Parameter	Value <sup>a</sup>
$K_{oc}$	11.75 mL/g
Water Column Half-life	3 days at 25 °C
Photolysis Half-life	8.65 days at 25 °C
Hydrolysis Half-life	9,999 days at 25 °C <sup>b</sup>
Benthic Half-life	27 days at 25 °C
Molecular Weight	166.13 g/mol
Vapor Pressure	6.36E-07 mmHg
Solubility	6,994 mg/L

Parameter	Value <sup>a</sup>
Henry's Law constant	1E-10 atm-m <sup>3</sup> /mol
Reference Temperature	25 °C
<sup>a</sup> For details on selected values, see <i>Draft Physical Chemistry and Fate and Transport Assessment for Phthalic Anhydride</i> ( <a href="#">U.S. EPA, 2026d</a> ). <sup>b</sup> The value of 9,999 days at 25 °C is an EPA input value which effectively excludes degradation via hydrolysis in the model for PSC as <i>o</i> -phthalic acid does not hydrolyze.	

A common setup for the model environment and media parameters was applied consistently across all PSC runs. The standard EPA “farm pond” water body characteristics were used to parameterize the water column and sediment parameters (Table 4-2), which is applied consistently as a conservative screening scenario. Standardized water body geometry was also applied consistently across runs, with a standardized width of 5 m, length of 40 m, and depth of 1 m. Only the release parameters (daily release amount and days of release) and the hydrologic flow rate were changed between model runs for this chemical to reflect facility-specific release conditions.

**Table 4-2. Standard EPA “Farm Pond” Waterbody Characteristics for PSC Model Inputs**

Parameter	Value
DFAC <sup>a</sup>	1.19
Water Column Suspended Sediment	30 mg/L
Chlorophyll	0.005 mg/L
Water Column foc	0.04
Water Column DOC	5.0 mg/L
Water Column Biomass	0.4 mg/L
Benthic Depth	0.05 m
Benthic Porosity	0.50
Benthic Bulk Density	1.35 g/cm <sup>3</sup>
Benthic foc	0.04
Benthic DOC	5.0 mg/L
Benthic Biomass	0.006 g/m <sup>2</sup>
<sup>a</sup> DFAC = diffusion factor, a unitless ratio of optical path length to vertical depth (represents the ratio of vertical path lengths to depth as defined in EPA's Exposure Analysis Modeling System [EXAMS]) ( <a href="#">U.S. EPA, 2019b</a> ).	

A required input for the PSC tool is the hydrologic flow rate of the receiving water body. For facilities reporting releases to TRI, relevant flow data from the associated receiving water body were collected. Databases that were queried to estimate a flow rate include EPA's Enforcement and Compliance History Online (ECHO) that contains facilities with a National Pollutant Discharge Elimination System (NPDES) permit, National Hydrography Dataset Plus (NHDPlus), and NHDPlus V2.1 Flowline Network Enhanced Runoff Method (EROM) Flow. The complete methods for retrieving and processing flow data are provided in Appendix B.

The annual average flow represents long-term flow rates, but a harmonic mean provides a more conservative estimate and is preferred for assessing potential chronic human exposure via drinking

water. Per EPA's *Water Quality Standards Handbook* (<https://www.epa.gov/sites/default/files/2014-09/documents/handbook-chapter5.pdf>; accessed March 26, 2026), EPA's Office of Water (OW) recommends the harmonic mean flow for implementing human health criteria. Receiving water body o-phthalic acid concentrations were estimated at the point of release (*i.e.*, in the immediate receiving water body receiving the effluent). For this conservative screening analysis, EPA utilized releases associated with the Processing as a reactant OES. EPA's process for selecting the Processing as a reactant OES is detailed in Section 4.4 along with the confidence in using the surface water concentrations for the purpose of a screening-level assessment. The Processing as a reactant OES was selected as a screening-level exposure scenario as this COU resulted in the highest recorded releases to surface water according to TRI. Sixty-six facilities reported releasing o-phthalic acid to surface water, with ColorCon being the facility with releases to a body of water with a flow that would result in the highest modelled surface water concentration. This conservative screening analysis of the ColorCon releases acts as an upper-bound for exposure to general population resulting from surface water exposure.

#### 4.1.2 Modeled Screening-Level Concentrations in Surface Water

Releases were evaluated for resulting environmental media concentrations at the point of release (*i.e.*, in the immediate receiving waterbody receiving the effluent). Due to uncertainty about the prevalence of wastewater treatment from o-phthalic acid-releasing facilities, all releases were assumed initially to be released to surface water without treatment. These values are carried through to the drinking water risk assessment for further evaluation as a conservative upper-bound approach to screen for general population risk discussed in Section 5.1. The harmonic mean flow applied was 2,436 m<sup>3</sup>/day.

##### 4.1.2.1 Release to Surface Water

For the screening-level assessment, EPA utilized releases from a single facility associated with the Processing as a reactant OES, as these are projected to result in the highest modeled surface water concentrations. The selection of the OES with the highest modeled surface water was based on high volumes of releases paired with the assumption of harmonic mean flow in the receiving water body. EPA determined the surface water concentration associated with this OES represented conservative upper-bound exposure scenarios and was appropriate to use in its screening-level assessment to assess all other OESs and their associated COUs.

EPA utilized daily release information to estimate surface water concentrations. For the screening-level assessment, EPA identified the OES (Processing as a reactant) that resulted in the highest surface water concentrations, highlighted in the table below, to assess exposure. The Processing as a reactant OES was chosen to represent the upper-bound concentration of possible surface water exposures as this OES exhibits a robust weight of scientific evidence conclusion based on data sources, as well as representing the highest releases and lowest flow regime of receiving body. This evidence allows EPA to utilize the OES as an upper bound for surface water exposures while maintaining robust evidence that the exposure scenario is unlikely to be exceeded by other releases. For estimating concentrations from releases, EPA utilized TRI annual release reports. Releases from facilities reporting via TRI Form A, which represents undefined releases to unspecified media types, less than 500 lb per year, were not directly modeled. For the purpose of the tiered approach taken for the general population analysis, environmental concentrations from potential releases to surface water from facilities reporting via TRI Form A were lower than the upper-bound concentrations applied for screening.

For facilities reporting releases to TRI, relevant flow data from the associated receiving waterbody were collected by querying multiple EPA databases and permit IDs under NPDES. The flow data include self-reported hydrologic reach codes on NPDES permits and the best available flow estimates from EPA and U.S. Geological Survey (USGS) databases. Other model inputs such as environmental fate and transport

and physical and chemical parameters were derived from reasonably available literature collected and evaluated through EPA's systematic review process for TSCA risk evaluations. Based on the weight of scientific evidence conclusions regarding confidence in the release estimates from facilities and the associated receiving waterbody and hydrologic flow information described in the preceding paragraphs, EPA proceeded with the use of TRI data for modeling surface water concentrations. In considering the various OES for use in a screening assessment, EPA identified the Processing as a reactant OES as most appropriate as it resulted in the highest surface water concentration based on reporting data for actual facilities. Additionally, release concentrations were estimated at the point of release in the receiving waterbody, as a conservative assumption to evaluate the upper end of potential exposure concentrations for a given release. Overall, EPA has robust confidence that the highest estimated surface water concentration modeled using the Processing as a reactant OES is appropriate to use in its screening-level assessment of the general population drinking water exposure pathway, as the releases from all other OESs and their associated COUs are expected to result in lower environmental concentrations in surface water. General population exposure from *o*-phthalic acid drinking water utilizes the estimated surface water concentrations for *o*-phthalic acid and can be found in Section 5.1.

