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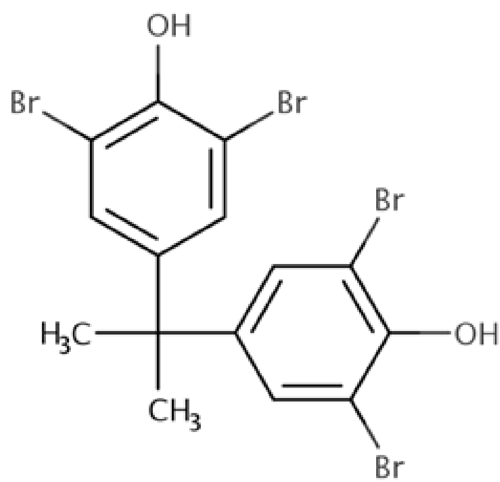
Draft Release Assessment for 4,4′-(1-Methylethylidene)bis[2,6-dibromophenol] (TBBPA)

Technical Support Document for the Draft Risk Evaluation

CASRN 79-94-7



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KEY ABBREVIATIONS AND ACRONYMS

ABS	Acrylonitrile-butadiene-styrene
ACC	American Chemistry Council
CASRN	Chemical Abstracts Service Registry Number
CBI	Confidential business information
CDR	Chemical Data Reporting
COU	Condition of use

DINP	Di-isononyl phthalate
DMR	Discharge Monitoring Report
ECHO	Enforcement and Compliance History Online
EPA	Environmental Protection Agency (U.S.)
ESD	Emission scenario document
GS	Generic scenario
LCD	Life cycle diagram
MWC	Municipal waste combustors
NAICS	North American Industry Classification System
NEI	National Emissions Inventory
NIOSH	National Institute for Occupational Safety and Health (U.S.)
NPDES	National Pollutant Discharge Elimination System
OECD	Organization for Economic Co-operation and Development
OES	Occupational exposure scenario
OPPT	Office of Pollution Prevention and Toxics (EPA)
OSHA	Occupational Safety and Health Administration (U.S.)
PBT	Persistent, bioaccumulative, and toxic
PCB	Printed circuit board
POTW	Publicly owned treatment works
PV	Production volume
RCRA	Resource Conservation and Recovery Act
SDS	Safety data sheet
SIC	Standard Industrial Classification
TBBPA	4,4′-(1-Methylethylidene)bis[2,6-dibromophenol]
TRI	Toxics Release Inventory
TSD	Technical support document
TSCA	Toxic Substances Control Act
U.S.	United States
WEEE	Waste from electronics and electronic equipment
WWT	Wastewater treatment

SUMMARY

This draft technical support document (TSD) is part of the TSCA *Draft Risk Evaluation for 4,4'-(1-Methylethylidene)bis[2,6-dibromophenol] (TBBPA)* (also called the "draft risk evaluation") (U.S. EPA, 2026h). TBBPA is on the TSCA Inventory, making it reportable under the Chemical Data Reporting (CDR) rule, it is also a Toxics Release Inventory (TRI)-reportable substance. This draft TSD describes the use of reasonably available information to estimate environmental releases of TBBPA. See the draft risk evaluation for a complete list of all TSDs and supplemental files for TBBPA.

Focus of the Environmental Release Assessment

During scoping, the U.S. Environmental Protection Agency (EPA or the Agency) considered all known conditions of use (COUs) for TBBPA under the Toxic Substances Control Act (TSCA). The 2024 CDR report indicated that 10 to 50 million pounds (lb) of TBBPA (CASRN 79-94-7) were manufactured or imported in the United States in 2023 (U.S. EPA, 2026a). It is primarily used as a flame retardant in plastics material and resin manufacturing.

Industrial, commercial, and consumer uses of TBBPA and TBBPA-containing articles may result in releases to air, water, or land as well as exposures to workers, consumers, the general population, and ecological species. Exposure to the general population and ecological species can occur from industrial and commercial releases related to the manufacture, import, processing, distribution, use, and disposal of TBBPA. This draft TSD provides the details of the preliminary assessment of the environmental releases that occur due to each COU of TBBPA. It should be noted that this TSD does not include releases resulting from consumer uses, which are assessed in the *Draft Consumer and Indoor Dust Exposure Assessment for 4,4'-(1-Methylethylidene)bis[2,6-dibromophenol] (TBBPA)* (U.S. EPA, 2026d)

Approach and Results for Environmental Releases

EPA assessed releases based on TBBPA TRI data in the case of 15 of 18 COUs; TRI data for TBBPA were available for 15 COUs, spanning 86 facilities, but not for the remaining 3 COUs under TSCA. For those three COUs, EPA quantified releases for two (see Table 1-2 for a brief description of the assessment approach) and provided a qualitative assessment for one COU. Section 1.2 contains an overview of the release assessment methodology. For COUs assessed based on TRI data, releases to water were assessed as zero except for the following three COUs: (1) Processing as a reactant – Flame retardant in plastic material and resin manufacturing; (2) Processing as a reactant – Intermediate in all other chemical product and preparation manufacturing; and (3) Processing – Incorporation into formulation, mixture, and reaction product – Flame retardant in: Plastic material and resin manufacturing; Plastics product manufacturing; Custom compounding of purchased resins; and Paint and coating manufacturing. The Processing as a reactant – Flame retardant in: Plastic material and resin manufacturing COU is the one with the greatest assessed water release; this release is from a particular TRI site with direct discharge to surface water equal to 0.0415 kg per day.

The Agency's assessments of releases to air and land are screening-level assessments. The maximum assessed release to stack or fugitive air is 14.7 kg per day and results from the Recycling COU. EPA estimated this daily TBBPA release employing emission factors measured at a state-of-the-art Swiss waste electrical and electronic equipment (WEEE) facility times WEEE daily throughput. Throughput was set to the U.S. average for the central tendency and to the Swiss facility's capacity for the high end. The maximum assessed release to land is 105,784 kg per year and equals the total release for all COUs and all types of land releases. EPA used the TRI Toxics Tracker to calculate total TBBPA land releases.

Uncertainties

The following factors result in uncertainty in the assessment results: (1) uncertainty about the number of days of release to water, (2) uncertainty about the accuracy of the TRI releases to water in the case of the release data that is associated with "other" as the basis of estimate, and (3) uncertain association (mapping) of TRI sites with COUs.

Environmental and Exposure Pathways Considered

EPA used environmental releases to air, water, and land to estimate exposures to the general population and ecological species for TBBPA COUs under TSCA. The environmental release estimates developed by the Agency were used to estimate the presence of TBBPA in the environment and biota and to evaluate the environmental hazards. The release estimates were also used to model exposure to the general population and ecological species where environmental monitoring data were not available.

1 INTRODUCTION

This draft TSD provides details on the environmental release assessment and supports the risk evaluation for TBBPA under the Frank R. Lautenberg Chemical Safety for the 21st Century Act, which amended TSCA. TSCA section 6(b)(4) requires EPA to establish a risk evaluation process. In performing risk evaluations for existing chemicals, the Agency is directed to "determine whether a chemical substance presents an unreasonable risk of injury to health or the environment, without consideration of costs or other non-risk factors, including an unreasonable risk to a potentially exposed or susceptible subpopulation identified as relevant to the risk evaluation by the Administrator under the conditions of use." In December 2019, EPA published a list of 20 chemical substances designated high priority substances for risk evaluations (84 FR 71924, December 30, 2019), as required by TSCA section 6(b)(2)(B), which initiated the risk evaluation process for those chemical substances. TBBPA is one of the chemicals designated as a high-priority substance for risk evaluation.

TBBPA is a common chemical name for a chemical substance that includes the following names: 4,4′-(1-Methylethylidene)bis[2,6-dibromophenol] (CASRN 79-94-7); tetrabromobisphenol A; and 3,3',5,5'-tetrabromobisphenol A. It is a white crystalline solid that is primarily used as a reactant for flame retardants in plastic material and resin manufacturing and as a flame retardant incorporated into electrical equipment. TBBPA is a TRI-reportable substance, included on the TSCA Inventory, and reported under the Chemical Data Reporting (CDR) rule.

Based on the 2024 CDR reporting period, TBBPA has a total production volume in the United States between 10 to 50 million lb (U.S. EPA, 2026a). The production volume reported in the *Final Scope of the Risk Evaluation for 4,4'-(1-Methylethylidene)bis[2, 6-dibromophenol] (TBBPA); CASRN 79-94-7* (also called the "final scope document") was between 50 and 100 million lb, based on total production volume of TBBPA in 2015 from the 2016 CDR reporting period (U.S. EPA, 2020b). The range decreased in the latest 2020 CDR data (the reported total production volume in 2019 was between 20 and 100 million lb (U.S. EPA, 2022a).

This draft assessment addresses environmental releases of TBBPA in industrial and commercial settings. Releases of TBBPA in consumer settings and the discussion of downstream environmental fate and transport factors used to estimate exposures to the general population and ecological species are not addressed in this TSD but can be found in the *Draft Environmental Media, General Population, and Environmental Exposure Assessment for 4,4'-(1-Methylethylidene)bis[2,6-dibromophenol] (TBBPA)* (U.S. EPA, 2026e) that support the draft risk evaluation of TBBPA.

1.1 Scope

EPA assessed environmental releases that result from the TBBPA COUs listed in Table 1-1 of the draft risk evaluation of TBBPA (U.S. EPA, 2026h). These COUs are also listed (by number) in Table 1-1 of this draft TSD. The latter table also contains an abbreviation of each COU, which are used throughout the remainder of this TSD for brevity.

Table 1-1. TBBPA Conditions of Use (COUs) Assessed

COU Number	Life Cycle Stage	Category	Subcategory	COU Abbreviation in Draft TSD
1	Manufacture	Domestic manufacture	N/A	Manufacturing
2		Import	N/A[a]	N/A
3	Processing	As a reactant	Flame retardant in plastic material and resin manufacturing	Processing as a reactant in plastic material and resin manufacturing
4			Intermediate in all other chemical product and preparation manufacturing	Processing as a reactant in all other chemical product and preparation manufacturing
5		Incorporation into formulation, mixture, or reaction product	Flame retardant in: Plastic material and resin manufacturing; plastics product manufacturing; custom compounding of purchased resins; paint and coating manufacturing	Processing: Additive flame retardant in plastic, resin, and paints and coatings
6			Adhesive manufacturing	Processing: Adhesive manufacturing
7		Incorporation into article	Reactive flame retardant in: Computer and electronic product manufacturing; Electrical equipment, appliance, and component manufacturing; Plastic product manufacturing (*e.g.,* printed circuit boards and semiconductor packages)	Processing: Reactive flame retardant in computer and electronic product manufacturing
8			Reactive flame retardant in transportation equipment manufacturing (*e.g.,* interior material for automotive and aviation articles)	Processing: Reactive flame retardant in transportation equipment manufacturing
9			Additive flame retardant in: Computer and electronic product manufacturing; Electrical equipment, appliance, and component manufacturing; Plastic product manufacturing (*e.g.,* plastic electronic enclosures)	Processing: Additive flame retardant in plastic products
10		Repackaging	N/A	Repackaging
11		Recycling	N/A	Recycling
12	Distribution in commerce	N/A	N/A[b]	N/A
13	Industrial use	Construction, paint, electrical, and metal products	Powder coatings	Industrial use in powder coatings

COU Number	Life Cycle Stage	Category	Subcategory	COU Abbreviation in Draft TSD
14	Industrial and commercial use	Construction, paint, electrical, and metal products	Reactive flame retardant in electrical and electronic articles	Reactive use in electrical and electronic articles
15			Additive flame retardant in electrical and electronic articles (*i.e.,* plastic enclosures)	Additive use in electrical and electronic articles
16			Reactive flame retardant in automotive and aviation articles (*i.e.,* laminate and prepreg material)	Reactive use in automotive and aviation articles
17			Building/construction materials	Use in building and construction materials
18		Packaging, paper, plastic, hobby products	Plastic and rubber products	Use in plastic and rubber products
19		Other	Laboratory chemical	Laboratory chemical use
20	Disposal	N/A	N/A	Disposal

[a] Importation results in potential release to the environment once the contents of imported containers are transferred for repackaging or processing. Repackaging of imported containers is part of the repackaging COU and unloading of imported containers for processing is part of the COUs involving TBBPA processing.
[b] For the purpose of the draft risk evaluation and this TSD, distribution in commerce is the transportation of TBBPA and TBBPA-containing products between sites at which TBBPA manufacturing, processing, and use occurs or the transportation of TBBPA-containing wastes for recycling or disposal. EPA expects all of the aforementioned materials to be transported in closed system or otherwise to be transported in a form (*e.g.,* articles containing TBBPA) such that there is negligible potential for release to the environment except during an accident.

EPA assessed releases of TBBPA to air, water, and land. The assessed releases to air include both fugitive and stack air emissions including emissions resulting from on-site waste treatment equipment, such as incinerators. The assessed releases to water include both direct discharges to surface water and off-site transfers to publicly owned treatment works (POTWs) or for non-POTW wastewater treatment (WWT). Although TRI includes information about on-site wastewater treatment, EPA did not provide this information. On-site releases to land include any disposal of liquid or solid wastes containing TBBPA via underground injection or into landfills, land treatment, surface impoundments, or other land applications.

The purpose of this draft TSD/assessment is to quantify releases; therefore, downstream environmental fate and transport factors used to estimate exposures to the general population and ecological species are not discussed herein. Environmental fate and transport of TBBPA is discussed in the *Draft Physical Chemistry and Fate Assessment for 4,4'-(1-Methylethylidene)bis[2,6-dibromophenol] (TBBPA)* (U.S. EPA, 2026g). The details on how these factors were considered when determining risk are described in the draft risk evaluation for TBBPA (U.S. EPA, 2026h).

1.2 Overview of Assessment Methodology

Discharge Monitoring Report (DMR) and National Emissions Inventory (NEI) data for TBBPA do not exist but TRI data are available. EPA assessed releases based on TBBPA TRI data for 15 COUs only because TBBPA TRI data for the other 3 COUs are not available. The Agency assessed releases quantitatively for two of the remaining COUs and qualitatively for one COU. The assessment approach by COU and medium of release is given in Table 1-2. The Agency assessed releases to water from the TRI data of the 2019 to 2023 reporting years and assessed releases to air and land from the TRI data of the 2014 to 2023 reporting years; the total number of TRI sites is 86. EPA assessed releases to water from each site of the TRI data as presented in Section 3 (*i.e.,* a site-specific assessment). In contrast, the releases to air and land that are based on TRI data are screening-level assessments that used the maximal possible rate of release from any site as presented in Sections 3.1 and 3.2.

EPA obtained annual environmental release rates from TRI and calculated daily release rates from these annual release rates and from estimates of the number of release days. In the case of releases to water, the Agency estimated the number of release days in accordance with the method described in Section 2.2.2 below. In the case of releases to air, EPA estimated screening-level estimates of the number of release days as discussed in Section 3.1. The Agency assessed annual release rates only in the case of releases to land (Section 3.2).

The possible sources of release to environment are stated as part of the process descriptions of each COU. EPA assessed the number of sites per COU based on the 2020 CDR and TRI data or trade association data about the number of electronics recycling sites.