**Table 4-3. PSC Modeling Results for Total Water Column Using Harmonic Mean Flow**

OES	Release Estimate (kg/day) <sup>a</sup>	Harmonic Mean Flow (m <sup>3</sup> /d)	Harmonic Mean Concentration (µg/L)
Processing as a reactant (TRI reported release) <i>without wastewater treatment</i>	52.57	2,436	21,500
<sup>a</sup> Details on operating days and daily releases are provided in the <i>Draft Environmental Release and Occupational Exposure Assessment for Phthalic Anhydride</i> ( <a href="#">U.S. EPA, 2026b</a> ).			

## 4.2 Measured Concentrations

EPA identified monitoring studies through systematic review to provide context to modeling results. The monitoring studies presented here were not used as part of the analysis for quantifying exposure estimates because they could not be directly associated with a specific condition of use. EPA prioritized the use of facility specific release data that could be attributed to specific OESs and COUs. Measured concentrations of phthalic anhydride and its hydrolysis product *o*-phthalic acid in surface water and sediment are presented in Section 4.2.1 and 4.2.2, respectively.

### 4.2.1 Measured Concentrations in Surface Water

The Water Quality Portal (WQP) documented eight samples of water measuring *o*-phthalic acid in surface water in the United States from STORage and RETrieval Dashboard (STORET) collected between 1985 and 2008. Only two samples detected *o*-phthalic acid with concentrations ranging from 1.2 to 5.1 µg/L. Six of the eight samples were non-detects. Detection limits ranged from 0.013 to 4.76 µg/L. The WQP documented only one sample of water measuring phthalic anhydride and it was below the detection limit of 0.0009 µg/L.

Three studies identified through systematic review reported phthalic anhydride concentrations in surface water (Table 4-4). In the study, levels measured in the blank contamination were not subtracted from the results but if environmental concentrations were within twice the blank contamination levels, then they were set as the reporting limit. A second study measured phthalic anhydride in standing water around

the installation site of an ultraviolet light-cured cast in place pipe in New York. The maximum concentration was 9.5 µg/L ([Li et al., 2019](#)).

Three studies identified through systematic review reported *o*-phthalic acid concentrations in wet precipitation. Within the United States, one study reported concentrations of phthalic acid in rain and snow samples collected in Southern California between 1982 to 1984, ranging from 0.04 to 1.87 µM ([Kawamura et al., 1996](#)). Outside the United States, one study reported concentrations of phthalic acid in snowpacks collected from the Canadian Arctic in 2,000, ranging from 0.02 to 3.18 µg/L ([Narukawa et al., 2002](#)), while a second study reported concentrations of phthalic acid in wet precipitation (snow/sleet or rain) in Tokyo in 1992 ranging from 0.38 to 30.7 µg/L ([Sempere and Kawamura, 1994](#)).

**Table 4-4. Summary of Measured Phthalic Acid Concentrations in Surface Water**

Reference	Sampling Location (Country)	<i>o</i> -Phthalic Acid Concentration (µg/L)	Sampling Notes
<a href="#">Li et al. (2019)</a>	United States	Max: 9.5 Min: NA	Standing water around the installation site of a ultra violet light-cured cast in place pipe
<a href="#">Guzzella and Sora (1998)</a>	Italy	NA	Lakes
<a href="#">Kawamura et al. (1996)</a>	United States	Max: 1.87 µM Min: 0.04 µM	Rain and Snow samples
<a href="#">Narukawa et al. (2002)</a>	Canada	Max: 3.18 Min: 0.02	Snowpacks
<a href="#">Sempere and Kawamura (1994)</a>	Tokyo	Max: 30.7 Min: 0.38	Snow/sleet/rain

#### 4.2.2 Measured Concentrations in Sediment

The WPQ included 13 samples from Puerto Rico in 2006 for *o*-phthalic acid. All samples were non-detect with a detection limit ranging from 1.5 to 1.8 µg/kg. Phthalic anhydride was reported to occur in contaminated sediments of San Diego Bay; however, it is possible that phthalic anhydride was formed during pyrolysis as it was not detected in sediments that had a different form of pretreatment prior to GC/MS ([OECD, 2005](#)).

### 4.3 Evidence Integration for Surface Water

#### 4.3.1 Strengths, Limitations, and Sources of Uncertainty for Modeled and Monitored Surface Water Concentration

EPA used PSC to estimate concentrations of phthalic anhydride as *o*-phthalic acid in surface water using modeled release amounts and estimated receiving waterbody flow rates from a distribution of known releasing facilities. PSC considers model inputs of physical and chemical properties of *o*-phthalic acid (*i.e.*,  $K_{ow}$ ,  $K_{oc}$ , water column half-life, photolysis half-life, hydrolysis half-life, and benthic half-life) allowing EPA to model predicted water column concentrations. The systematic review process and selection of physical and chemical properties of *o*-phthalic acid increases confidence in the inputs applied within the PSC tool. Only the chemical release amount, days-on of chemical release, and the receiving water body hydrologic flow were specific to the selected facility selected to represent the upper-bound (highest releases) of exposure scenarios related to the COU/OES. A standard EPA waterbody (width of 5 m, length of 40 m, and depth of 1 m) was used to represent a consistent and conservative receiving waterbody scenario.

The modeled data represent estimated concentrations near actual facilities at the point of discharge that are actively releasing phthalic anhydride to surface water, while the reported measured concentrations represent sampled ambient water concentrations of phthalic anhydride or *o*-phthalic acid that may be upstream or downstream of a point of discharge. Upper-bound modeled concentrations tended to be orders of magnitude higher than the highest monitored concentrations. Differences in magnitude between modeled and measured concentrations may be due to measured concentrations not being geographically or temporally close to releases of phthalic anhydride, as information about the proximity of known releases did not accompany monitoring data. Furthermore, conservative modelled concentrations were chosen to place an upper-bound on exposure scenarios in the screening approach, thus modelled concentrations are overestimates of real-world monitoring values. In addition, when modeling with PSC, EPA assumed all releases were directly discharged to surface waters without prior treatment, and that no releases were routed through publicly owned treatment works prior to release. EPA recognizes that this is a conservative assumption utilized in this screening assessment that results in no removal of *o*-phthalic acid prior to release to surface water. Direct releases to surface water reported via TRI and DMR were applied as the actual loading to surface water.