Table 1-2. TBBPA Environmental Release Assessment Approaches by COU and Release Medium

COU Abbreviation	Releases to Water[a,b]	Releases to Air[b]	Releases to Land[a,b]
Manufacturing	TRI (release reported as zero in TRI)	TRI	TRI
Repackaging	TRI (release reported as zero in TRI)	TRI (release reported as zero in TRI)	TRI
Processing as a reactant in plastic material and resin manufacturing	TRI	TRI	TRI
Processing as a reactant in all other chemical product and preparation manufacturing			
Processing: Additive flame retardant in plastic, resin, and paints and coatings	TRI	TRI	TRI
Processing: Adhesive manufacturing	TRI (release reported as zero in TRI)	TRI	TRI
Processing: Reactive flame retardant in computer and electronic product manufacturing	TRI (release reported as zero in TRI)	TRI	TRI
Processing: Reactive flame retardant in transportation equipment manufacturing	TRI (release reported as zero in TRI)	TRI	TRI
Processing: Additive flame retardant in plastic products	TRI (release reported as zero in TRI)	TRI	TRI
Recycling	This COU is not part of TRI[c]. Releases to water not expected. EPA estimated releases to air and land estimated from empirically derived TBBPA emission factors and throughput data for a certain site and from average throughput data that is derived from data on waste volumes and number of recyling sites.		
Reactive use in electrical and electronic articles	TRI (release reported as zero in TRI)	TRI	TRI

COU Abbreviation	Releases to Water[a,b]	Releases to Air[b]	Releases to Land[a,b]
Additive use in electrical and electronic articles			
Reactive use in automotive and aviation articles	TRI (release reported as zero in TRI)	TRI	TRI
Use in building and construction materials	TRI (release reported as zero in TRI)	TRI (release reported as zero in TRI)	TRI
Industrial use in powder coatings	EPA assessed releases that result from this COU as part of the releases that result from the "Processing: Reactive flame retardant in computer and electronic product manufacturing" and "Reactive and additive use in electrical and electronic articles" COUs.		
Use in plastic and rubber products	This COUs is a part of TRI, but TRI TBBPA data are lacking; releases assessed qualitatively.		
Laboratory chemical use	This COU is not part of TRI[d]. EPA estimated a TBBPA use rate based on TBBPA packaging sizes and estimated releases from this use rate in accordance with the Use of Laboratory Chemicals GS (U.S. EPA, 2023a).		
Disposal	TRI (release reported as zero in TRI)	TRI	TRI

COU = condition of use; GS = generic scenario; TRI = Toxics Release Inventory

[a] The assessments of releases to water and land based on TRI data include assessments of transfers of waste containing TBBPA from the sites of the COUs to disposal sites where applicable. For example, the assessments of releases to water from the sites of the COUs include assessments of transfers to POTW where applicable.

[b] If all or only some of the sites that EPA associated with a COU reported non-zero releases to a release medium, then EPA noted the assessment method as "TRI" in the case of that release medium. On the other hand, if all sites that EPA associated with a COU reported zero releases to a release medium, then EPA noted the assessment method as "TRI (release reported as zero in TRI)" in the case of that release medium.

[c] The NAICS code for electronics recycling sites (562920) is not included in the NAICS list for TRI reporting.

[d] The NAICS codes for laboratories (541380 and 541714) are not included in the NAICS list for TRI reporting.

For more information on the reviewed sources used to build this preliminary assessment, as well as the evaluation strategies for these sources, refer to the *Draft Systematic Review Protocol Supporting TSCA Risk Evaluations for Chemical Substances, Version 1.0* (U.S. EPA, 2021a) (also referred to as the "2021 Draft Systematic Review Protocol") and *Draft Systematic Review Protocol for 4,4'-(1-Methylethylidene)bis[2,6-dibromophenol] (TBBPA)* (U.S. EPA, 2026i).

2 APPROACH AND METHODOLOGY

Environmental release assessments of each COU comprised the following components:

- **Process Description:** A description of relevant chemical processes, including physical forms and weight fractions of the chemical throughout the process, process equipment used, and potential sources of releases to the environment from the process.
- **Facility Estimates:** An estimate of the number of sites per TBBPA COU and operating days for these sites.
- **Water Release Assessment Results:** Estimates of TBBPA released into water for the given COU.

The approach and methodology for completing each of the above components is described in more detail in this section. EPA's assessments of air and land releases are screening-level assessments that are presented in Sections 3.1 and 3.2, respectively.

2.1 Process Descriptions

EPA reviewed readily available information from systematic review to find descriptions of processes involved in each COU. Where data were available, EPA included the following information in each process description:

- Facility operating schedules (*e.g.,* year-round, 5 days per week, batch process, continuous process, multiple shifts);
- Key process steps;
- Physical form and weight fraction of the chemical throughout the process;
- Information on receiving and shipping containers; and
- Ultimate destination of chemical leaving the facility.

Each COU's process description includes TBBPA-specific information where available. Where TBBPA-specific process descriptions were unclear or not available, EPA referenced generic process descriptions from literature, including relevant emission scenario documents (ESDs) or generic scenarios (GSs). Sections 3.3.1 through 3.18.1 provide process descriptions for each COU.

2.2 Facility Estimates

2.2.1 Number of Facilities

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

1. Identify or "map" each facility that reported TBBPA in the 2020 CDR (U.S. EPA, 2022a) and TRI databases (U.S. EPA, 2023b) to a COU. Mapping consists of using facility reported industry sectors (typically reported as either North American Industry Classification System [NAICS] or Standard Industrial Classification [SIC] codes), chemical activity, and processing and use information to assign the most likely COU to each facility.

2. Based on the reporting thresholds and requirements of each data set, determine whether the total number of facilities in the COU is equal to the count of facilities mapped to the COU from each data set.

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

a. Identify the NAICS codes for the industry sectors associated with the COU.
b. Estimate total number of facilities using the U.S. Census' Statistics of U.S. Businesses (SUSB) data on total sites by 6-digit NAICS code.
c. Use market penetration data to estimate the percentage of sites likely to be using TBBPA instead of other chemicals.
d. Combine the data generated in Steps #3a through 3c to produce an estimate of the number of facilities using TBBPA in each 6-digit NAICS code and sum across all applicable NAICS codes to arrive at an estimate of the total number of facilities within the COU. Typically, it was assumed that this estimate encompassed the facilities identified in Step #1; therefore, the total number of facilities for the COU were assessed as the total generated from the analysis.

4. If market penetration data required for Step #3c are not available, EPA relied on generic industry data from GSs, ESDs, and other literature sources on typical throughputs/use rates, operating schedules, and the TBBPA production volume used within the COU to estimate the number of facilities. The approaches, equations, and input parameters used in stochastic modeling are described in the relevant COU sections throughout this report.

EPA estimated the number of facilities associated with TBBPA based on CDR and TRI or via systematic review and did not conduct Steps #3 and 4 of the above procedure

2.2.2 Estimating Release Days per Year

EPA typically assumes that, for sites reporting release quantities to the TRI, the number of release days equals to the number of operating days.

EPA's standard method for assessing the number of operating days uses the following hierarchy:

1. Facility-specific data: EPA used facility-specific operating days per year data if available. If facility-specific data were not available for one facility of interest but was available for other facilities within the same COU, the Agency estimated the operating days per year using one of the following approaches:
   a. If other facilities have known or estimated average daily use rates, EPA calculated the days per year as:

$$Days\ per\ year = \frac{Estimated\ annual\ use\ rate\ for\ facility\ (kg/year)}{Average\ daily\ use\ rate\ from\ facilities\ with\ available\ data\ (kg/day)}$$

   b. If facilities with days per year data do not have known or estimate average daily use rates, EPA used the average number of days per year from the facilities with such data available.
2. Industry-specific data: EPA used industry-specific data available from GSs, ESDs, trade publications, or other relevant literature.
3. Manufacture of large-PV commodity chemicals: Commodity chemicals are basic and relatively inexpensive compounds that are often produced in large quantities at plants built specifically to make one chemical. These plants are often run continuously, typically only shutting down for a few weeks a year for maintenance. Because of this, for the manufacture of the large-PV commodity chemicals, EPA used a value of 350 days per year. This assumes the plant runs seven days per week and 50 weeks per year (with 2 weeks down for turnaround) and assumes that the plant is always producing the chemical.
4. Manufacture of lower-PV specialty chemicals: Specialty chemicals are often more

expensive and are produced less frequently, at smaller quantities, and on an "as needed" basis. Because of this, for the manufacture of lower-PV specialty chemicals, it is unlikely the chemical is being manufactured continuously throughout the year. Therefore, EPA used a value of 250 days per year. This assumes the plant manufactures the chemical 5 days per week and 50 weeks per year (with 2 weeks down for turnaround).

5. Processing as reactant (intermediate use) in the manufacture of commodity chemicals: Similar to #3 above, EPA assumed the manufacture of commodity chemicals occurs 350 days per year such that the use of a chemical as a reactant to manufacture a commodity chemical would also occur 350 days per year.

6. Processing as reactant (intermediate use) in the manufacture of specialty chemicals: Similar to #4, the manufacture of specialty chemicals is not likely to occur continuously throughout the year. Therefore, EPA used a value of 250 days per year.

7. Other chemical plant COUs (*e.g.,* processing into formulation and use of industrial processing aids): For these COUs, EPA assumed that the chemical of interest is not always in use at the facility, even if the facility operates 24/7. Therefore, in general, EPA used a value of 300 days per year based on the "SpERC fact sheet – Formulation & (re)packing of substances and mixtures – Industrial (Solvent-borne)" which uses a default of 300 days per year for the chemical industry (ESIG, 2012). However, in instances where the COU uses a low volume of the chemical of interest, EPA used 250 days per year as a lower estimate.

8. POTWs: Although EPA expects POTWs to operate continuously over 365 days per year, the discharge frequency of the chemical of interest from a POTW will be dependent on the discharge patterns of the chemical from the upstream facilities discharging to the POTW. However, there can be multiple upstream facilities (possibly with different COUs) discharging to the same POTW and information to determine when the discharges from each facility occur on the same day or separate days is typically not available. Therefore, EPA could not determine an exact number of days per year the chemical of interest is discharged from the POTW and used a value of 365 days per year.

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

Site-specific data about the number of release days is available for Ravago Americas LLC and SolEpoxy, Inc. at their locations in Manchester, Tennessee, and Olean, New York, respectively. At the Ravago site, one batch of TBBPA-containing product is produced each month (Integral Consulting, 2025a). Therefore, EPA assumed 12 days of operation per year for this site. SolEpoxy, Inc. reported the number of operating days for TBBPA-containing products to be equal to 15 days (Integral Consulting, 2026). Therefore, the Agency assumed 15 days of operation for this site.

Some data on the operating days of certain TBBPA processes at various sites are reported in the American Chemistry Council (ACC) TBBPA Consortium's Amended Final Study Report (Integral Consulting, 2025a), which contains TBBPA worker monitoring data collected pursuant to EPA's test order. The consortium consists of 21 companies that process or industrially use TBBPA at 26 sites in the United States. The processes at these sites are grouped into four OESs. Each group is associated with multiple COUs because the processes within a group vary by COU. For each group, two ranges of annual operating days are reported—one for batch processes and one for continuous processes—except for Group 1, for which a single range applying to all processes is reported; these ranges are given in Table 2-1. As indicated in Table 2-1, the processes are associated with the following eight COUs

(Integral Consulting, 2025a):

1. Processing as a reactant in plastic material and resin manufacturing,
2. Processing: Additive flame retardant in plastic, resin, and paints and coatings,
3. Processing: Adhesive manufacturing,
4. Processing: Reactive flame retardant in computer and electronic product manufacturing,
5. Processing: Reactive flame retardant in transportation equipment manufacturing,
6. Processing: Additive flame retardant in plastic products,
7. Reactive use in electrical and electronic articles, and
8. Reactive use in automotive and aviation articles.

Table 2-1. Number of Operating Days for Each of the ACC TBBPA Consortium Group

ACC TBBPA Consortium Group	EPA COU[a]	Range of Operating Days per Year (Integral Consulting, 2025a)
1st	5	6–13
2nd	3, 5, 6	Batch processes: 2–305 Continuous processes: 260–312
3rd	5, 7, 8, 9	Batch processes: 4–156 Continuous Processes: 104–260
4th	14, 16	Batch processes: 12–365 Continuous processes: 260–275

[a] Table 1-1 contains the names of all COUs and their corresponding ordinal numbers.

Based on the above data, EPA assessed the number of operating days in the case of Sabic Innovative Plastics Mt. Vernon LLC as a range values equal to 2 to 350 days. The lower-end of this range is equal to the lower-end of the range of values reported by the ACC TBBPA Consortium and the high-end of this range equal to the value determined based on EPA's standard method.

Other than Ravago Americas LLC, SolEpoxy, Inc., and Sabic Innovative Plastics Mt. Vernon LLC, Benvic Trinity LLC and Avient Colorants USA LLC also reported non-zero water releases to TRI. The Agency estimated the number of days of operation per year to be equal to 246 for these 2 sites in accordance with EPA's standard method that is summarized above because site-specific data or data associated with occupational exposure OESs are not available for these sites.

EPA estimated the number of days of release to air and land based on the ACC TBBPA Consortium's information.

2.3 Environmental Releases Approach and Methodology

Releases to the environment are a component of potential exposure and may be derived from reported data that are obtained through direct measurement via monitoring, calculations based on empirical data, and/or assumptions and models. For each COU, EPA, where possible, provided annual releases, daily releases, and the number of release days per year.

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

1. Monitoring and measured data:
    a. Releases calculated from site-specific concentration in medium and flow rate data
    b. Releases calculated from mass balances or emission factor methods using site-specific measured data

2. Modeling approaches:
    a. Surrogate release data
    b. Fundamental modeling approaches
    c. Statistical regression modeling approaches

EPA's preference was to rely on facility-specific release data reported in TRI (U.S. EPA, 2023b), where available. There were cases where releases were expected for an COU, but TRI data were not available. In these cases, the Agency conducted a qualitative assessment of the COU and provided an overarching discussion of releases. EPA's general approach to estimating releases from these sources is described in Sections 2.3.1 through 2.3.3. Specific details related to the use of release data or qualitative assessments for each COU can be found in Section 3.

The final release results are described as point estimates (*i.e.,* a single descriptor or statistic such as central tendency or high-end).

2.3.1 Identifying Release Sources

EPA reviewed data available from systematic review to identify process operations that could potentially result in releases of TBBPA to water from each COU. For each COU, the Agency identified the potential release sources to water. Where TBBPA-specific release sources were unclear or not available, EPA referenced relevant ESDs or GSs. Descriptions of release sources for each COU can be found in Section 3.

2.3.2 Estimating Releases from Data Reported to EPA

Generally, EPA used the facility-specific release data reported in TRI as annual releases for each site and estimated the daily release by averaging the annual release over the expected release days per year. The Agency's approach to estimating release days per year is described in Section 2.2.2. The supplemental files contain the calculations of the central tendency and high-end annual and daily releases for each COU that used EPA databases to estimate releases. Water release calculations are in *Draft Water Releases for 4,4'-(1-Methylethylidene)bis[2,6-dibromophenol] (TBBPA)* (U.S. EPA, 2026k). Land release calculations are provided in *Draft Land Releases for 4,4'-(1-Methylethylidene)bis[2,6-dibromophenol] (TBBPA)* (U.S. EPA, 2026f). Air release calculations are provided in *Draft Air Releases for 4,4'-(1-Methylethylidene)bis[2,6-dibromophenol] (TBBPA)* (U.S. EPA, 2026b).

Toxics Release Inventory (TRI)

Section 313 of the Emergency Planning and Community Right-to-Know Act (EPCRA) established the TRI, which tracks the waste management of designated toxic chemicals at facilities of certain industry sectors. TRI data about a facility must be submitted to the EPA subject to the following conditions: 10 or more full-time employees work at the facility; the facility is associated with an applicable NAICS code; and the chemical is manufactured, processed, or used at the facility in quantities greater than a certain threshold (25,000 lb for manufacturers and processors and 10,000 lb for users). In the case of TBBPA specifically, the threshold is 100 lb for manufacturers, processors and users because TBBPA is persistent, bioaccumulative, and toxic (PBT) according to TRI (U.S. EPA, 2023b). Companies determine on-site releases of a facility from readily available data (including monitoring data) that was collected pursuant to other provisions of law, or, where such data are not readily available, from "reasonable estimates" of the amounts released, and then submit this information to EPA. EPA makes the reported information publicly available through TRI.

Each facility subject to the rule must report either using a Form R or a Form A. Facilities reporting using a Form R must report annually the volume of chemical released to the environment (*i.e.,* surface water, air, or land) and/or managed through recycling, energy recovery, and treatment (*e.g.,* incineration) from the facility. Facilities may submit a Form A if the volume of chemical manufactured, processed, or otherwise used does not exceed 1,000,000 lb per year and the total annual reportable releases do not exceed 500 lb per year. Facilities reporting using a Form A are not required to submit annual release and waste management volumes or use/sub-use information for the chemical. Due to reporting limitations, some sites that manufacture, process, or use TBBPA may not report to TRI and are therefore not included in this preliminary assessment.