#### 4.4 Weight of Scientific Evidence Conclusions

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For the screening-level assessment, EPA utilized releases associated with the processing as a reactant OES as it resulted in the highest surface water concentrations. The selection of the OES with the highest modeled surface water was based on high volumes of releases paired with the assumption of harmonic mean flow in the receiving water body. EPA determined the surface water concentrations associated with the Processing as a reactant OES represented conservative exposure scenarios appropriate to use in its screening-level assessment to assess all other OESs and their associated COUs.

EPA utilized daily release information to estimate surface water concentrations for use in the general population and environmental exposure assessments. As discussed in further detail in the *Draft Environmental Release and Occupational Exposure Assessment for Phthalic Anhydride* ([U.S. EPA, 2026b](#)), EPA estimated a range for daily releases for each OES when possible. The Agency has robust confidence that no surface water release scenarios exceed concentrations of concern presented in this evaluation. 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 upper-bound modeled concentrations in the surface water exceeded the highest values available from monitoring studies by more than three orders of magnitude. This confirms EPA's expectation that modeled concentrations presented herein are biased toward overestimation and are thus a conservative estimation as applied in this screening evaluation.

## 5 DRINKING WATER EXPOSURE

Drinking water in the United States typically comes from surface water (*i.e.*, lakes, rivers, and reservoirs) and groundwater. The source water then flows to a treatment plant where it undergoes a series of water treatment steps before being dispersed to homes and communities. In the United States, public water systems often use conventional treatment processes that include coagulation, flocculation, sedimentation, filtration, and disinfection, as required by law.

Limited information is reasonably available on the removal of phthalic anhydride as *o*-phthalic acid in drinking water treatment plants. As stated in the *Draft Physical Chemistry and Fate and Transport Assessment for Phthalic Anhydride* (U.S. EPA, 2026d), no data were identified by the EPA for *o*-phthalic acid in drinking water in the United States. Based on its water solubility and log  $K_{ow}$ , *o*-phthalic acid in water is not expected to be efficiently removed during conventional drinking water treatment. Therefore, EPA conducted a quantitative screening analysis to ensure exposure via drinking water is evaluated.

### 5.1 Modeling Approach for Estimating Concentrations in Drinking Water

#### 5.1.1 Drinking Water Ingestion

##### *Drinking Water Intake Estimates via Modeled Surface Water Concentrations*

Modeled surface water concentrations estimated in Section 4.1 were used to estimate drinking water exposures. For this screening exercise, only the highest modeled facility release was included in the drinking water exposure analysis, alongside the highest monitored surface water concentration. Two scenarios were considered: one assuming no wastewater treatment before release to surface water, and another assuming a wastewater treatment process with 20% removal efficiency through biodegradation (Kotowska et al., 2012) for treating facility effluent before it is discharged into the receiving waterbody and subsequently becomes influent at a downstream drinking water treatment plant. No data source providing information on the removal of *o*-phthalic acid in drinking water treatment was identified during the EPA's systematic review of the relevant literature; thus, a conservative 20% removal was applied for the scenario with drinking water treatment. The drinking water scenario presented herein without wastewater treatment on the facility effluent is expected to be the scenario most representative of actual upper bound drinking water exposure in the general population.

Drinking water doses were calculated using Equation 5-1 below:

##### Equation 5-1. Average Daily Drinking Water Ingestion Calculation

$$ADD_{POT} = \frac{SWC \times \left(1 - \frac{DWT}{100}\right) \times IR_{dw} \times ED \times RD \times CF1}{BW \times AT \times CF2}$$

Where:

$ADD_{POT}$	= Potential average daily dose (mg/kg/day)
$SWC$	= Surface water concentration (ppb or $\mu\text{g/L}$ ; harmonic mean for ADD)
$DWT$	= Removal during drinking water treatment (%)
$IR_{dw}$	= Drinking water intake rate (L/day)
$RD$	= Release days (days/yr for ADD, LADD and LADC; 1 day for ADR)
$ED$	= Exposure duration (years for ADD, LADD and LADC; 1 day for ADR)
$BW$	= Body weight (kg)

730 *AT* = Exposure duration (years for ADD, LADD and LADC; 1 day for ADR)  
 731 *CF1* = Conversion factor ( $1.0 \times 10^{-3}$  mg/ $\mu$ g)  
 732 *CF2* = Conversion factor (365 days/year)  
 733

734 The ADD for chronic non-cancer was calculated using the 95th percentile ingestion rate for drinking  
 735 water. The lifetime average daily dose (LADD) was not estimated because available data are insufficient  
 736 to determine the carcinogenicity of *o*-phthalic acid, and EPA preliminarily concluded that phthalic  
 737 anhydride is *Not Likely to Be Carcinogenic to Humans* for the oral exposure route, as further described  
 738 in the *Draft Human Health Hazard Assessment for Phthalic Anhydride* ([U.S. EPA, 2026c](#)). Therefore,  
 739 EPA is not evaluating *o*-phthalic acid for carcinogenic risk. Table 5-1 summarizes the drinking water  
 740 doses for adults, youth, and children. These estimates do not incorporate additional dilution beyond the  
 741 point of discharge and in this case, it is assumed that the surface water outfall is located very close  
 742 (within a few km) to the drinking water intake location. Applying dilution factors would decrease the  
 743 dose for all scenarios. This screening level assessment assumes no downstream dilution. This results in  
 744 upper-bound, conservative concentrations (assumes drinking water intake proximal to release point, no  
 745 wastewater treatment, and no dilution).  
 746

747 **Table 5-1. Modeled Average Daily Drinking Water Doses (ADD) for Adults, Infants, and Toddlers**  
 748 **for the Upper-Bound Release Estimate from Modeling and Monitoring Results (mg/kg-day)**

Scenario	Surface Water Concentrations, Harmonic Mean, ( $\mu$ g/L)	ADD Adult ( $\geq 21$ years) (mg/kg/day)	ADD Infant (birth to <1 year) (mg/kg/day)	ADD Toddler (1–5 years) (mg/kg/day)
Processing as a reactant <i>Without Wastewater Treatment or Drinking Water Treatment</i>	2.15E04	1.62E-01	4.14E-01	1.77E-01
Processing as a reactant <i>With Wastewater Treatment</i>	1.72E04	1.3E-01	3.31E-01	1.42E-01
Highest Values from Monitoring <i>With Wastewater Treatment</i>	9.50	7.4E-05	1.9E-04	8.1E-05

## 5.2 Evidence Integration for Drinking Water

751 EPA estimates low potential exposure to *o*-phthalic acid via drinking water, when considering expected  
 752 treatment removal efficiencies, even under upper-bound release scenarios. Environmental degradation  
 753 due to photolysis or biodegradation as well as treatment in conventional drinking water treatment  
 754 processes (flocculation, ultraviolet [UV] treatment) would suggest that actual measured concentrations  
 755 in raw drinking water would be higher than finished water. Upper-bound releases such as the one  
 756 modeled in this screening exercise would more likely be discharged to waterbodies with more  
 757 substantial flow, reducing the environmental concentrations further as drinking water sources are more  
 758 likely to be from larger water bodies (reservoirs, rivers) than the relatively low flow regime that was  
 759 modelled in this conservative screening analysis,

## 5.3 Weight of Scientific Evidence Conclusions

761 EPA has robust confidence that the use of surface water *o*-phthalic acid concentrations as a source for

762 drinking water *o*-phthalic acid concentrations to assess drinking (oral) exposures for the general  
763 population was appropriate for a screening-level approach. The confidence assigned was based on the  
764 use of conservative assumptions for the screening approach resulting in an upper-bound of exposure. As  
765 described in Section 3.2, EPA did not assess drinking water estimates as a result of leaching from  
766 landfills to groundwater and subsequent migration to drinking water wells due to the expected  
767 biodegradation of *o*-phthalic acid in both landfill and groundwater environments.

## 6 AMBIENT AIR PATHWAY AND INHALATION EXPOSURE

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Because phthalic anhydride is highly reactive and hydrolyzes upon contact with atmospheric moisture to *o*-phthalic acid, EPA considered both modeled and monitored concentrations of *o*-phthalic acid in the ambient air for this ambient air exposure assessment. The Agency's modeling estimates both short-term and long-term concentrations in ambient air as well as dry, wet, and total deposition rates. EPA considers monitoring data from published literature for additional insight into ambient air concentrations of *o*-phthalic acid.

### 6.1 Modeling Approach for Estimating Concentrations in Ambient Air

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EPA used the Integrated Indoor/Outdoor Air Calculator (IIOAC) Model to estimate daily- and annual-average ambient air concentrations of *o*-phthalic acid, as well as annual average wet, dry, and total air deposition rates of *o*-phthalic acid from the ambient air. IIOAC is a spreadsheet-based tool that estimates outdoor air concentrations using pre-run results from a suite of dispersion scenarios in a variety of meteorological and land-use settings within EPA's American Meteorological Society/Environmental Protection Agency Regulatory Model (AERMOD). Additional information on IIOAC can be found in the user guide ([U.S. EPA, 2019c](#)).

In line with previously peer-reviewed methodology ([U.S. EPA, 2022](#)), EPA's analysis with IIOAC estimates ambient concentrations of *o*-phthalic acid at three distances (e.g., 100, 100–1,000, and 1,000m) from the releasing facility. To perform a screening analysis for ambient air, EPA used the maximum reported releases from a single facility across all COUs from the *Draft Environmental Release and Occupational Exposure Assessment for Phthalic Anhydride* ([U.S. EPA, 2026b](#)) as direct inputs to the IIOAC model to estimate concentrations and deposition rates for both stack and fugitive emissions. The selected facilities were both associated with the Manufacturing (without engineering controls) COU.

EPA used the single highest fugitive and stack releases reported across all datasets considered to model a high-end upper-bounding concentration estimate and ensure high-end exposures were not missed. Although the maximum releases for each release type are from different facilities in different locations for this assessment, the Agency assumed the releases occurred from the same location at the same time under the same OES to determine a "total exposure" to *o*-phthalic acid from both release types. This approach may overestimate ambient concentrations of *o*-phthalic acid at the distances evaluated since exposures to each release type at the distances evaluated cannot occur at a single location at the same time.

#### 6.1.1 Release and Exposure Scenarios Evaluated

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The release and exposure scenarios evaluated for this analysis are summarized below:

- Release: Maximum Release (kg/site-day)
- Release Dataset: TRI. For this ambient air analysis, the TRI data reported and used to calculate releases to air corresponded to phthalic anhydride. EPA assumed that all of the phthalic anhydride released into ambient air hydrolyzes to *o*-phthalic acid in the presence of water in air. Thus, the exposure scenarios for ambient air evaluated exposures to *o*-phthalic acid.
- Release Type: Stack and Fugitive
- Release Pattern: Consecutive
- Distances Evaluated: 100, 100–1,000, and 1,000 m
- Meteorological Stations:
  - South (Coastal): Surface and Upper Air Stations at Lake Charles, Louisiana

- Operating Scenario: 250 days/year; 24 h/day and 8 h/day to identify the scenario resulting in the maximum ambient air concentration. This is the operating scenario associated with the releases modeled.
- Topography: Urban and Rural
- Particle Size:
  - Coarse (PM<sub>10</sub>): Particulate matter with an aerodynamic diameter of 10 microns
  - Fine (PM<sub>2.5</sub>): Particulate matter with an aerodynamic diameter of 2.5 microns

EPA used default release input parameters integrated within the IIOAC Model for both stack and fugitive releases along with a user-defined length and width for fugitive releases as listed in Table 6-1.

**Table 6-1. IIOAC Input Parameters for Stack and Fugitive Air Releases**

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

### 6.1.2 IIOAC Model Output Values

The IIOAC Model provides multiple output values as shown in the *Draft Ambient Air IIOAC Exposure Results and Risk Calculations for Phthalic Anhydride* (U.S. EPA, 2026a). A description of select outputs used in this assessment are provided below. These outputs were used because they represent a more conservative exposure scenario where modeled concentrations are expected to be higher, thus are overestimates of exposed populations, ensuring potential upper-bound exposures are not missed during screening for the ambient air pathway.

- **Fenceline Average:** represents the daily-averaged and annual-averaged concentrations at 100 m distance from a releasing facility.
- **Upper-Bound, Daily-Average:** represents the 95th percentile daily average of all modeled hourly concentrations across the entire distribution of modeled concentrations at 100 m.
- **Upper-Bound, Annual-Average:** 95th percentile annual-average concentration across the entire distribution of modeled concentrations at 100 m.
- **Upper-Bound, Annual Average Deposition Rate:** 95th percentile annual-average deposition rate across the entire distribution of modeled deposition rates at 100 m.

### 6.1.3 Modeled Results from IIOAC

All results for each scenario described in Section 6.1.1 are included in the *Draft Ambient Air IIOAC Exposure Results and Risk Calculations for Phthalic Anhydride* (U.S. EPA, 2026a) and discussed in Section 6.1.2. EPA used the highest estimated concentrations across all modeled scenarios to evaluate exposures and deposition rates near a releasing facility. This exposure scenario represents a national

level exposure estimate inclusive of sensitive and locally impacted populations who live next to a releasing facility.

The IIOAC Model provides source *o*-phthalic acid apportioned concentrations and deposition rates (fugitive and stack) based on the respective releases. To evaluate exposures and total deposition rates for this ambient air assessment, EPA assumed the fugitive and stack releases occur simultaneously throughout the day and year. Therefore, the total concentration and deposition rate used to evaluate exposures and derive risk estimates in this ambient air assessment is the sum of the separately modeled fugitive and stack concentrations and total deposition rates at 100 m from a releasing facility. The source apportioned concentrations and the total concentrations for the scenario used are provided in Table 6-2.