For each release quantity reported, TRI filers select a "basis of estimate" code to indicate the principal method used to determine the release quantity. TRI provides six bases of estimate codes which, in no particular order, are continuous monitoring, periodic monitoring, mass balance calculations, published emission factors, site-specific emission factors, and engineering calculations/best engineering judgment. For facilities that use a TRI chemical in multiple operations, the filer may use a combination of methods to calculate the overall release quantity. In such cases, TRI instructs the facility to enter the basis of estimate code for the method that corresponds to the largest portion of the reported release quantity. Additional details on the basis for the reported release estimate (*e.g.,* calculations, underlying assumptions) are not reported in TRI.

For TBBPA, all TRI submissions were Form R submissions. Here, the Agency assessed releases using the reported annual release volumes from each media. For the draft risk evaluation and this TSD, EPA used TRI data from the reporting years 2019 to 2023 to provide a basis for estimating releases (U.S. EPA, 2023b). Further details on EPA's approach to using TRI data for estimating releases are described in Appendix C.

EPA obtained TRI data from the reporting years between 2019 to 2023 for TBBPA from EPA's Basic Plus Data Files. To estimate water releases, EPA used the reported annual releases directly as reported in TRI and then divided the annual releases over the number of estimated operating days to obtain daily average release estimates. The Agency presents the release data as high-end and central tendency estimates by calculating the 50th and 95th percentiles respectively of the releases from all facilities mapped to a given COU. Release estimates are separated where relevant by surface water discharges, POTWs, and non-POTW WWT releases. Water releases in TRI include both reports of annual direct discharges to surface water and annual indirect discharges to off-site POTWs and WWT facilities. A total of five facilities reported non-zero water releases of TBBPA with a total of 15 reports over the five years that were assessed. For total water releases of TBBPA reported to TRI, there is a decreasing general trend from 2019 to 2023.

For air and land releases, EPA used the TRI Toxics Tracker to estimate total TBBPA releases from all facilities for each reporting year. Total air releases of TBBPA reported to TRI have been consistent from 2019 to 2022, with a recent decrease in 2023. For total land releases of TBBPA reported to TRI, there is an increasing general trend from 2019 to 2023.

Discharge Monitoring Reports (DMRs)

Under the Clean Water Act, EPA regulates the discharge of pollutants into receiving waters through National Pollutant Discharge Elimination System (NPDES). An NPDES permit authorizes discharging facilities to discharge pollutants to specified effluent limits. NPDES permits require facilities to monitor their discharges and report the results to EPA and the state regulatory agency. Facilities report these results in DMRs. EPA makes these reported data publicly available via EPA's Enforcement and Compliance History Online (ECHO) system and EPA's Water Pollutant Loading Tool (also referred to as "Loading Tool"). The latter is a web-based tool that obtains DMR data through ECHO, presents data summaries and calculates pollutant loading (mass of pollutant discharged). For this draft risk evaluation, EPA queried DMRs for all TBBPA point source water discharges available for 2019 to 2023. No facilities reported discharges of TBBPA to DMRs within this period.

National Emissions Inventory (NEI)

The NEI was established to track emissions of Criteria Air Pollutants (CAPs) and CAP precursors and assist with National Ambient Air Quality Standard (NAAQS) compliance under the CAA. Air emissions data for the NEI are collected at the state, local, and tribal (SLT) level. SLT air agencies then submit these data to EPA through the Emissions Inventory System (EIS). In addition to CAP data, many SLT air agencies voluntarily submit data for pollutants on EPA's list of HAPs. The Agency uses the data collected from SLT air agencies, in conjunction with supplemental HAP data, to build the NEI. EPA makes an updated NEI publicly available every three years. For this draft risk evaluation, the Agency examined NEI data for reporting years 2017 and 2020 data to provide a basis for estimating releases (U.S. EPA, 2019d), but information on TBBPA emissions was lacking. Therefore, EPA did not use NEI data to estimate air releases of TBBPA.

2.3.2.1 Approach for Estimating Air Releases

EPA's assessment of air releases is a screening-level assessment as presented in Section 3.1.

2.3.2.2 Approach for Estimating Land Releases

EPA's assessment of land releases is a screening-level assessment as presented in Section 3.2.

2.3.2.3 Approach for Estimating Water Releases

EPA used TRI data to estimate annual wastewater discharges and average daily wastewater discharges. Water releases in TRI include both reports of annual direct discharges to surface water and annual indirect discharges to off-site POTWs and WWT facilities. Direct discharges to surface water and indirect discharges to off-site POTWs and WWT facilities from TRI were assessed. Although surface water discharges are released to the environment, discharges to POTWs and WWT facilities are not directly released into the environment, but to treatment facilities.

For TRI, annual discharges are reported directly by facilities. To estimate average daily discharges, EPA used the following steps:

1. Obtain TRI reported annual direct surface water discharges and indirect discharges to POTW and non-POTW WWT. Because treatment is expected at the receiving POTW prior to discharge to surface water, EPA applied a mean removal efficiency of 90.1%.
2. Divided the annual discharges over the number of estimated operating days (estimated as described in Section 2.2.2).

2.3.3 Approach for Estimating Releases from Models

For the COUs without TRI data, EPA assessed water releases qualitatively. EPA did deterministically model releases for the Recycling COU; however, this modeling showed only air and land releases, with no releases to water. Therefore, the modeling results are not presented for the Recycling COU Section 3.11, but are instead discussed in Appendix A below.

2.4 Evidence Integration for Environmental Releases

Evidence integration for the environmental release assessment includes analysis, synthesis, and integration of information and data to produce estimates of environmental releases.
During evidence integration, EPA considered the likely location, duration, intensity, frequency, and

quantity of releases while also considering factors that increase or decrease the strength of evidence when analyzing and integrating the data. Key factors the Agency considered when integrating evidence include the following:

1. **Data Quality:** EPA only integrated data or information rated as *high*, *medium*, or *low* obtained during the data evaluation phase. Data and information rated as *uninformative* are not used in exposure evidence integration. In general, higher rankings are given preference over lower ratings; however, lower ranked data may be used over higher ranked data when specific aspects of the data are carefully examined and compared. For example, a lower ranked data set that precisely matches the COU of interest may be used over a higher ranked study that does not as closely match the COU of interest.

2. **Data Hierarchy:** EPA used measured data to obtain accurate and representative estimates (*e.g.,* central tendency, high-end) of the environmental releases resulting directly from a specific source, medium, or product.

EPA considered both data quality and data hierarchy when determining evidence integration strategies. The final integration of the environmental release evidence combined decisions regarding the strength of the available information, including information on plausibility and coherence across each evidence stream.

3 INDUSTRIAL AND COMMERCIAL RELEASE ASSESSMENT

This section includes process descriptions, facility estimates, and water release assessments for each TBBPA COU. EPA conducted screening-level assessments of air and land releases as presented in Sections 3.1 and 3.2, respectively.

3.1 Screening-Level Air Release Estimates from TRI Data

EPA assessed releases to air from TRI data by calculating the maximum possible rate of release to air from any of the sites of the TRI data. To accomplish this, EPA used the TRI Toxics Tracker (U.S. EPA, 2021b) to obtain TRI data and divided this data into two datasets. One data set comprised the annual TBBPA air release rates for Albemarle Corporation and the other dataset comprised the TBBPA annual air release rates from all TRI sites other than Albemarle. Both datasets comprise annual air release rates for each year in the period of 2014 to 2023. EPA calculated the total of the annual TBBPA air release rates from all TRI sites other than Albemarle for each year in the period of 2014 to 2023. Table 3-1 through Table 3-3 present these data for stack and fugitive air. According to this tabulated data, the maximum stack and fugitive releases are the stack releases at the Albemarle site during 2020 and the total of the fugitive releases during 2020 from all sites other than the Albemarle site. EPA calculated the daily release rates that correspond to the annual release rates mentioned above by assuming the number of release days is equal to 2 or 365 and these estimated daily release rates are given in Table 3-2 and Table 3-3 below.

EPA estimated the minimum number of release days to be equal to two days based on the final study report (Integral Consulting, 2025a). This screening-level analysis does not include the assessment of releases to air from electronics recycling which does not involve TRI data and is presented in Section 3.11. Facility-level average annual and daily air releases are not presented in this TSD, though they are calculated in the *Draft Ambient Air IIOAC Results and Risk Calculations for 4,4'-(1-Methylethylidene)bis[2,6-dibromophenol] (TBBPA)* (U.S. EPA, 2026c).

The following COUs result in non-zero air releases because some or all of the sites that EPA associated with each of these COUs reported non-zero releases to air:

- Manufacturing
- Processing as a reactant in plastic material and resin manufacturing
- Processing as a reactant in all other chemical product and preparation manufacturing
- Processing: Additive flame retardant in plastic, resin, and paints and coatings
- Processing: Adhesive manufacturing
- Processing: Reactive flame retardant in computer and electronic product manufacturing
- Processing: Reactive flame retardant in transportation equipment manufacturing
- Processing: Additive flame retardant in plastic products
- Reactive use in automotive and aviation articles
- Disposal.

EPA associated a single site with the manufacturing COU, and this site is the Albemarle Corporation South Plant, Magnolia, Arkansas, site; this is the only manufacturing site as discussed in Section 3.3.2. With regard to the other COUs that are associated with non-zero releases to air, the total number of sites associated with these COUs that reported non-zero stack and fugitive releases to air is 30 and 28.

The following two COUs result in zero air releases because all of the sites that EPA associated with each of these COUs reported zero releases to air:

- Repackaging
- Use in building and construction materials

Table 3-1. Annual Releases of TBBPA (kg)

Year	Stack Air (5.2)			Fugitive Air (5.1)		
	1) Total of Releases from All Sites	2) Release from Albemarle Corporation South Plant, Magnolia, AR	3) Total of Releases from All Sites Except Albemarle	1) Total of Releases from All Sites	2) Release from Albemarle Corporation South Plant, Magnolia, AR	3) Total of Releases from All Sites Except Albemarle
2014	1,012	721	291	163	5	158
2015	1,210	794	416	312	5	307
2016	1,798	794	1,004	340	6	334
2017	1,897	794	1,103	280	6	274
2018	3,197	2,237	960	327	5	322
2019	2,857	2,237	620	325	5	321
2020	3,351	2,370	981	440	29	410
2021	3,327	2,328	998	155	5	151
2022	3,443	2,316	1,127	195	5	190
2023	1,120	637	483	407	5	402

Table 3-2. Daily Releases of TBBPA (kg/day) Assuming 2 Days of Releases per Year

Year	Stack Air (5.2)			Fugitive Air (5.1)		
	1) Total of Releases from All Sites	2) Release from Albemarle Corporation South Plant, Magnolia, AR	3) Total of Releases from All Sites Except Albemarle	1) Total of Releases from All Sites	2) Release from Albemarle Corporation South Plant, Magnolia, AR	3) Total of Releases from All Sites Except Albemarle
2014	506	361	145	81	2	79
2015	605	397	208	156	3	153
2016	899	397	502	170	3	167
2017	949	397	552	140	3	137
2018	1,599	1,119	480	163	2	161
2019	1,429	1,118	310	163	2	160
2020	1,676	1,185	491	220	15	205
2021	1,663	1,164	499	78	2	75

Year	Stack Air (5.2)			Fugitive Air (5.1)		
	1) Total of Releases from All Sites	2) Release from Albemarle Corporation South Plant, Magnolia, AR	3) Total of Releases from All Sites Except Albemarle	1) Total of Releases from All Sites	2) Release from Albemarle Corporation South Plant, Magnolia, AR	3) Total of Releases from All Sites Except Albemarle
2022	1,721	1,158	564	97	2	95
2023	560	318	241	203	2	201

Table 3-3. Daily Releases of TBBPA (kg/day) Assuming 365 Days of Releases per Year

Year	Stack Air (5.2)			Fugitive Air (5.1)		
	1) Total of Releases from All Sites	2) Release from Albemarle Corporation South Plant, Magnolia, AR	3) Total of Releases from All Sites Except Albemarle	1) Total of Releases from All Sites	2) Release from Albemarle Corporation South Plant, Magnolia, AR	3) Total of Releases from All Sites Except Albemarle
2014	2.77	1.98	7.97E–01	4.46E–01	1.24E–02	4.34E–01
2015	3.31	2.17	1.14	8.55E–01	1.49E–02	8.40E–01
2016	4.93	2.17	2.75	9.32E–01	1.62E–02	9.16E–01
2017	5.20	2.17	3.02	7.67E–01	1.62E–02	7.51E–01
2018	8.76	6.13	2.63	8.95E–01	1.24E–02	8.82E–01
2019	7.83	6.13	1.70	8.91E–01	1.24E–02	8.78E–01
2020	9.18	6.49	2.69	1.20	8.08E–02	1.12
2021	9.11	6.38	2.74	4.26E–01	1.24E–02	4.13E–01
2022	9.43	6.34	3.09	5.33E–01	1.24E–02	5.21E–01
2023	3.07	1.74	1.32	1.11	1.24E–02	1.10

3.2 Screening-Level Land Release Estimates from TRI Data

EPA used the TRI Toxics Tracker (U.S. EPA, 2021b) to calculate total TBBPA land releases from all TRI sites for each reporting year. Table 3-4 presents these totals for various land release methods. Facility-level average annual and daily land releases are not presented in this TSD, though they are calculated in the supplemental file, *Draft Land Releases for 4,4'-(1-Methylethylidene)bis[2,6-dibromophenol] (TBBPA)* (U.S. EPA, 2026f).

All COUs that are associated with TRI data result in non-zero releases to land because some or all of the sites that EPA associated with each of these COUs reported non-zero releases to land; these COUs are as follows:

- Manufacturing
- Repackaging
- Processing as a reactant in plastic material and resin manufacturing
- Processing as a reactant in all other chemical product and preparation manufacturing
- Processing: Additive flame retardant in plastic, resin, and paints and coatings
- Processing: Adhesive manufacturing
- Processing: Reactive flame retardant in computer and electronic product manufacturing
- Processing: Reactive flame retardant in transportation equipment manufacturing
- Processing: Additive flame retardant in plastic products
- Reactive use in automotive and aviation articles
- Use in building and construction materials
- Disposal

Table 3-4. Total TBBPA Land Releases Reported to the Toxics Release Inventory (TRI)

Year	Underground Injection (kg/yr)	RCRA Subtitle C Surface Impoundments (kg/yr)	Land Treatment (kg/yr)	Other Land Disposal (kg/yr)	RCRA Subtitle C Landfills (kg/yr)	Other Landfills (kg/yr)	Other Surface Impoundments (kg/yr)	Off-Site Transfers (kg/yr)
2014	34	0	0	0	417	4	0	3,641
2015	23	0	0	45	32,601	1	0	4,170
2016	23	0	0	45	33,386	0	0	11,603
2017	23	0	0	45	48,844	0	0	28,810
2018	23	0	0	0	33,699	21,202	0	18,825
2019	0	0	0	2.3	18,097	82,321	0	11,482
2020	0	0	0	0	19,085	64,263	0	22,745
2021	0	0	0	0	17,737	41,145	0	10,011
2022	0	0	0	1.1	23,271	0	0	56,065
2023	0	0	0	1.2	12,862	0	0	1,332

3.3 Manufacturing

3.3.1 Process Description

TBBPA is produced via bromination of bisphenol A (BPA). The bromination reaction may be conducted in the presence of a hydrocarbon solvent or with water, and 50% hydrobromic acid or aqueous alkyl monoethers (ILS, 2002). The production process is largely conducted in closed systems (Earthjustice, 2019; ECB, 2006; IPCS, 1995; Ethyl Corporation).

In the 2020 CDR, two sites reported a physical form of TBBPA as dry powder, and a produced concentration of 90% or greater (U.S. EPA, 2022a). Literature has reported purities of 98.5 to 99% in manufactured TBBPA (NICNAS, 2020; ECB, 2006; Van Esch, 1995). According to the ACC TBBPA Consortium's final test report, TBBPA feed is reported to range from 90% to greater than 98% concentration, which can indicate the concentration of TBBPA being manufactured (Integral Consulting, 2025a).