**Table 6-2. *o*-Phthalic Acid Source Apportioned and Total Daily-Averaged and Annual-Averaged IIOAC Modeled Concentrations at 100 m from Releasing Facility**

Source Type	<i>o</i> -Phthalic Acid Daily-Average Concentration (µg/m <sup>3</sup> )	<i>o</i> -Phthalic Acid Annual-Average Concentration (µg/m <sup>3</sup> )
Fugitive	97.4	93.19
Stack	7.96	6.21
Total	105.36	99.39

The *o*-phthalic acid source apportioned wet and dry deposition rates and the total deposition rates for the scenario used are provided in Table 6-3.

**Table 6-3. *o*-Phthalic Acid Source Apportioned and Total Annual-Average IIOAC Modeled Wet, Dry, and Total Deposition Rates at 100 m from Releasing Facility**

Source Type	Total <i>o</i> -Phthalic Acid Annual-Average Deposition Rates (g/m <sup>2</sup> )		
	Total	Wet	Dry
Fugitive	1.56E-03	1.55E-03	2.25E-05
Stack	4.98E-04	4.80E-04	2.97E-05
Total	2.06E-03	2.03E-03	5.21E-05

## 6.2 Measured Concentrations in Ambient Air

EPA searched peer-reviewed literature, gray literature, and databases to obtain concentrations of phthalic anhydride in ambient air. Only three studies report concentrations of phthalic anhydride as *o*-phthalic acid in air in the United States (Table 6-4). The first study reported concentrations of *o*-phthalic acid in the air ranging from 0.07 to 16.3 ng/m<sup>3</sup> measured in Philadelphia in 1999. The second study reported *o*-phthalic acid concentrations ranging from 0.3 to 3 ng/m<sup>3</sup> in air particulates measured in California between 2002 and 2003. The last study reported concentrations of *o*-phthalic acid ranging from 0.01 to 13.1 ng/m<sup>3</sup> measured in Los Angeles in 2005. There were also two studies that reported concentrations of *o*-phthalic acid in Canada ranging from 0.02 to 3.18 ng/m<sup>3</sup>. In the available studies, *o*-phthalic acid was mostly measured in air particulates.

**Table 6-4 Summary of Measured *o*-Phthalic Acid Concentrations in Air**

Reference	Sampling Location –Country	<i>o</i> -Phthalic acid Concentration (ng/m <sup>3</sup> )	Sampling Notes
<a href="#">Ray and McDow (2005)</a>	United States	Max: 16.3 Min: 0.07	Daytime air samples from Philadelphia in 1999
<a href="#">Fine et al. (2004)</a>	United States	Max: 0.3 Min: 3	Concentrations measured in particulate matter over the 4 seasons and throughout the day in 2002 to 2003 in Los Angeles
<a href="#">Sheesley et al. (2010)</a>	United States	Max: 13.1 Min: 0.01	Ambient air concentrations in Los Angeles in 2005
<a href="#">Narukawa et al. (2002)</a>	Canada	Max: 3.18 Min: 0.02	Concentrations in aerosols collected in 2000 in Canada
<a href="#">Fu et al. (2009)</a>	Canada	Max: 2.848 Min: 0.056	Concentrations in arctic aerosol, collected in Canada in 1991

### 6.3 Evidence Integration

EPA relied on the IIOAC-modeled concentrations and deposition rates to characterize human and ecological exposures for the ambient air exposure assessment. Modeled ambient air concentrations were estimated using the maximum daily ambient air release of phthalic anhydride from TRI, conservative meteorological data, and a distance of 100 m from a releasing facility. Because phthalic anhydride is expected to readily convert to *o*-phthalic acid in the air due to the presence of moisture, it was assumed that *o*-phthalic acid is present in the ambient air at concentrations equal to the modelled ambient air concentrations of phthalic anhydride output from IIOAC. The modeled concentrations are higher than measured concentrations (Sections 6.1 and 6.2, respectively). EPA has low confidence that this comparison is representative of actual environmental concentrations because modeled concentrations are near a releasing facility (100 m away), and for the monitoring data, it is unknown if the sampling sites are located at a similar distance. However, EPA has high confidence that the modeling results present an overestimate of exposure for use in the screening level MOE analysis.

#### 6.3.1 Strengths, Limitations, and Sources of Uncertainty for Modeled Air and Deposition Concentrations

EPA considered the strengths, limitations, and sources of uncertainty for the modeled air and deposition concentrations. EPA applied peer-reviewed approaches and methods for its ambient air exposure assessment ([U.S. EPA, 2022](#)). While this represents a strength in the analysis due to consistency, there are several limitations to those approaches that are considered below.

Phthalic anhydride releases were obtained from the TRI database and used as direct inputs to the IIOAC Model. Any limitations and uncertainties of these releases, as described in the *Draft Environmental Release and Occupational Exposure Assessment for Phthalic Anhydride* ([U.S. EPA, 2026b](#)), are carried over to this ambient air exposure assessment. The IIOAC Model has limitations regarding which inputs can be modified and which cannot. Since it is based on pre-run scenarios within AERMOD, default input parameters (e.g., stack characteristics and 2011 to 2015 meteorological data) are already predefined and cannot be changed without fully rebuilding the IIOAC Model. This is a limitation of the IIOAC model, although the default parameters are typically based on national averages identified during development of the IIOAC model. Certain parameters like building dimensions, release elevation, and

land use cannot be considered by the IIOAC model. Furthermore, IIOAC does not consider the presence or location of residential areas relative to the 100 m distance from releasing facilities, the size of the facility, and the release point within a facility. For larger facilities, 100 m from a release point may still fall within the facility property where individuals within the general population do not live or frequent. In contrast, for smaller facilities, there may be individuals within the general population that do live in or frequent locations at 100 m away from the release point and therefore could be exposed continuously. However, most individuals may not stay within their residences 24 hours per day, 7 days per week throughout the year.

The use of annual release data and number of operating days to calculate daily average releases assumed operations are continuous and releases are the same for each day of operation. This can underestimate short-term or daily concentrations and deposition rates because results may miss actual peak releases (and associated exposures) if higher and lower releases occur on different days.

For the ambient air assessment, EPA used the highest stack and fugitive release reported to TRI for phthalic anhydride between 2019 and 2023 (85 kg/site-day and 52 kg/site-day, respectively) is released to ambient air. EPA acknowledges the highest stack and fugitive releases across all 5 years of TRI data considered may not align either spatially (from the same facility) or temporally (at the same time and year). None-the-less, for this assessment EPA assumes the two highest releases do occur from the same facility, at the same time, and the same year. This approach supports the screening analysis, and it provides a conservative assumption for each individual release type (fugitive or stack) ensuring upper-bound exposures are not missed. The spatial and temporal assumptions associated with releases provide low confidence that the exposure scenario is representative of actual *o*-phthalic acid air concentrations because the releases used in the modeling do not occur from the same facility at the same time. The use of the highest releases in the manner modeled in this assessment overestimates ambient concentrations and deposition rates at the evaluated distances. EPA has high confidence that the conservative assumptions and inputs used in the screening approach for the ambient air exposure scenario modeled represent an overestimate that is inclusive of all possible exposures.

## 6.4 Weight of Scientific Evidence Conclusions

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EPA has slight confidence that the exposure scenario modeled for this assessment is representative of annual *o*-phthalic acid ambient air concentrations. The slight confidence was based on the use of conservative assumptions in the screening approach modeling, which resulted in overestimates of annual *o*-phthalic acid air concentrations and modeled concentrations were the highest value measured at 100 m from the facility regardless of whether people live in that area. The stack and fugitive emissions used in the modeling were assumed to occur in the same year when in fact, they occurred in different years (2020 for the highest fugitive release and 2023 for the highest stack release). The Agency added the results together and assumed as if the emissions occurred in the same year to inform a screening-level analysis.

EPA has moderate confidence in the IIOAC-modeled results selected methodology used to characterize exposures and deposition rates. The moderate confidence in the IIOAC model was based on the use of conservative inputs from previously peer reviewed methodology, and incorporation of recommendations received during previous peer review and public comment for similar ambient air concentration evaluations. For example, consideration of a series of exposure scenarios under varying operating conditions and inclusion of multiple particle sizes, were included in the modeling approach and applied broadly. Despite the limitations and uncertainties described in Section 6.3, this screening-level analysis presents an upper-bound estimate of ambient air concentrations of *o*-phthalic acid. The conservative

956 inputs and assumptions lead to overestimation of exposure and deposition rates. EPA has high  
957 confidence that the upper bound exposures are captured in in these modeling results, which provides  
958 high confidence that the upper bound exposures are not missed to maintain a conservative estimate.

## 7 AMBIENT AIR TRANSPORT PATHWAY AND SUBSEQUENT IMPACTS TO SOIL

### 7.1 Exposure Calculations for Inhalation of Air

EPA evaluated chronic general population exposures to *o*-phthalic acid in ambient air in proximity to air emissions. In this analysis, EPA evaluated chronic exposures based on the 95th percentile air concentrations estimated for ambient air (Section 6.1.3) using the highest stack releases and the highest fugitive releases reported to TRI for the purposes of conducting a screening level analysis. In the following sections, EPA is presenting exposures to ambient air based on the maximum 95th percentile estimated air concentrations for the selected facilities (both within the Manufacturing OES) to characterize upper-bound exposures.

For this exposure assessment, EPA assumed the general population is continuously exposed (*i.e.*, 24 hours per day, 365 days per year) to outdoor ambient air concentrations. The annual average modeled ambient air concentrations from the IIOAC outputs were used to calculate the exposure concentrations using Equation 7-1 below. The calculated exposure concentration is the average daily concentration (ADC) and used to derive chronic exposure estimates using the Equation 7-1 is presented in Table 7-1.

#### Equation 7-1. Average Daily Concentration

$$ADC = \frac{C_{AAC} \times ET \times EF \times ED}{AT_{ADC}}$$

Where:

$ADC$  = Average daily concentration ( $\mu\text{g}/\text{m}^3$ )  
 $C_{AAC}$  = Annual average concentration ( $\mu\text{g}/\text{m}^3$ )  
 $ET$  = Exposure time (24 hours/day)  
 $EF$  = Exposure frequency (365 days/year)  
 $ED$  = Exposure duration (1 year)  
 $AT_{ADC}$  = Averaging time = 1 year  $\times$  365 days/year  $\times$  24 hours/day

**Table 7-1. Maximum 95th Percentile Average Daily Concentration (Stack and Fugitive) Estimated 100 m of *o*-Phthalic Acid Releases to Air for the Manufacturing OES**

OES	Annual Average Concentration ( $\mu\text{g}/\text{m}^3$ )
Manufacturing	99.39

### 7.2 Weight of Scientific Evidence Conclusions

EPA has high confidence that the conservative assumptions and inputs used in the screening-level approach for the ambient air exposure scenario modeled represent an overestimate that is inclusive of all possible exposures.

## 8 BIOACCUMULATION

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In the natural environment, phthalic anhydride hydrolyzes to 1,2-benzenedicarboxylic acid, also known as *o*-phthalic acid (CASRN 88-99-3), when allowed contact with water or moisture in the air. Under normal environmental conditions, phthalic anhydride is expected to be hydrolyzed into *o*-phthalic acid on the order of minutes (NCBI, 2020), depending upon pH. Complete hydrolysis is achieved in approximately 8 minutes in simulated seawater or physiological fluids (U.S. EPA, 2026d). Given the hydrolysis of phthalic anhydride to *o*-phthalic acid, data from both chemicals were considered for assessing the bioaccumulation potential in the environment.

Bioaccumulation is the process by which chemical contaminants can be taken up by organisms through dietary and media exposures and be transferred from one trophic level to another. Bioconcentration is the process where the concentration of a chemical in an aquatic organism (like fish) becomes higher than its concentration in the surrounding water, due to direct uptake through gills or skin, rather than diet. The reported physical and chemical properties suggest that *o*-phthalic acid is likely to rapidly biodegrade and not likely to bioaccumulate or bioconcentrate under normal environmental conditions. Available data suggest that *o*-phthalic acid is not likely to bioaccumulate based on predicted BCF and BAF values. A comprehensive description of the environmental fate of phthalic anhydride and *o*-phthalic acid can be found in the *Draft Physical Chemistry and Fate and Transport Assessment for Phthalic Anhydride* (U.S. EPA, 2026d).

### 8.1 Environmental Fate, Bioaccumulation, Bioconcentration, and Trophic Transfer

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Chemicals are capable of being absorbed by terrestrial, avian and aquatic species via oral and epithelial exposure routes, yet few studies have evaluated the bioaccumulation and absorption, distribution, metabolism, and excretion (ADME) of phthalic anhydride in various environmental receptors.

There are multiple robust lines of evidence support that *o*-phthalic acid is not expected to significantly bioaccumulate within the environment with multiple high-quality studies that were largely in agreement with each other. Modeled predicted BCF values of 2, 2.49, and 3.2 L/kg were reported based on *o*-phthalic acid's log Kow of 0.73 (U.S. EPA, 2020; OECD, 2005; U.S. EPA, 1986). These predicted BCF values suggest that *o*-phthalic acid is not expected to significantly bioaccumulate in the natural environment. This is supported by the reported model predicted BAF value of 1.32 L/kg (U.S. EPA, 2020). Additionally, *o*-phthalic acid has a high-water solubility (6,994 mg/L) and low log Kow which indicate a high affinity to water and low potential to sorb to organic matter. It completely dissociates under normal environmental conditions with pKa1 and pKa2 values that suggest that *o*-phthalic acid will be present as negative charge species not likely to be sorbed to organic matter. Overall, there is robust evidence suggesting that *o*-phthalic acid is not expected to bioaccumulate in aquatic and terrestrial organisms.