Per ACC Consortium correspondence, TBBPA powder is amorphous in shape, with 10, 50, and 90% of TBBPA particles having diameters less than 20, 140, and 470 µm, respectively (U.S. EPA, 2025b). In one study, the overall mass median diameter for two samples of TBBPA was determined as 31.81 and 52.20 µm. Approximately 4% of the particles had an aerodynamic diameter of less than 15 µm (ECB, 2008).

In general, EPA expects potential sources of releases in the chemical industry to include equipment cleaning operations, transport container cleaning, sampling, and transfer losses from unloading raw materials. The media of release for these are unknown and depend on site-specific waste management practices.

3.3.2 Facility Estimates

In the 2016 CDR, one site reported the domestic manufacture of TBBPA, Albemarle Corporation (Magnolia, AR) (U.S. EPA, 2019a). In the 2020 CDR, no sites reported manufacturing, but two sites claimed their activity as CBI, so it is possible that these sites conduct TBBPA manufacturing (U.S. EPA, 2020a). No individual sites disclosed their production volumes to CDR, but according to the nationally aggregated production volume in CDR, the United States was estimated to handle between 20 to 100 million lb per year from 2016 to 2019 (U.S. EPA, 2020a). In conclusion, the number of sites associated with this COU is between one to three sites based on CDR.

EPA mapped one TRI site to this COU. This facility reported to TRI under the industry type of "Other Basic Inorganic Chemical Manufacturing" (NAICS 325180) (U.S. EPA, 2023b). This is the same Albemarle site in Magnolia, Arkansas. EPA did not identify other data on current manufacturing sites from systematic review.

EPA did not identify data on facility operating schedules; therefore, since TBBPA is a large-PV chemical, EPA assumes 350 days per year of operation as discussed in Section 2.2.2.

3.3.3 Water Release Assessment

The TRI site that EPA associated with Manufacturing of TBBPA COU is ALBEMARLE CORP. This site reported zero annual water releases for each of the reporting years of 2019 to 2023 (U.S. EPA, 2023b). Therefore, TBBPA is not released to water from facilities that EPA associated with this COU.

3.4 Repackaging

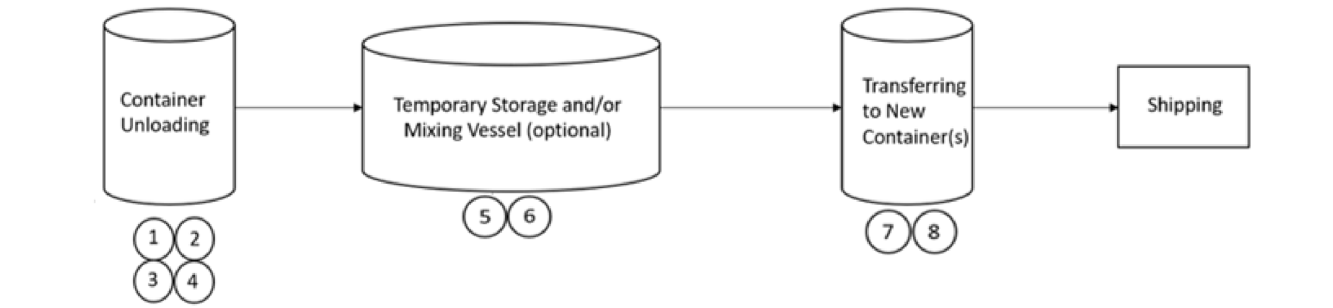
3.4.1 Process Description

Exposures and releases are not expected to occur routinely at facilities that import but do not repackage, process or use TBBPA (U.S. EPA, 2022b) because importation containers are not opened at such sites. This COU is strictly associated with sites at which TBBPA is received in bulk and is transferred into other containers, without any dilution, mixing, or other modification. This COU is not associated with sites at which TBBPA is repackaged and then processed or used on-site. EPA associated such sites with the COUs that correspond to the TBBPA processing or use that occurs at these sites.

One repackaging site, Albemarle, historically imports one-ton Flexible Intermediate Bulk Containers (Super Sacks) of raw material containing 98 to 100% coarse powder TBBPA to their facility for repackaging (Integral Consulting, 2025b).

Repackaging operations for liquid chemicals typically involve pumping or pouring in between the original larger container into a new smaller container. For solids, sacks of product are lifted with a forklift over a metal bin, cut, and emptied over a bin or a hopper. From the hoppers the solids are gravity fed into smaller cardboard boxes or paper sacks that are shipped to customers (U.S. EPA, 2022b). At Albemarle, Super Sacks of TBBPA are hoisted above a truck using lifting equipment and transloaded into the truck via a funnel cone (Integral Consulting, 2025c). The operator opens the door enclosing the funnel cone, unties the bottom of the Super Sack, closes the funnel cone door, and empties the bag into the truck by gravity, sometimes with manual jostling. Other documented sites use automated systems to repackage TBBPA. One site uses a powder drop mechanism to feed TBBPA into production reactors, while another site repackages TBBPA into bags using a self-contained machine with dust collection controls (Integral Consulting, 2025c). In some cases, quality control samples may be taken at import and repackaging sites for analysis.

Figure 3-1 presents a generic flowchart for chemical repackaging scenarios and shows the various sources of releases of the process (U.S. EPA, 2022b).



Environmental Releases:

1. Releases to air from unloading TBBPA from transport containers.
2. Releases to air, water, incineration, or landfill from unloading solids transport containers.
3. Release to water, incineration or land from transport container residue (via containers or direct disposal of empty containers).
4. Releases to air from cleaning transport containers containing TBBPA.
5. Release to water, incineration or land from cleaning of storage/ mixing vessels and other equipment.
6. Release to air from cleaning equipment used to process TBBPA.
7. Releases to air from loading volatile chemicals into transport containers.
8. Releases to air, water, incineration, or landfill from loading solids into transport containers.

Figure 3-1. Chemical Repackaging Diagram (U.S. EPA, 2022b)

3.4.2 Facility Estimates

EPA assessed the total number of sites associated with this COU based on TRI data. EPA mapped two TRI sites to this COU. These facilities that reported to TRI under the industry type of "All Other Basic Organic Chemical Manufacturing" (NAICS 325199) or "All Other Miscellaneous Chemical Product and Preparation Manufacturing" (NAICS 325998) and both facilities use reported TRI uses of "Processing: Repackaging" (U.S. EPA, 2023b).

In 2020 CDR, eight total sites reported importing TBBPA; however, they also report not using the chemical on site, so they are not repackaging sites (U.S. EPA, 2022a). In conclusion, EPA assessed the number of sites associated with this COU to be two sites, based on the TRI data discussed above and these two sites are stated in Section 3.4.3.

EPA assumed 260 days per year of operation according to the Revised Chemical Repackaging GS as discussed in Section 2.2.2. (U.S. EPA, 2022b).

3.4.3 Water Release Assessment

The names of the TRI sites that EPA associated with Repackaging of TBBPA COU are ALBEMARLE CORP (Baton Rouge, Louisiana), and HB CHEMICAL – RAVAGO CHEMICAL DISTRIBUTION INC. Both of these sites reported zero annual water releases for each of the reporting years of 2019 to 2023 (U.S. EPA, 2023b). Therefore, TBBPA is not released to water from facilities that EPA associated with this COU.

3.5 Processing as a Reactant in Plastic Material and Resin Manufacturing; Processing as a Reactant in All Other Chemical Product and Preparation Manufacturing

3.5.1 Process Description

TBBPA is used as a reactive flame retardant in the production of plastic materials and epoxy resins.

Here, TBBPA is reacted, typically with an excess of diglycidyl ether of BPA, or another similar epoxy (U.S. EPA, 2015b). A public comment from EarthJustice indicates that FR-4 laminate used for printed circuit boards (PCBs) typically is produced by reacting 5 to 15% of TBBPA in the epoxy resin (Earthjustice, 2019). Often, raw materials are loaded from a hopper into a reaction vessel. Other liquids may be pumped into the reactor gradually via automated systems (U.S. EPA, 2015b).

TBBPA is also used as a reactive flame retardant in polycarbonate and unsaturated polyester resins (ECB, 2008). Reactive flame retardants are added to thermosetting resins before the cross-linking reaction (Pelzl et al., 2018). Once introduced, it becomes entrained in the polymer structure.

In 2020 CDR, sites that reported TBBPA being used as a reactant reported TBBPA's physical form as a dry powder with a maximum concentration of 90% or higher (U.S. EPA, 2022a). Figure 3-2 shows the typical release points during the processing of TBBPA as a reactant or intermediate, which EPA developed based on the above process information and typically expected release points.

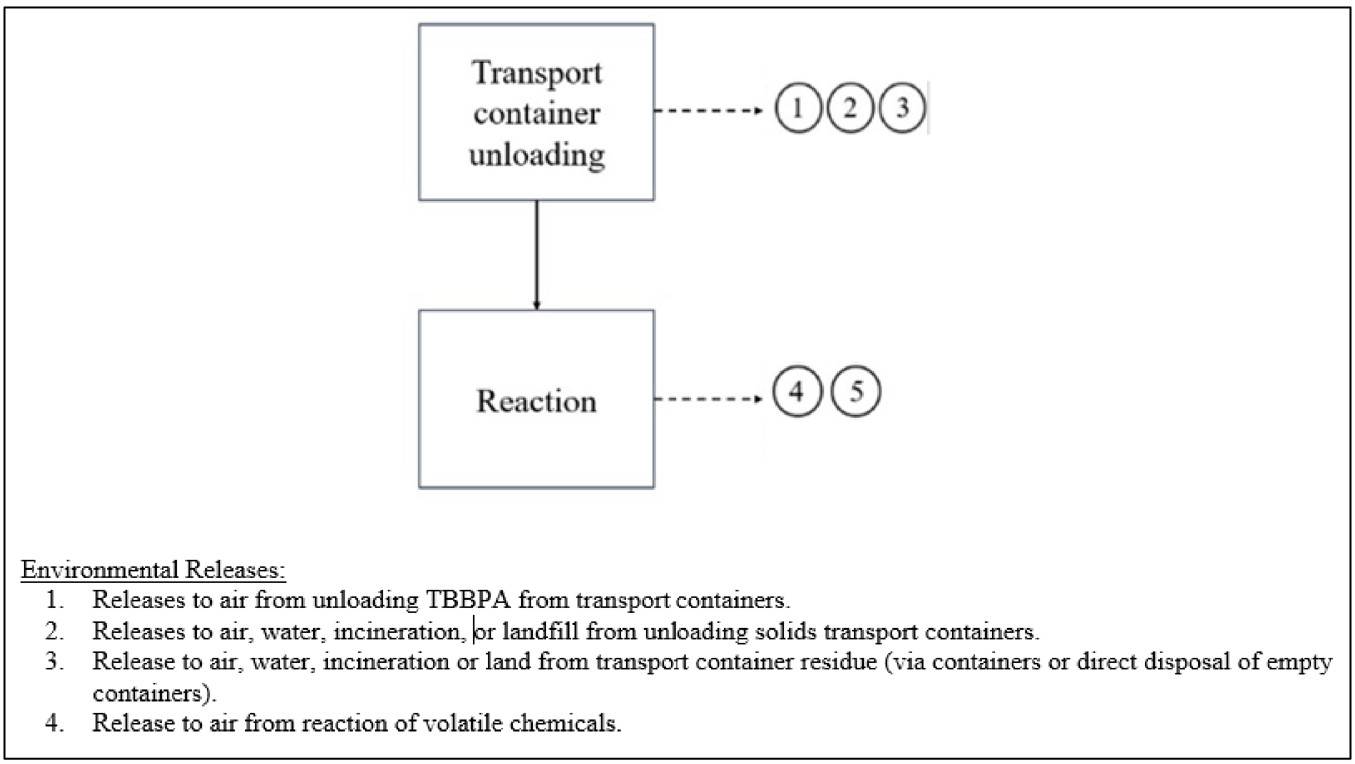


Figure 3-2. Processing as a Reactant Flow Diagram

3.5.2 Facility Estimates

According to the 2020 CDR, three reporting sites reported that TBBPA is used as an intermediate in the production of plastic materials and resin manufacturing (U.S. EPA, 2022a). One of these sites, Vandemark Chemical, reported a volume of 45,856 lb of TBBPA used on site in 2019. The two other sites are both Albemarle plants (one in Charlotte, NC and one in Magnolia, Arkansas); however, Albemarle Corporation claimed the volume of TBBPA used as CBI in the 2020 CDR (U.S. EPA, 2022a). It is also unclear if these three sites use all the TBBPA on-site for this use or if they sell to downstream customers for this use, as all three reported less than ten sites for this use. Therefore, there are 3 to 27 sites according to CDR.

EPA mapped nine facilities in TRI to the COU of Processing as a reactant in plastic material and resin manufacturing as possibly processing TBBPA as a reactant based on site names and their reported NAICS codes. The reported NAICS codes for these facilities include “Other Basic Inorganic Chemical Manufacturing” (NAICS 325180), “Current-Carrying Wiring Device Manufacturing” (NAICS 335931), and “Plastics Material and Resin Manufacturing” (NAICS 325211). These nine facilities are the facilities named in Table 3-5, except for LANXESS Central which is associated with the COU of Processing as a reactant in all other chemical products and preparation manufacturing (U.S. EPA, 2026h).

EPA did not identify data on facility operating schedules; therefore, since TBBPA is a large-PV chemical, EPA assumes 350 days per year of operation as discussed in Section 2.2.2.

3.5.3 Water Release Assessment

Table 3-5 presents daily and annual water releases for this COU based on TRI data from the reporting years 2019 to 2023 (U.S. EPA, 2023b), with the median and maximum presented for the one facility with water release estimates from across the 5-year reporting range. Of the 10 facilities mapped to this COU, 1 reported water releases to surface water. All other sites reported no releases to water.

Table 3-5. Summary of Water Releases from TRI for Processing TBBPA as a Reactant

<table>
<tr><th>Site Identity</th><th>Source – Discharge Type</th><th>Median Annual Discharge (kg/yr)</th><th>Median Daily Discharge (kg/day)</th><th>Maximum Annual Discharge (kg/yr)</th><th>Maximum Daily Discharge (kg/day)</th><th>Annual Release Days (days/yr)</th></tr>
<tr><td>SABIC INNOVATIVE PLASTICS MT. VERNON LLC</td><td>Surface water</td><td>4.54</td><td>1.30E–02</td><td>14.5</td><td>4.15E–02</td><td>350</td></tr>
<tr><td>AOC TENNESSEE PLANT</td><td colspan="6" rowspan="9">Each of these sites reported zero annual water releases for each of the reporting years of 2019–2023.</td></tr>
<tr><td>COOPER POWER SYSTEMS LLC</td></tr>
<tr><td>HUNTSMAN ADVANCED MATERIALS LLC</td></tr>
<tr><td>INEOS COMPOSITES PHILADELPHIA PLANT</td></tr>
<tr><td>INEOS COMPOSITES US LLC</td></tr>
<tr><td>INTERPLASTIC CORP</td></tr>
<tr><td>LANXESS – CENTRAL</td></tr>
<tr><td>POLYNT COMPOSITES USA INC</td></tr>
<tr><td>WESTLAKE EPOXY INC</td></tr>
</table>

3.6 Processing: Additive Flame Retardant in Plastic, Resin, and Paints and Coatings

3.6.1 Process Description

TBBPA is added as an additive flame retardant during plastic compounding, resin manufacturing, and paint and coating manufacturing. TBBPA is incorporated into as an additive flame retardant for use in the production of flame-retarded ABS resins and phenolic resins (EC, 2013). Over 90% of flame retardants used in thermoplastics are of the additive type. They are added before, during, or after polymerization (Pelzl et al., 2018).

Flame retardant additives in general are mixed with polymers and other raw materials to produce a compounded masterbatch (U.S. EPA, 2021c). A typical site receives chemical substances in drums where the components are unloaded into mixing vessels. Incorporation into plastics and resins occurs in either closed or partially open processes. Plastic manufacturing can be completed in a closed process such as tumbling, ball blending, gravity mixing, paddle/double arm mixers Banbury (type) internal mixers, and intensive vortex action mixers. Partially open processes are also used, including two-roll mills and extruders. Temperatures are expected to range from 65 to 365 ° Celsius. Once the solid masterbatch is completed, it is transferred into an extruder where it is converted into pellets, sheets, films, or pipes. The resulting converted masterbatch is packaged for shipment to downstream plastics converting sites (U.S. EPA, 2021c).

CDR reporters indicate that TBBPA used as a flame retardant in plastic materials is typically a dry powder used at concentrations of greater than 90% by weight (U.S. EPA, 2022a). According to the GS for Additives in Plastics Processing (Compounding), flame retardants are estimated to have a weight fraction of 0.4 in plastic resin and 0.2 in ABS plastics (U.S. EPA, 2004). Another source documents that once TBBPA is chemically-bound, the finished epoxy resin typically contains between 18 to 21% bromine (U.S. EPA, 2015b).

EPA developed the flow diagram in Figure 3-3 showing typical potential release and exposure points during plastics compounding from the Plastics Compounding GS (U.S. EPA, 2021c).

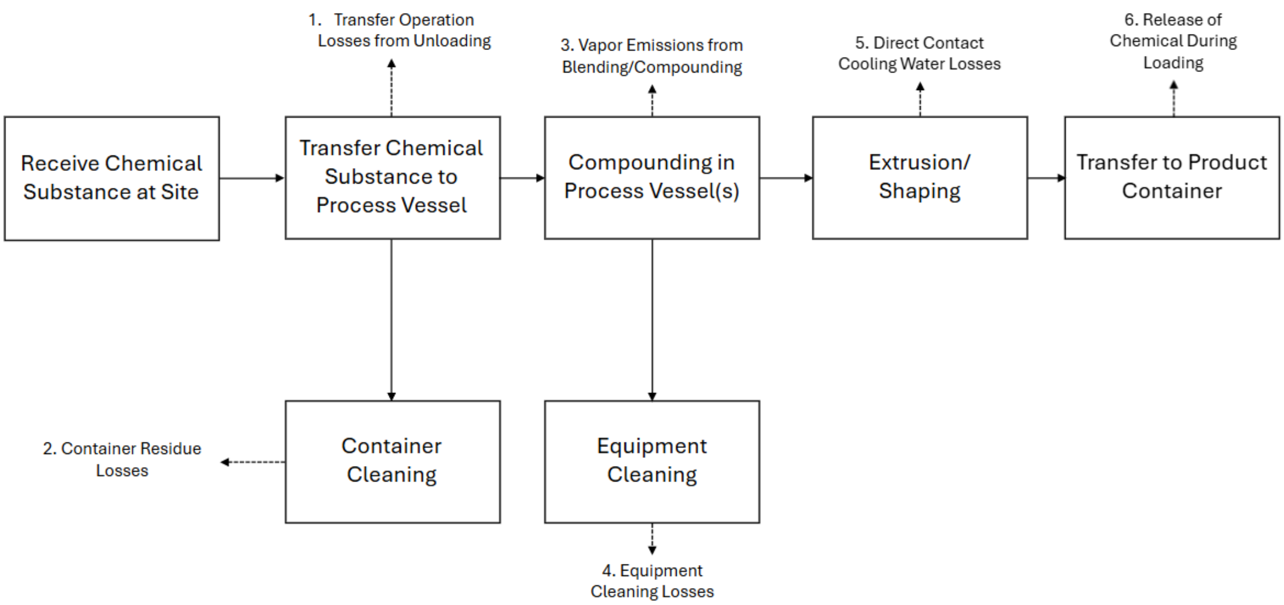


Figure 3-3. Additive Flame Retardant in Plastic and Resin Flow Diagram

TBBPA is also used to make liquid and powder coatings. During paint and coating formulation, sites receive and unload TBBPA into industrial mixing vessels as a batch blending or mixing process, with no reactions or chemical changes occurring to the additive (*i.e.,* TBBPA) during the mixing process (U.S. EPA, 2014a). Blending or mixing operations can take up to 8 hours a day. Process operations may include quality control sampling. In the case of waterborne paints and coatings, the formulator will transfer the blended formulation through an in-line filter. Sites may dispose of off-specification product when the product does not meet quality or desired standards. Following formulation, incorporation sites will load TBBPA-containing products into bottles, small containers, or drums depending on the product type. According to the GS on the Formulation of Waterborne Coatings, releases from unloading, container residues, equipment cleaning, and loading are expected (U.S. EPA, 2014a). This corresponds to Releases 1, 2, 4, and 6 in Figure 3-3.

3.6.2 Facility Estimates

According to the 2020 CDR, eight reporting sites reported that TBBPA is used in downstream operations as incorporated as an additive in the production of plastic materials and resin, plastic products, and paints and coatings (U.S. EPA, 2022a). Three of these sites reported less than 10 downstream facilities for this operation, 3 reported between 10 and 24 sites, and 2 reported between 25 and 99 sites. Therefore, in total there are between 110 and 300 sites.

EPA mapped 16 facilities in TRI as possibly processing TBBPA as an additive flame retardant in plastic, resin, and paints and coating manufacturing based on site names and their reported NAICS codes. NAICS codes reported by these facilities were either “Custom Compounding of Purchased Resins” (NAICS 325991) or “Plastic Material and Resin Manufacturing” (NAICS 325211).

EPA assumed 246 days per year of operation according to the Revised Plastics Compounding GS as discussed in Section 2.2.2, because all TRI sites reported NAICS associated with plastic compounding or plastic material production (U.S. EPA, 2022b).

3.6.3 Water Release Assessment

Table 3-6 presents daily and annual water releases for this COU based on TRI data from the reporting years 2019 to 2023 (U.S. EPA, 2023b), with medians and maxima presented from across the 5-year reporting range. Of the 15 facilities mapped to this COU, 1 reported water releases to surface water, and 4 reported releases to POTW. All other sites reported no releases to water.

Table 3-6. Summary of Water Releases from TRI For Processing: Additive Flame Retardant in Plastic, Resin, and Paints and Coating Manufacturing

<table>
<tr><th>Site Identity</th><th>Source – Discharge Type</th><th>Median Annual Discharge (kg/yr)</th><th>Median Daily Discharge (kg/day)</th><th>Maximum Annual Discharge (kg/yr)</th><th>Maximum Daily Discharge (kg/day)</th><th>Annual Release Days (days/yr)</th></tr>
<tr><td>SOLEPOXY, INC.</td><td>POTW</td><td>4.5</td><td>0.30</td><td>4.5</td><td>0.30</td><td>15</td></tr>
<tr><td>RAVAGO MANUFACTURING AMERICAS</td><td>Surface water</td><td>0[a]</td><td>0[a]</td><td>0.45</td><td>3.8E–02</td><td>12</td></tr>
<tr><td>RAVAGO MANUFACTURING AMERICAS</td><td>POTW</td><td>9.5</td><td>0.79</td><td>12</td><td>1.0</td><td>12</td></tr>
<tr><td>BENVIC TRINITY LLC</td><td>POTW</td><td>0.45</td><td>1.5E–03</td><td>0.45</td><td>1.5E–03</td><td>246</td></tr>
<tr><td>AVIENT COLORANTS USA LLC – ALBION FACILITY</td><td>POTW</td><td>1.4E–02</td><td>4.5E–05</td><td>1.4E–02</td><td>4.5E–05</td><td>246</td></tr>
<tr><td>CYTEC ENGINEERED MATERIALS INC</td><td colspan="6" rowspan="13">Each of these sites reported zero annual water releases for each of the reporting years of 2019–2023.</td></tr>
<tr><td>HEXCEL CORP</td></tr>
<tr><td>INFINITY LTL (Morrisville, PA)</td></tr>
<tr><td>INFINITY LTL (Swedesboro, NJ)</td></tr>
<tr><td>LYONDELLBASELL ADVANCED POLYMERS INC.</td></tr>
<tr><td>MILLER WASTE MILLS (DBA RTP CO.)</td></tr>
<tr><td>MITSUBISHI CHEMICAL CARBON FIBER & COMPOSITES INC</td></tr>
<tr><td>PRIMEX COLOR COMPOUNDING & ADDITIVES CORP</td></tr>
<tr><td>SABIC INNOVATIVE PLASTICS US LLC</td></tr>
<tr><td>STAR PLASTICS INC.</td></tr>
<tr><td>SUMITOMO BAKELITE N.A. INC</td></tr>
<tr><td>TECHMER PM LLC ILLINOIS</td></tr>
<tr><td colspan="7">[a] This site only reported TBBPA discharges to surface water for 1 year, so EPA was unable to calculate a median value.</td></tr>
</table>

3.7 Processing: Adhesive Manufacturing

3.7.1 Process Description

Based on the 2009 ESD on the Manufacture of Adhesives, a typical adhesive incorporation site combines raw materials into adhesive formulations in industrial mixing vessels as a batch blending or mixing process, with no reactions or chemical changes occurring during the mixing process (OECD, 2009a). Blending or mixing operations can take up to eight hours a day. Process operations may also include quality control sampling. Incorporation sites may also dispose of off-specification products when the adhesive product does not meet quality or desired standards. The ESD indicates that sites will load adhesive products into bottles, small containers, or drums depending on the product type (OECD, 2009a).

According to a public comment from EarthJustice, the 3M facility in Springfield, MO uses TBBPA in the manufacture of adhesives, specifically for specialty adhesives like foam tapes and sealant. A flame retardant epoxy powder manufactured by 3M (Scotchcast 521+ Epoxy Resin [Blue]) contains up to 5% TBBPA (Earthjustice, 2019).

Per 2020 CDR, the physical form of the imported TBBPA used in the adhesive manufacturing sector was a liquid with a concentration of 1 to 30% TBBPA (U.S. EPA, 2022a). Although most adhesive formulations contain TBBPA in a concentration of less than 10%, some specialty products may have amounts that exceed 10% (ACA, 2019). Based on product safety data sheets (SDSs), TBBPA is reported as having concentrations between 0.25 to 10% in epoxy adhesives (Cytec Industries, 2015; Henkel, 2014).

EPA developed Figure 3-4 with the typical release and exposure points during the manufacturing of chemical substances in general in adhesives.

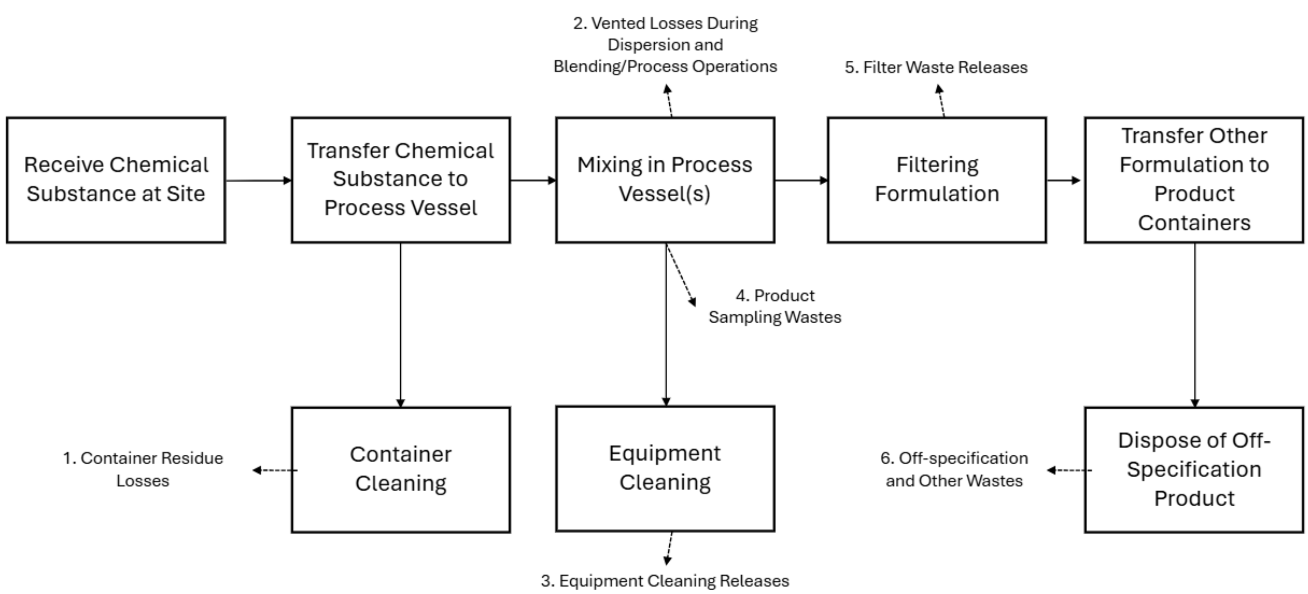


Figure 3-4. Adhesives Manufacturing Flow Diagram

3.7.2 Facility Estimates

In the 2020 CDR, one company reported the downstream industrial use in the adhesive manufacturing sector: Huntsman International LLC (The Woodlands, Texas). The company reported between 10 to 24 industrial sites associated with industrial use in adhesive manufacturing. Production volume from this company was reported as CBI (U.S. EPA, 2022a).

EPA mapped eight TRI facilities to this COU based on site names and their reported NAICS codes. NAICS codes reported by these facilities were either "Adhesive Manufacturing" (NAICS 325520), "All Other Miscellaneous Chemical Product and Preparation Manufacturing" (NAICS 325998), "All Other Basic Organic Chemical Manufacturing" (NAICS 325199), or "Paper Bag and Coated and Treated Paper Manufacturing" (NAICS 322220). For the latter three NAICS, EPA mapped these facilities to this COU based on information on the company websites indicating the production of adhesives. Seven facilities reported using TBBPA as a formulation component, and one facility reported use of TBBPA as an article component (U.S. EPA, 2023b).

EPA did not identify data on facility operating schedules; thus, EPA assumes 300 days per year of operation as discussed in Section 2.2.2.

3.7.3 Water Release Assessment

The names of the TRI sites that EPA associated with Processing: Adhesive manufacturing COU are listed below. Each of these sites reported zero annual water releases for each of the reporting years of 2019 to 2023 (U.S. EPA, 2023b). Therefore, TBBPA is not released to water from the facilities that EPA associated with these COUs.

- 3M CO – SPRINGFIELD
- BOSTIK MANUFACTURING PLANT
- CYTEC ENGINEERED INC
- CYTEC SOLVAY COMPOSITE MATERIALS ANAHEIM
- HENKEL US OPERATIONS CORP (Oak Creek, Wisconsin)
- HENKEL US OPERATIONS CORP (Salisbury, North Carolina)
- LAMART CORP

3.8 Processing: Reactive Flame Retardant in Computer and Electronic Product Manufacturing

3.8.1 Process Description

This COU involves the manufacture of prepreg, laminate, and TBBPA-coated straps for use in electrical and electronic products such as printed circuit boards (PCBs), and the use of TBBPA containing adhesive in the manufacture of electrical or electronic components (U.S. EPA, 2026h). The process of the manufacturing of prepreg is described in Section 3.9. PCBs are fabricated using a variety of laminates, including FR-4, laminates. To make this laminate, the TBBPA-containing epoxy resin is applied to a woven fiberglass mat, then hardened (cured) to form a sheet. Then, layers of copper foil are bonded to both sides of the sheet to form a laminate (U.S. EPA, 2015b; OECD, 2010). TBBPA may not be completely reacted during the production of flame retarded epoxy resin and therefore epoxy resin may contain unreacted TBBPA. This residual content of TBBPA in some epoxy resin products is less than 0.02% by weight. Thus, laminates may contain residual TBBPA. The amount of TBBPA in PCBs was reported to be equal to 700 µg/kg of PBC.

3.8.2 Facility Estimates

According to the 2020 CDR, one reporting site reported that TBBPA is used in downstream operations as incorporated into electrical equipment, appliance, and component manufacturing (U.S. EPA, 2022a).

This site reported the number of downstream sites associated with this use to be between 10 to 24 sites.