### 8.2 Weight of Scientific Evidence Conclusions

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EPA has robust evidence that *o*-phthalic acid has limited bioaccumulation and bioconcentration potential based on its physical, chemical, and fate properties. Based on the conclusions on the physical and chemical, and fate properties of phthalic anhydride presented in the *Draft Physical Chemistry and Fate and Transport Assessment for Phthalic Anhydride* (U.S. EPA, 2026d) and reasonably available literature on biotransformation, biomonitoring data, and bioaccumulation data, EPA conducted a qualitative assessment of trophic transfer in biota. The conclusion that *o*-phthalic acid does not biomagnify is supported by the estimated BCF (bioconcentration factor), BAF (bioaccumulation factor), BSAF (biota-

1041 sediment accumulation factor), and TMF (trophic magnification factor) values and studies specifically  
1042 centered on the physical chemical characteristics of trophic transfer of phthalic anhydride and *o*-phthalic  
1043 acid.

## 9 CONCLUSION OF ENVIRONMENTAL MEDIA CONCENTRATIONS AND GENERAL POPULATION EXPOSURE

### 9.1 Environmental Exposure Conclusions

EPA conducted a trophic transfer in biota qualitative assessment based on physical and chemical and fate properties of phthalic anhydride and *o*-phthalic acid presented in the *Draft Physical Chemistry and Fate and Transport Assessment for Phthalic Anhydride* (U.S. EPA, 2026d). Due to the physical and chemical properties, environmental fate, and exposure parameters of phthalic anhydride and *o*-phthalic acid, they are not expected to persist in surface water, groundwater, or air. The Agency has robust confidence that phthalic anhydride and *o*-phthalic acid have limited bioaccumulation and bioconcentration potential based on physical-chemical and fate properties as well as biotransformation and empirical bioaccumulation metrics. Briefly, because phthalic anhydride and *o*-phthalic acid do not biomagnify, EPA did not conduct a quantitative modeling analysis of the trophic transfer of phthalic anhydride through human or ecological food webs.

### 9.2 General Population Screening Conclusion

The general population can be exposed to *o*-phthalic acid from various exposure pathways. As shown in Table 2-1, exposures to the general population via drinking water, inhalation and soil ingestion from air to soil deposition were quantified while exposures via the land pathway (biosolids, underground injection wells and landfills) were qualitatively assessed. Based on the upper-bound estimates of environmental media concentrations, Table 9-1 summarizes the estimated general population exposures for the pathways that were quantitatively assessed.

**Table 9-1. Summary of *o*-Phthalic Acid Concentrations in Various Environmental Media from Environmental Releases**

OES <sup>a</sup>	Release Media	Environmental Media	<i>o</i> -Phthalic Acid Concentration
Processing as a reactant <i>Without Wastewater Treatment</i>	Water	Surface water (harmonic mean <sup>b</sup> flow)	2.15E04 µg/L
Manufacturing	Air	Annual-averaged total (fugitive and stack, 100m)	9.94E01 µg/m <sup>3</sup>
Manufacturing	Air	Soil concentration (from air deposition to soil)	4.85E-05 mg/kg

<sup>a</sup> Table 1-1 provides the crosswalk of OES to COUs  
<sup>b</sup> Harmonic mean is defined as the inverse mean of reciprocal daily arithmetic mean flow values. These flows represent a long-term average

### 9.3 Weight of Scientific Evidence Conclusions for General Population Exposure

The weight of scientific evidence supporting the exposure estimate is decided based on the strengths, limitations, and uncertainties associated with the exposure estimates, which are discussed in detail for biosolids (Section 3.1), landfills (Section 3.2), underground injection wells (Section 3.3), surface water (Section 4.3.1), drinking water (Section 5.2) and ambient air (Section 7.2). EPA summarized its weight of scientific evidence using confidence descriptors: robust, moderate, slight, or indeterminate confidence descriptors. EPA used general considerations (*i.e.*, relevance, data quality, representativeness,

1076 consistency, variability, uncertainties) as well as chemical-specific considerations for its weight of  
1077 scientific evidence conclusions.

1078  
1079 EPA determined robust confidence in its qualitative assessment of biosolids (Section 3.1), landfills  
1080 (Section 3.2 and underground injection wells (Section 3.3). For its quantitative assessment, the Agency  
1081 modeled exposure due to various exposure scenarios resulting from different pathways of exposure.  
1082 Exposure estimates used conservative upper-bound inputs for the purpose of a screening-level analysis.  
1083 For its quantitative exposure assessment of surface water (Section 4.4), drinking water (Section 5.3),  
1084 ambient air (Section 7.2), EPA has robust confidence that the screening-level analysis was appropriately  
1085 conservative resulting in exposure overestimations that ensure the upper bound exposures were not  
1086 missed. EPA is confident that the overestimates of exposure from the screening-level analysis provides  
1087 the necessary information to evaluate risk to the general population from releases into the environment.

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## APPENDICES

### Appendix A EXPOSURE FACTORS

**Table\_Apx A-1. Body Weight by Age Group**

Age Group <sup>a</sup>	Mean Body Weight (kg) <sup>b</sup>
Infant (<1 year)	7.83
Young toddler (1 to <2 years)	11.4
Toddler (2 to <3 years)	13.8
Small child (3 to <6 years)	18.6
Child (6 to <11 years)	31.8
Teen (11 to <16 years)	56.8
Adults (>16 years)	80.0
<sup>a</sup> Age group weighted average	
<sup>b</sup> See Table 8-1 of ( <a href="#">U.S. EPA, 2011</a> )	

**Table\_Apx A-2. Recommended Default Values for Common Exposure Factors**

Symbol	Definition	Recommended Default Value	Recommended Default Value	Source
		Occupational	Residential	
ED	Exposure Duration (hrs/day)	8	24	
EF	Exposure Frequency (days/year)	250	365	
EY	Exposure Years (years)	40	33 Adult 1 Infant (birth to <1 year) 5 Toddler (1–5 years) 5 Child (6–10 years) 5 Youth (11–15 years) 5 Youth (16–20 years)	Number of years in age group, up to the 95th percentile residential occupancy period. See Table 16-5 of <i>U.S. EPA Exposure Factors Handbook</i> ( <a href="#">U.S. EPA, 2011</a> ).  Note: Age bins may vary for different measurements and sources
AT	Averaging Time Non-cancer	Equal to total exposure duration or 365 days/yr × EY; whichever is greater	Equal to total exposure duration or 365 days/yr × EY; whichever is greater	See pg. 6-23 of <i>Risk Assessment guidance for Superfund, Volume I: Human Health Evaluation Manual</i> (Part A) ( <a href="#">U.S. EPA, 1989</a> )
	Averaging Time Cancer	78 years (28,470 days)	78 years (28,470 days)	See Table 18-1 of <i>EPA Exposure Factors Handbook</i> ( <a href="#">U.S. EPA, 2011</a> )
BW	Bodyweight (kg)	80	80 Adult 7.83 Infant (birth to <1 year) 16.2 Toddler (1 to 5 years) 31.8 Child (6 to 10 years) 56.8 Youth (11 to 15 years) 71.6 Youth (16 to 20 years) 65.9 Adolescent woman of childbearing age (16 to <21) – apply to all developmental	See Table 8-1 of <i>EPA Exposure Factors Handbook</i> ( <a href="#">U.S. EPA, 2011</a> )  (Refer to Figure 31 for age-specific BW)  Note: Age bins may vary for different measurements and sources