EPA mapped four TRI sites to this COU based on the reported NAICS codes. These facilities reported to TRI for either "Semiconductor and Related Device Manufacturing" (NAICS 334413), "Carbon and Graphite Product Manufacturing" (NAICS 335991), "Fabric Coating Mills" (NAICS 313320), or "Other Electronic Component Manufacturing" (NAICS 334419) (U.S. EPA, 2023b). EPA infers that these sites are associated with this COU based on the NAICS codes and information on company websites indicating the products offered

EPA assumed 253 days per year of operation according to the Revised Plastic Converting GS as discussed in Section 2.2.2. (U.S. EPA, 2014b).

3.8.3 Water Release Assessment

The names of the TRI sites that EPA associated with Processing: Flame retardant in computer and electronic product manufacturing COU are listed below. Each of these sites reported zero annual water releases for each of the reporting years of 2019 to 2023 (U.S. EPA, 2023b). Therefore, TBBPA is not released to water for sites mapped to this COU.

- CYTEC SOLVAY COMPOSITE MATERIALS ORANGE
- ISOLA USA CORP
- MITSUBISHI CHEMICAL CARBON FIBER & COMPOSITES I
- PARKER HANNIFIN CORP CHOMERICS DIV

3.9 Processing: Reactive Flame Retardant in Transport Equipment Manufacturing

3.9.1 Process Description

This COU involves the manufacture of prepreg, laminate and adhesive film for use in transportation equipment manufacturing (U.S. EPA, 2026h). Prepeg is a composite material used to impart certain properties in resin applications.

Laminates are systems of woven glass reinforced with epoxy-like resin, notable for their resistance to heat, mechanical shock, solvents, and chemicals (U.S. EPA, 2015b). The first step in laminate material fabrication is the processing of the reinforcement material, which typically is in the form of yarn made from glass, quartz (fused glass), aramid, polyester, or cellulose paper. After processing, yarns are woven together to form a fabric using the weaving loom. (U.S. EPA, 1994). Next, an organic resin is used to bind layers of fabric together into sheets. The resins, predominantly epoxy, polyamide, and polytetrafluorethylene, contain chemical additives to provide desired properties such as opacity, fire resistance, speed curing time, etc. TBBPA is a reactive component added to the epoxy for flame retardancy (U.S. EPA, 1994). The concentration of TBBPA in feed material for the manufacture of prepreg composites and adhesive films is less than 30% by weight (Integral Consulting, 2025a). The prepared resin is combined with the fabric in metered amounts to a desired percentage by weight, depending on the desired mechanical and electrical properties. The concentration of TBBPA in laminates and prepregs before reaction is 0.5 to 14% (U.S. EPA, 2020d; Hexcel, 2015). The combined resin/fabric is partially cured in an oven to a "prepreg condition." A minimum of two fabric layers are necessary to form the prepreg. The prepreg may then be packaged and sent to users or additional buildup of layers may occur to create laminates. Copper foil may then be added to the laminates prior to packaging and shipping to customers (U.S. EPA, 2015b, 1994).

Potential releases of chemical substances in general during prepreg and laminate manufacturing are shown in Figure 3-5 (U.S. EPA, 1994).

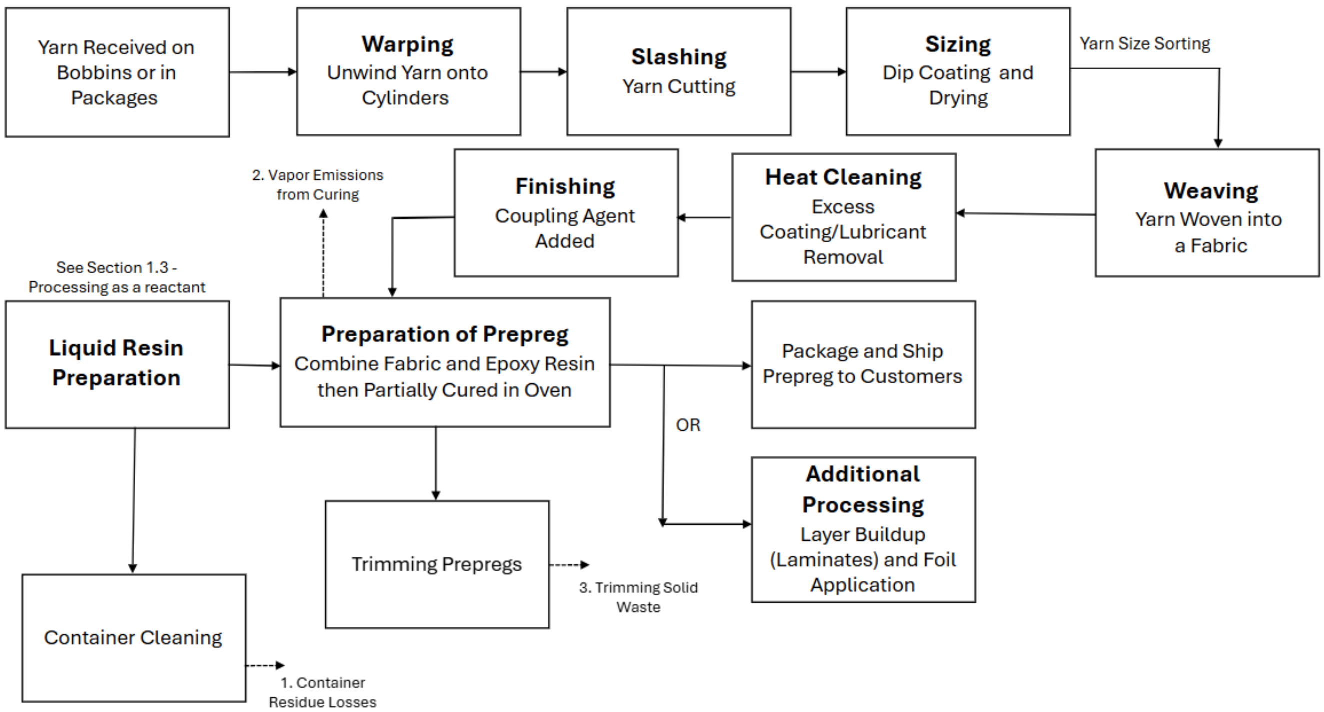


Figure 3-5. Prepreg and Laminate Manufacturing Flow Diagram

TBBPA is reported as having concentrations between 0.25 and 10% in adhesive films (Cytec Industries, 2015; Henkel, 2014). Henkel Corporation manufactures an epoxy film adhesive for use in the aviation industry (LOCTITE EA 9690 Aero) with a TBBPA concentration between 5 and 10%.

3.9.2 Facility Estimates

EPA assessed the number of sites of this COU to be equal to 13 based on TRI data. EPA associated 13 TRI sites with this COU based on the reported NAICS codes. These facilities reported to TRI for either "Aircraft Manufacturing" (NAICS 336411), "Fabric Coating Mills" (NAICS 313320), "Other Aircraft Parts and Auxiliary Equipment Manufacturing" (NAICS 336413), or "Laminated Plastics Plate, Sheet (except Packaging), and Shape Manufacturing" (NAICS 326130) (U.S. EPA, 2023b). The TBBPA 2020 CDR data does not include mention of industry sectors that correspond to these NAICS codes and therefore TBBPA 2020 CDR data about number of sites are not available for this COU.

EPA did not identify data on facility operating schedules; therefore, the Agency assumes 250 days per year of operation as discussed in Section 2.2.2.

3.9.3 Water Release Assessment

The names of the TRI sites that EPA associated with Processing: Flame retardant in transportation equipment manufacturing COU are listed below. Each of these sites reported zero annual water releases for each of the reporting years of 2019 to 2023 (U.S. EPA, 2023b). Therefore, TBBPA is not released to water from facilities that EPA associate with this COU.

- AXIOM MATERIALS
- BOEING CO

- BOEING COMMERCIAL AIRPLANES – EVERETT
- BOEING SOUTH CAROLINA INTERIORS RESPONSIBILITY CENTER SOUTH
- C&D ZODIAC INC
- GENERAL DYNAMICS MISSION SYSTEMS INC.
- HEXCEL CORP
- L3HARRIS TECHNOLOGIES INTEGRATED SYSTEMS L.P.
- NORDAM I&S DIV
- NORTHROP GRUMMAN SYSTEMS CORP. AEROSPACE STRUCTURES BUSINES
- PARK AEROSPACE CORP.
- SIKORSKY AIRCRAFT STRATFORD FACILITY
- TORAY ADVANCED COMPOSITES

3.10 Processing: Additive Flame Retardant in Plastic Products (Plastic Converting)

3.10.1 Process Description

After the compounding process described in Section 3.6.1, TBBPA-containing compounded plastic resins are converted into solid plastic articles. According to the ESD on Plastic Additives, plasticized resin can be converted into final products through many processes, including closed processes such as extrusion, injection molding, compression molding, extrusion blow molding, partially open processes such as film extrusion, and open processes including calendaring, thermoforming, and fiber reinforced plastic fabrication (OECD, 2009b). Vapor (fume) elimination equipment is commonly used during these processes (OECD, 2009b). Per the Plastics Converting GS, TBBPA and other additives are present in plastic pellets, granules, powders, or sheets (U.S. EPA, 2014b) upon arrival to the converting sites.

Based on product SDSs, TBBPA is reported as having concentrations between 10 to 20% in plastic products (FPC, 2024; GPPC, 2023; LG Chem, 2023; U.S. EPA, 2020d; 3DXTECH, 2017). Sources indicate that flame retardants in general are used at concentrations ranging from 3 to 22% of the product (Hahladakis et al., 2018; Pelzl et al., 2018; Van Esch, 1995).

For a general process diagram with typical release points, see Section 3.8.1.

3.10.2 Facility Estimates

EPA assessed the number of sites that are associated with this COU from CDR and TRI data. According to the 2020 CDR, one reporting site reported that TBBPA is used in downstream operations as incorporated into article for plastic product manufacturing (U.S. EPA, 2022a); however, this site reported the number of downstream sites associated with this use to be not known or reasonably ascertainable.

EPA mapped eight TRI sites to this COU based on the reported NAICS codes. These facilities reported to TRI for either “All Other Plastics Product Manufacturing” (NAICS 326199) or “Unlaminated Plastics Film and Sheet (except Packaging) Manufacturing” (NAICS 326113) (U.S. EPA, 2023b).

In conclusion, EPA assessed the number of sites of this COU to be equal to eight sites per TRI; however, EPA notes that the number of sites may be higher due to the unknown number of sites from CDR.

EPA assumed 253 days per year of operation according to the Revised Plastic Converting GS as discussed in Section 2.2.2 (U.S. EPA, 2014b).

3.10.3 Water Release Assessment

The names of the TRI sites that EPA associated with Processing: Flame retardant in plastic COU are listed below. Each of these sites reported zero annual water releases for each of the reporting years of 2019 to 2023 (U.S. EPA, 2023b). Therefore, TBBPA is not released to water from the facilities that EPA associated with this COU.

- 3D PLASTICS INC.
- MACK MOLDING CO
- MISSION PLASTICS NORTH
- PLASTECH CORP
- PSI MOLDED PLASTICS, formerly known as GI PLASTEK
- SMITH & WESSON PRECISION COMPONENTS PLASTICS LLC
- SPARTECH LLC.
- TITUS PRECISION LLC

3.11 Recycling

3.11.1 Process Description

As discussed for other COUs, TBBPA is used in a variety of electronics products, including PCBs, laminates, plastic housings for computer jacks, terminal boards, and as a component in the resin used in refrigerators and other appliances, business machines and telephones (Panduit, 2017; U.S. EPA, 2015a; EC, 2013). This COU captures the recycling of such electronic waste (e-waste).

In 2022, it was estimated that approximately 22% of e-waste generated in the United States was recycled (Baldé et al., 2024). A 2005 study on the release of brominated flame retardants conducted by Morf et al. (2005b) sampled the releases of a wastes from electronics and electronic equipment (WEEE) plant in Switzerland. A combination of manual and automatic processes is used to separate different types of WEEE and extract and recover valuable materials such as gold, silver, platinum, palladium, selenium, and copper that are part of the recycled products.

The recycling process typically begins with three main stages: dismantling, upgrading, and refining (Ashiq et al., 2019). The first stage, dismantling, is labor-intensive and focuses on separating hazardous and valuable components using basic tools such as hammers, screwdrivers, and conveyor beds to categorize materials for recovery. Next, the upgrading stage involves mechanical shredding of the materials through crushers and grinders, followed by electrical and magnetic separation to isolate nonmetallic components. Finally, in the refining stage, various metallurgical processes—hydrometallurgical, pyrometallurgical, electrometallurgical, biometallurgical, or a combination of these techniques—are applied to the recovered metals to further purify and enhance the materials (Ashiq et al., 2019).

EPA developed Figure 3-6 to provide an illustration of the general WEEE recycling process and potential release points. This diagram is based on information from Morf et al. (2005b).

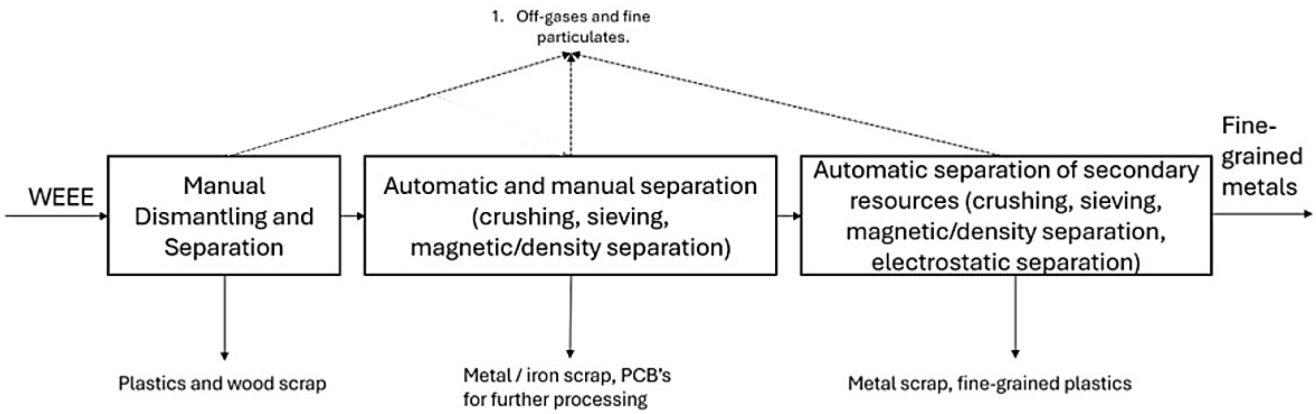


Figure 3-6. Example WEEE Recycling Flow Diagram

3.11.2 Facility Estimates

EPA based the estimate for number of sites on the number of certified e-waste recycling facilities in the United States. This value was 841 in 2025 (e-Stewards, 2026; Sustainable Electronics, 2026). However, not all recycling facilities are certified. In 2026, there were 19 non-certified sites (Sustainable Electronics, 2026). Therefore, EPA estimates a total of 860 sites. This is the same assessment approach that EPA used in the cyclic aliphatic bromide cluster (HBCD) risk evaluation (U.S. EPA, 2019b).

In conclusion, EPA assessed the number of sites of this COU to be equal to 860 sites based on the information above.

Due to the large volume of e-waste recycled per year, EPA assumed that an e-waste recycling facility is operated continuously with 2 weeks of annual downtime for maintenance, for a total of 350 days per year. This assumption is consistent with EPA's Draft GS for Electric Vehicle (EV) Battery Manufacturing and Recycling (U.S. EPA, 2026l).

3.11.3 Release Assessment

As discussed in detail in Appendix A, EPA estimated the releases that result from this COU by calculating the daily TBBPA release rate to air or land as the product of the following three quantities: (1) a WEEE daily site throughput, (2) the concentration of TBBPA in WEEE, and (3) the sum of three TBBPA emission factors and emission factors. EPA calculated the central tendency and high-end values of WEEE site throughput as, respectively, the average value in the United States and the capacity of the state-of-the-art facility in Switzerland; the later value is more than an order of magnitude greater than the earlier value. The concentration of the three TBBPA emission factors equal the ratios of the mass of TBBPA in (1) bag filters that contain airborne dust that is collected; (2) the air emitted from bag filters; and (3) the plastic fines process stream, respectively, to the mass of TBBPA in the WEEE feed to the recycling facility. The values of these emission factors were obtained by measurement at a state-of-the-art WEEE recycling facility in Switzerland. EPA included the first and third emission factors in the calculation because EPA assumed the lack of collection of dust and plastic fines.

The results of EPA's calculation of the TBBPA daily release rate are as follows:

- 0.19 to 0.54 kg/day-site (central tendency estimate); and
- 5.1 to 14.7 kg/day-site (high-end estimate).

Based on the information in Section 3.11.1, EPA does not expect releases to water during activities under this COU. EPA is uncertain of the media of release and hence assesses these rates as rates of releases to air or to landfill or to incineration or to some combination of these methods of release, disposal, or treatment methods. EPA assumed a lack of collection of dust and plastic fines. Although this assumption is reasonable in the case of a facility with a capacity equal to the central tendency value, it is a conservative assumption in the case of a facility with a high-end WEEE recycling capacity because this capacity is the capacity of an actual state-of-the-art facility that includes pollution controls. Therefore, the high-end estimate of releases is a screening-level estimate.

3.12 Reactive and Additive Use in Electrical and Electronic Articles

This section contains information about the two COUs that are abbreviated as Reactive use in electrical and electronic articles and Additive use in electrical and electronic articles, respectively. The COU of Reactive use in electrical and electronic articles involves the use of articles (*e.g.,* prepreg and laminate) for the manufacture of electrical and electronic products such as PCBs, and the abbreviated COU of Additive use in electrical and electronic products involves the use of TBBPA-containing articles (*e.g.,* TBBPA-containing plastic enclosures) to produce other article or final products (U.S. EPA, 2026h).

3.12.1 Process Description

With regard to the COU of reactive industrial use, PCBs are made using laminates, including FR-4 laminates, which are made from resin which may contain residual TBBPA. Laminates are the base on which circuits are etched, and micro-components are fixed to produce PCBs (OECD, 2010; LaDou, 2006). To manufacture PCBs, excess copper is first removed using various methods such as PCB milling, photoengraving, and silk screen printing (U.S. EPA, 2015b). Next, several conductive and insulating dielectric layers are bonded into a single board structure using heat and pressure. Holes are drilled and then plated with copper to provide the conductive circuit between layers (U.S. EPA, 2015b; LaDou, 2006). Outer PCB surfaces may then be coated with a protective resin, and then writing is added via silk screening. Following coating and silk screen printing, components can be mechanically fixed to the board with molten metal solder (through-hole construction) or soldered to pads on the outer surfaces of the PCB (surface mount construction) (U.S. EPA, 2015b; OECD, 2010).

EPA developed the flow diagram in Figure 3-7 showing typical potential release and exposure points for PCB manufacturing from the final report of "Flame Retardants in Printed Circuit Boards" (U.S. EPA, 2015b).

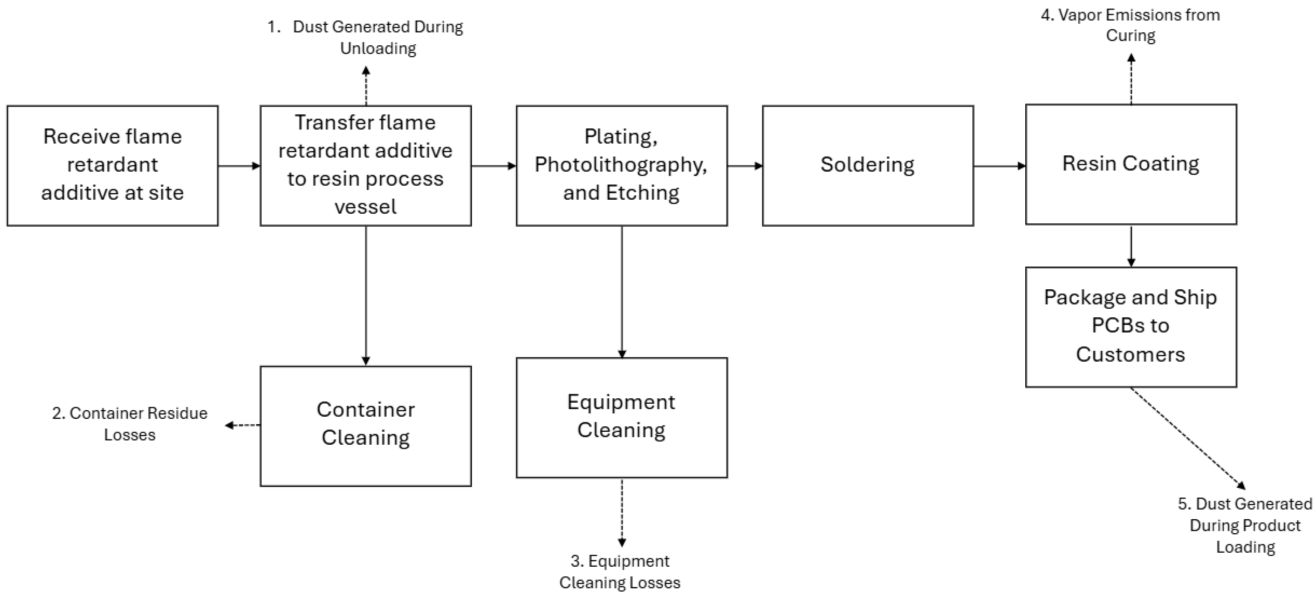


Figure 3-7. PCB Manufacturing Flow Diagram

Zhou et al. (2014) reported releases of TBBPA to the environment that result from the manufacture of PCBs at a site in China. The concentration of TBBPA in waste streams was measured and TBBPA emission factors were reported. This was done across multiple PCB production stages, including raw material storage, lamination cutting, imaging, inner and outer layer etching, drilling, plating, solder leveling, profiling, final inspection, packing, and shipping. Data were collected for multiple waste streams. The estimated emission factors associated with solid waste ranged from 115 to 1,220 µg TBBPA/kg PCBs, with the highest contributions from cut lamination and milling processes. Releases via liquid waste ranged from 5.46 to 41.0 µg TBBPA/kg PCBs, primarily originating from general rinse liquid waste releases. Aggregated solid releases are 3,103 µg TBBPA/kg PCBs and water releases are 83.87 µg TBBPA/kg PCBs (WWTP influent) and 5.46 µg TBBPA/kg PCBs (WWTP effluent).

The amount of TBBPA in the finished PCB will vary depending on the amount of epoxy resin used and the concentration of TBBPA in the resin. One source indicated that unreacted TBBPA is less than 0.02% by weight of the resin or 0.06% of the amount of TBBPA incorporated into the resin, is always present in PCB products (Zhou et al., 2014). The results from another sampling study estimated approximately 0.7 nanograms of TBBPA per gram of circuit board (Sellstrom and Jansson, 1995).

TBBPA is used additively in various resins, and plastics as discussed in previous sections; these various materials and products are subsequently used to make various types of electronic products (U.S. EPA, 2015b). Concentrations of TBBPA in electronic products such as electronics wiring and computer network components range from less than 0.5 to 20% based on product SDSs (U.S. EPA, 2020d; Panduit, 2017).

This COU involves components containing TBBPA that are assembled to build electronic products. EPA assumes that the use of such components may include assembly without any manipulation of the part, or it may include melting, drilling, cutting, grinding, or otherwise shaping the parts containing TBBPA in order to form/assemble other products.

Table 3-7 describes the expected fabrication and use activities that may potentially generate releases. The extent to which these activities are performed is unknown, as sites may just assemble parts without requiring any cutting, griding, or other manipulation.

Table 3-7. Release Activities for Use of Electrical and Electronic Articles Containing TBBPA

Release Point	Release Behavior	Release Media
Cutting, grinding, shaping, drilling, abrading, and similar activities	Dust generation	Fugitive or stack air, water, incineration, or landfill
Heating/plastic welding activities	Vapor generation	Fugitive or stack air

EPA developed Figure 3-8 with the general process for use in electrical and electronic articles. Due to lack of information, EPA is unable to determine more granular operations or release points for this COU. As this COU is in-scope with regard to TRI reporting, the lack of identified TRI data is an indication of lack of releases.

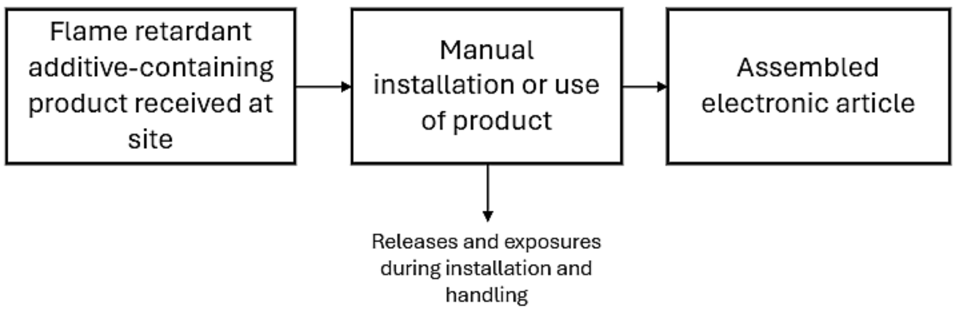


Figure 3-8. Use in Electrical and Electronic Articles Flow Diagram

3.12.2 Facility Estimates

EPA assessed the number of sites of the COU of this section from TRI data. EPA mapped three TRI sites to this COU based on the reported NAICS codes. These facilities reported to TRI for either "Other Communication and Energy Wire Manufacturing" (NAICS 335929) or "All Other Miscellaneous Electrical Equipment and Component Manufacturing" (NAICS 335999) (U.S. EPA, 2023b). EPA infers that these sites use articles for the manufacture of electronic products based on the NAICS codes and information on company websites indicating the products offered.

In conclusion, EPA assessed the number of sites of this COU to be equal to three sites per TRI. EPA did not identify data on facility operating schedules; thus, EPA assumes 250 days per year of operation as discussed in Section 2.2.2.

3.12.3 Water Release Assessment

The names of the TRI sites that EPA associated with Reactive and Additive Use in Electrical and Electronic Articles COU are listed below. Each of these sites reported zero annual water releases for each of the reporting years of 2019 to 2023 (U.S. EPA, 2023b). Therefore, TBBPA is not released to water for sites mapped to this COU.

- ALPHA WIRE CO
- HUBBELL CARIBE LTD
- WOODSTREAM CORP

3.13 Reactive Use in Automotive and Aviation

3.13.1 Process Description

This COU involves the use of laminate, prepreg composite and solid adhesive film for the manufacture of transportation equipment (U.S. EPA, 2026h). TBBPA is used in products including structural film adhesives, epoxy pre-impregnated fiberglass, and graphite tapes and woven fabrics (AIA, 2019) that are feed material of sites that are associated with this COU. Prepreg that contains TBBPA is wrapped or molded to form composite parts for the aerospace industry. Specifically, feed materials are first formed, heated and cured and then cooled and formed or cut into final products. (Integral Consulting, 2025a). Henkel Corporation manufactures a casting compound for aviation use (Loctite Stycast EE 1067) with a TBBPA concentration of 1 to 5% (Henkel, 2018; Henkel Corporation, 2014).

3.13.2 Facility Estimates

EPA assessed the number of sites of this COU to be equal to nine based on TRI data; 2020 CDR data are not available for this COU. EPA associated nine TRI sites to this COU. These facilities reported to TRI for either "Aircraft Manufacturing" (NAICS 336411), "Automobile Manufacturing" (NAICS 336111), "Automobile and Light Duty Motor Vehicle Manufacturing" (NAICS 336110), "Other Aircraft Parts and Auxiliary Equipment Manufacturing" (NAICS 336413), or "National Security" (NAICS 928110) (U.S. EPA, 2023b).

EPA did not identify data on facility operating schedules; therefore, the Agency assumes 250 days per year of operation as discussed in Section 2.2.2.

3.13.3 Water Release Assessment

The names of the TRI sites that EPA associated with Processing: Flame Retardant in Plastic COU are listed below. Each of these sites reported zero annual water releases for each of the reporting years of 2019 to 2023 (U.S. EPA, 2023b). Therefore, TBBPA is not released to water from the facilities that EPA associated with this COU.

- DASSAULT FALCON JET CORP.
- FCA US STERLING HEIGHTS ASSEMBLY PLANT
- NORDAM REPAIR DIV
- SAFRAN CABIN BELLINGHAM INC
- SAFRAN CABIN MATERIALS LLC
- THE BOEING CO DEFENSE SPACE & SECURITY ROTORCRAFT PR
- U.S. DOD USAF HILL AFB
- U.S. DOD USAF TINKER AFB
- U.S. NAVY NAVAL AIR STATION CORPUS CHRISTI

3.14 Use in Building and Construction Materials

3.14.1 Process Description

TBBPA is commonly used in the manufacture of building and construction materials, like fiberglass composites, pipelines, storage tanks, and decorative laminates used in interiors of public buildings, such as elevator linings, hospital furniture, doors, partitions, public corridors, and hallways according to the Australian Industrial Chemicals Introduction Scheme (NICNAS, 2020). Environment Canada states that TBBPA is used as a flame retardant in epoxy resins for glass-reinforced construction panels, in ABS resins for pipes, fittings, refrigerators, and other appliances, and in the building industry as an as both a reactive and additive flame retardant in expanded polystyrene foam (EC, 2013).

High impact polystyrene contains approximately 12% TBBPA but whether TBBPA is used additively or reactively is not reported (Pelzl et al., 2018). Epoxy resins, which employ reactive flame retardants like TBBPA, contain a minimum of 20% bromine content (Pelzl et al., 2018). Recommended levels of TBBPA in ABS are 17.6 to 22% in medium-high impact polystyrene and 14% in high impact polystyrene (ECB, 2006).

EPA developed Figure 3-9 with the general process for the use of building and construction materials. Due to lack of information, EPA is unable to determine more granular operations, release points, and exposure points for this COU.

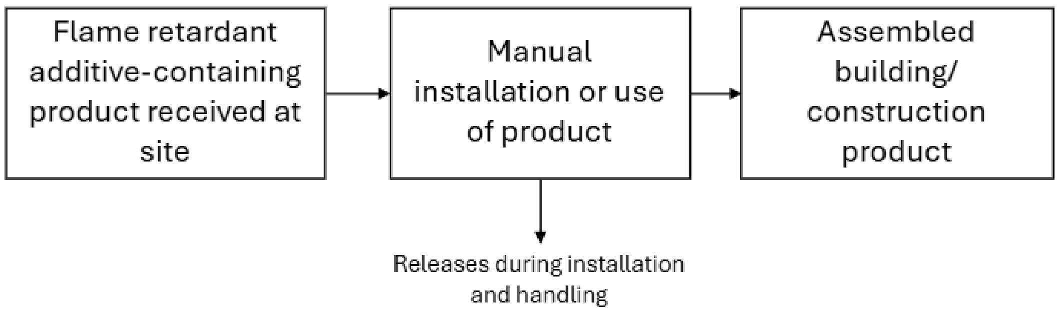


Figure 3-9. Use in Building and Construction Materials Flow Diagram

3.14.2 Facility Estimates

EPA assessed the number of sites that are associated with this COU from TRI data. No 2020 CDR data were available for this COU. EPA mapped one TRI site to this COU. The facility reported to TRI for "Other Concrete Product Manufacturing" (NAICS 327390). The facility reported using TBBPA as an article component (U.S. EPA, 2023b).

In conclusion, EPA assessed the number of sites of this COU to be equal to one site per TRI. EPA did not identify data on facility operating schedules; therefore, the Agency assumes 250 days per year of operation as discussed in Section 2.2.2.

3.14.3 Water Release Assessment

The name of the TRI site that EPA associated with Processing: Flame retardant in plastic COU is OLDCASTLE INFRASTRUCTURES INC – NAPOLEON. This site reported zero annual water releases for each of the reporting years of 2019 to 2023 (U.S. EPA, 2023b). Therefore, TBBPA is not released to water from the facility that EPA associated with this COU.