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Symbol	Definition	Recommended Default Value	Recommended Default Value	Source
		Occupational	Residential	
			exposure scenarios	See Table 8-5 of EPA <i>Exposure Factors Handbook</i> ( <a href="#">U.S. EPA, 2011</a> )
IR <sub>dw-acute</sub>	Drinking Water Ingestion Rate (L/day) – acute	3.219 Adult	3.219 Adult 1.106 Infant (birth to <1 year) 0.813 Toddler (1–5 years) 1.258 Child (6–10 years) 1.761 Youth (11–15 years) 2.214 Youth (16–20 years)	See Tables 3-15 and 3-33; weighted average of 90th percentile consumer-only ingestion of drinking water (birth to <6 years) ( <a href="#">U.S. EPA, 2011</a> )
IR <sub>dw-chronic</sub>	Drinking Water Ingestion Rate (L/day) – chronic	0.880 Adult	0.880 Adult 0.220 Infant (birth to <1 year) 0.195 Toddler (1–5 years) 0.294 Child (6–10 years) 0.315 Youth (11–15 years) 0.436 Youth (16–20 years)	U.S. EPA <i>Exposure Factors Handbook</i> Chapter 3 ( <a href="#">U.S. EPA, 2011</a> ), Table 3-9 per capita mean values; weighted averages for adults (years 21 to 49 and 50+), for toddlers (years 1 to 2, 2 to 3, and 3 to <6)
IR <sub>inc</sub>	Incidental water Ingestion Rate (L/hr)		0.025 Adult 0.05 Child (6 to <16 years)	U.S. EPA ( <a href="#">2015</a> ), Evaluation of Swimmer Exposures Using the SWIMODEL Algorithms and Assumptions
IR <sub>fish</sub>	Fish Ingestion Rate (g/day)		22 Adult	U.S. EPA ( <a href="#">2014</a> ), Estimated Fish Consumption Rates for the U.S. Population and Selected Subpopulations  This represents the 90th percentile consumption rate of fish and shellfish from inland and nearshore waters for the U.S. adult population 21 years of age and older, based on NHANES data from 2003 to 2010
IR <sub>soil</sub>	Soil Ingestion Rate (mg/day)	50 Indoor workers 100 Outdoor workers	100 Infant (<6 months) 200 Infant to Youth (6 months to <12 years) 100 Youth to Adult (12+ years) 1,000 Soil Pica Infant to Youth (1 to <12 years) 50,000 Geophagy (all ages)	U.S. EPA Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (1991)  U.S. EPA <i>Exposure Factors Handbook</i> Chapter 5 ( <a href="#">2011</a> ), Table 5-1, Upper percentile daily soil and dust ingestion
SA <sub>water</sub>	Skin Surface Area Exposed (cm <sup>2</sup> ) used for incidental water dermal contact		19,500 Adult 7,600 Child (3 to <6 years) 10,800 Child (6 to <11 years) 15,900 Youth (11 to <16 years)	U.S. EPA <i>Exposure Factors Handbook</i> Chapter 7 ( <a href="#">2011</a> ), Table 7-1, Recommended Mean Values for Total Body Surface Area, for Children (sexes combined) and Adults by Sex
Kp	Permeability Constant (cm/hr) used for incidental water dermal contact		0.001  Or calculated using Kp equation with chemical specific Kow and MW (see exposure formulas)	US EPA, 1992. Dermal Exposure Assessment: Principles and Applications. Office of Research and Development. Table 5-7, “Predicted Kp Estimates for Common Pollutants

Symbol	Definition	Recommended Default Value	Recommended Default Value	Source
		Occupational	Residential	
SA <sub>soil</sub>	Skin Surface Area Exposed (cm <sup>2</sup> ) used for soil dermal contact	3,300 Adult	5,800 Adult 2,700 Child	EPA Risk Assessment Guidance for Superfund RAGS Part E for Dermal Exposure ( <a href="#">U.S. EPA, 2004</a> )
AF <sub>soil</sub>	Adherence Factor (mg/cm <sup>2</sup> ) used for soil dermal contact	0.2 Adult	0.07 Adult 0.2 Child	EPA Risk Assessment Guidance for Superfund RAGS Part E for Dermal Exposure ( <a href="#">U.S. EPA, 2004</a> )

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## Appendix B ESTIMATING HYDROLOGICAL FLOW DATA FOR SURFACE WATER MODELING

EPA's ECHO database was accessed via the Application Programming Interface (API) and queried for facilities releasing DEHP that are regulated under the Clean Water Act. All available NPDES permit IDs were retrieved from the facilities returned by the query. An additional query of the DMR REST service was conducted via the ECHO API to return the NHDPlus reach code associated with the receiving water body for each available facility. Modeled flow metrics were then extracted for the retrieved reach codes from the NHDPlus V2.1 Flowline Network's EROM Flow database. The EROM database provides modeled monthly average flows for each month of the year. While the EROM flow database represents averages across a 30-year time period, the lowest of the monthly average flows was selected as a substitute for the 30Q5 flow used in modeling, as both approximate the lowest observed monthly flow at a given location. The substitute 30Q5 flow was then plugged into the regression equation used by EPA's Exposure and Fate Assessment Screening Tool (E-FAST) ([U.S. EPA, 2007](#)) to solve for the 7Q10 using Equation\_Apx B-1. In previous assessments, the EPA has selected the 7Q10 flow as a representative low-flow scenario for biological impacts due to effluent in streams, while the harmonic mean represents a more average flow for assessing chronic drinking water exposure.

### Equation\_Apx B-1. Calculating the 7Q10 Flow

$$7Q10 = \frac{\left(0.409 \frac{cfs}{MLD} \times \frac{30Q5}{1.782}\right)^{1.0352}}{0.409 \frac{cfs}{MLD}}$$

Where:

7Q10 = Modeled 7Q10 flow, in million liters per day (MLD)  
30Q5 = Lowest monthly average flow from NHD, in MLD

Furthermore, the harmonic mean (HM) flow was calculated using Equation\_Apx B-2, derived from the relevant E-FAST regression ([U.S. EPA, 2007](#)).

### Equation\_Apx B-2. Calculating the Harmonic Mean Flow

$$HM = 1.194 \times \frac{\left(0.409 \frac{cfs}{MLD} \times AM\right)^{0.473} \times \left(0.409 \frac{cfs}{MLD} \times 7Q10\right)^{0.552}}{0.409 \frac{cfs}{MLD}}$$

Where:

HM = Modeled harmonic mean flow, in MLD  
AM = Annual average flow from NHD, in MLD  
7Q10 = Modeled 7Q10 flow from the previous equation, in MLD