3.15 Industrial Use in Powder Coatings

3.15.1 Process Description

Powder coatings containing TBBPA as a flame retardant are used in electronic products. In 2020 CDR, TRI-ISO Tryline, LLC (Cardiff by the Sea, California) reported "processing – incorporation into formulation, mixture, or reaction product" of TBBPA in the sector of "paint and coating manufacturing" (U.S. EPA, 2022a). TRI-ISO Tryline, LLC reported use of TBBPA as a flame retardant in the dry powder form with a maximum concentration of over 90 with a commercial product category of "powder coatings," where TBBPA was documented as a dry powder flame retardant (U.S. EPA, 2022a).

However, EPA does not have any details on the specific application method of these powder coatings.

According to a public comment from EarthJustice, SolEpoxy, Inc., a large producer of epoxy powder coatings for the electronics industry, produces a product (SolEpoxyTM DK18-05 BLUE) that contains 5 to 10% TBBPA by weight.

EPA expects potential releases from container residues, equipment cleaning, and unloading of TBBPA-containing coating products from transport containers. Due to lack of information, EPA is unable to determine more granular operations or release points for this COU, including media of release. As this COU is in-scope with regard to TRI reporting, the lack of identified TRI data is an indication of lack of releases.

3.15.2 Facility Estimates

As discussed in the previous section, one site in 2020 CDR reported a commercial product category of "powder coatings" (U.S. EPA, 2022a). Additionally, a public comment from EarthJustice identified one large producer of epoxy powder coatings for the electronics industry produces products that contain TBBPA (Earthjustice, 2019). EPA did not identify any information on the number of sites where these powder coatings may be used. Due to a lack of readily available information for this COU, the number of industrial or commercial use sites is unquantifiable and unknown

EPA did not identify data on facility operating schedules; therefore, the Agency assumes 250 days per year of operation as discussed in Section 2.2.2.

3.15.3 Water Release Assessment

EPA did not quantitatively assess releases from the use of TBBPA in powder coatings. EPA identified various powder coating products, all of which state they are for use in electronics, and not for commercial use in coating infrastructure (3M, 2023, 2019). As the only powder coatings identified are incorporated into electronics, these water releases would already be encompassed by the COUs "Processing: Flame retardant in computer and electronic product manufacturing" and "Use in electrical and electronic articles." Therefore, EPA did not separately assess water releases for this COU.

3.16 Use in Plastic and Rubber Products

3.16.1 Process Description

TBBPA is incorporated into polymers either as a reactive or additive flame retardant, primarily in epoxy and polycarbonate resins and, to a lesser extent, in ABS and phenolic resins (EC, 2013). Flame-retarded polycarbonate resins are used in a range of applications, including communications and electronic equipment, household appliances, transportation components, sporting and recreational goods, lighting fixtures, and signage, and ABS resins containing TBBPA are used in automotive parts, pipes and fittings, refrigerators, business machines, and telephones (GPPC, 2023).

The processes for producing these resins and subsequent plastic products are covered under other COUs, including Processing: Additive flame retardant in plastic, resin, and paints and coating manufacturing and Processing: Flame retardant in plastic products. Similarly, the use of plastic products for specific applications like PCBs, aviation and automotive assembly, and building and construction materials, are also covered under other COUs (Processing: Flame retardant in computer and electronic product manufacturing and Processing: Flame retardant in transportation equipment manufacturing). Thus, this COU only captures the use of already produced plastic and rubber components for applications like assembling and light fixtures with plastic parts.

Use of such plastic and rubber articles may include assembly without any manipulation of the part, or it may include melting, drilling, cutting, grinding, or otherwise shaping the parts containing TBBPA in order to form/assemble other products.

EPA identified that TBBPA is contained in plastic materials at concentrations between 10 to 50% (LANXESS, 2024; 3DXTECH, 2017). EPA did not identify other data on current use sites for the U.S. from systematic review.

Table 3-8 describes the expected installation and use activities that may potentially generate releases. The extent to which these activities are performed is unknown, as sites may just assemble parts without requiring any cutting, griding, or other manipulation.

Table 3-8. Release Activities for Use of Building and Construction Materials Containing TBBPA

Release Point	Release Behavior	Release Media
Cutting, grinding, shaping, drilling, abrading, and similar activities	Dust generation	Fugitive or stack air, water, incineration, or landfill
Heating/plastic welding activities	Vapor generation	Fugitive or stack air

EPA developed Figure 3-10 with the general process for use in plastic and rubber products. Due to lack of information, EPA is unable to determine more granular operations, release points, and exposure points for this COU. As this COU is in-scope with regard to TRI reporting, the lack of identified TRI data is an indication of lack of releases.

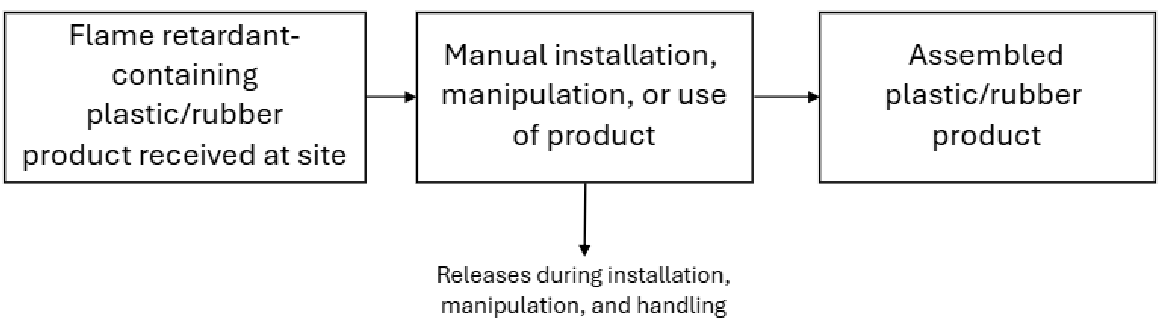


Figure 3-10. Use in Plastic and Rubber Products Flow Diagram

3.16.2 Facility Estimates

EPA did not identify representative site- or chemical-specific operating data for this COU (*i.e.,* facility throughput, number of sites, total production volume, operating days, product concentration), as TBBPA-containing article use occurs at many disparate industrial and commercial sites, with different operating conditions. Due to a lack of readily available information for this COU, the number of industrial or commercial use sites is unquantifiable and unknown. EPA assumed the number of operating days was 250 days per year with 5 days per week operations and 2 full weeks of downtime per operating year.

3.16.3 Water Release Assessment

As stated in Section 3.16.1, this COU captures the use of plastic and rubber products not covered by other COU in this assessment, such as assembling and manipulating light fixtures, signage, pipes and fittings, business machines, or refrigerators that contain TBBPA. EPA did not find water release data for this COU in TRI or during systematic review, so the Agency did not quantitatively assess environmental releases for this COU due to the lack of process-specific and TBBPA-specific data. However, consistent with previous chemical risk evaluations such as dibutyl phthalate (DBP) (U.S. EPA, 2025a), diisodecyl phthalate (DIDP) (U.S. EPA, 2024) and diisononyl phthalate (DINP) (U.S. EPA, 2025c), EPA expects releases from this COU to be small and disperse in comparison to other upstream COUs. EPA also expects TBBPA to predominantly remain in the final article, limiting the potential for release.

3.17 Laboratory Chemical Use

3.17.1 Process Description

TBBPA is used in laboratories as a reference material (ACC, 2020) or laboratory chemical (Sigma-Aldrich Inc, 2019). Based on the Use of Laboratory Chemicals GS (U.S. EPA, 2023a), EPA expects transfer of TBBPA to labware and lab equipment for analyses and, after analysis, the cleaning of containers, labware, and lab equipment and the disposal of laboratory waste containing unreacted TBBPA. Sources of potential releases of laboratory chemicals in general are shown in Figure 3-11 (U.S. EPA, 2023a).

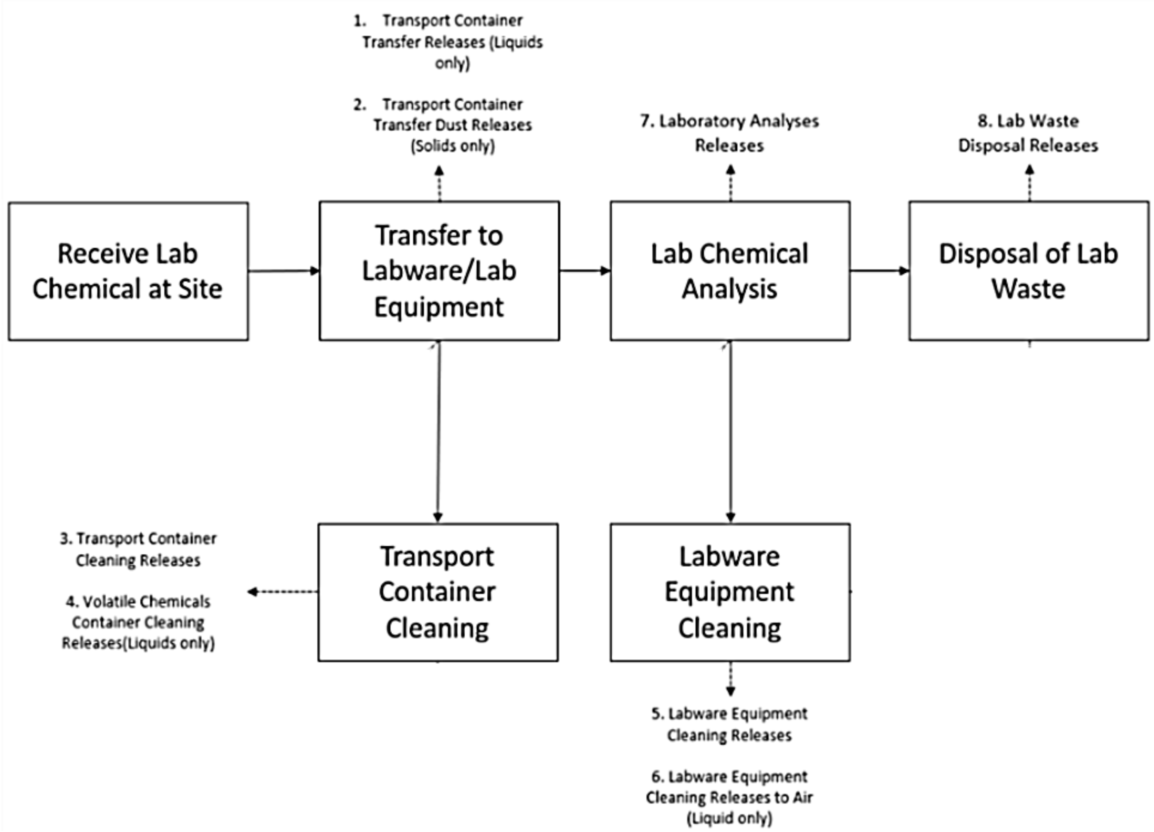


Figure 3-11. Laboratory Chemicals Use Flow Diagram

Environmental Releases:

1. Release of vapor to air caused by the transfer of volatile chemicals from transport containers.
2. Release of dust to air, water, incineration, or landfill caused by the transfer of powders from transport containers.
3. Release of liquid or solids to water, incineration, or land from cleaning of transport containers.
4. Release of vapor to air from cleaning containers that contained volatile chemicals.
5. Release of liquid or solids to water, incineration, or landfill caused by the cleaning of labware following use of chemicals.
6. Release of vapor to air caused by the cleaning of labware equipment that contained volatile chemicals.
7. Release of vapor to air caused by the use of volatile chemicals.
8. Release of liquids or solids to water, incineration, or landfill caused by the disposal of excess material.

Laboratory chemicals in general that are solids may be used in laboratories in quantities of 0.003 to 510 g per day (U.S. EPA, 2023a). TBBPA is likely used in laboratories as a neat dry powder (U.S. EPA, 2023a; Sigma-Aldrich Inc, 2019). Package sizes for TBBPA products marketed for laboratory use are 100 mg, 250 mg, 1 g, 25 g, 100 g, 500 g, and 1 mL of a 50 µg/mL solution of TBBPA in methanol (Avantor, 2026; Sigma-Aldrich, 2026; TCI America, 2026). Based on these package volumes, EPA assumed the daily use rate of TBBPA does not exceed 1 g because the largest available packages are likely intended as a supply that suffices for use during periods exceeding a single day. Also, TBBPA is a specialty industrial chemical and therefore the Agency expects it to be used in laboratories for relatively few purposes.

3.17.2 Facility Estimates

This COU was not reported by any manufacturer or importer in the 2020 CDR (U.S. EPA, 2022a), and EPA did not associate any TRI site to this COU taking into consideration the TRI data for the reporting years 2019 to 2023 (U.S. EPA, 2023b). There are an estimated 40,639 laboratories per U.S. Census data (U.S. EPA, 2023a), but EPA lacks data on how many of these sites utilize TBBPA. EPA assumes between 174 and 260 (default) days of operation according to the Use of Laboratory Chemicals GS.

3.17.3 Release Estimates

According to Figure 3-11, the use of TBBPA as a laboratory chemical may result in releases of TBBPA to air, water, incineration or landfill. EPA assessed TBBPA releases to air, incineration or landfill to be equal to the TBBPA use rate or 0.001 kg/site-day. This is a screening-level assessment because EPA assessed the rate of daily TBBPA release per site to any medium other than water to be equal to the maximal release rate. With regard to releases to water, TBBPA releases result from fugitive emissions caused by the transfer of TBBPA powder from transport containers, and cleaning of transport containers and labware equipment; EPA assessed releases from these three sources in accordance with the Use of Laboratory Chemicals GS (U.S. EPA, 2023a). According to Figure 3-11, disposal of spent laboratory chemical (release #8) could lead to water releases only if the laboratory chemical is water soluble (U.S. EPA, 2023a). Because TBBPA has a low water solubility (4.15 mg/L at pH 7.56 and 25 °C (U.S. EPA, 2026g)), EPA did not assess water releases from Release #8. However, other water releases (Release points #2, #3, and #5 in Figure 3-11) were evaluated. Model equations and parameter values for EPA's assessment of TBBPA releases to water are given in the supplemental file, the *Draft Use of Laboratory Chemicals OES Environmental Release Modeling Results for 4,4'-(1-Methylethylidene)bis[2,6-dibromophenol] (TBBPA)* (U.S. EPA, 2026j).

In conclusion, EPA's release estimates are as follows:

- release of TBBPA to fugitive air, stack air, incineration or landfill: 0.001 kg/site-day; and
- release of TBBPA to onsite wastewater treatment or directly to surface water or to POTW (with or without on-site pretreatment): 2.5×10^{-5} kg/site-day.

The above releases occur 174 to 260 days per year and the number of sites is unknown.

3.18 Disposal

3.18.1 Process Description

Each COU of TBBPA that may generate waste streams of the chemical that are collected and transported to third-party sites for disposal. TRI data lists off-site transfers of TBBPA to land disposal, wastewater treatment, incineration, and recycling facilities (U.S. EPA, 2023b). Approximately 7.3% of off-site transfers were incinerated, 62.3% sent to land disposal, 26.5% sent to off-site energy recovery facilities, 3.8% was recycled off-site, less than 0.1% sent to POTW, and less than 0.1% was sent to other or unknown off-site disposal/treatment.

Disposal processes for articles containing TBBPA have the potential to release polybrominated dibenzofurans and dibenzo-*p*-dioxins into the environment. A large proportion of waste containing TBBPA ends up in landfills, and some is incinerated (ECB, 2006). TBBPA is primarily disposed of in offsite landfills that are RCRA Subtitle C hazardous waste landfills and other non-hazardous waste landfills that may be regulated under other federal, state, and local programs (U.S. EPA, 2015c).

Municipal Waste Incineration

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

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

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

Hazardous Waste Incineration

Commercial scale hazardous waste incinerators are generally two-chamber units, a rotary kiln followed by an afterburner, that accept both solid and liquid waste. Liquid wastes are pumped through pipes and are fed to the unit through nozzles that atomize the liquid for optimal combustion. Solids may be fed to the kiln as loose solids gravity fed to a hopper, or in drums or containers using a conveyor.[1] [2]

Incoming hazardous waste is usually received by truck or rail, and an inspection is required for all waste received. Receiving areas for liquid waste generally consist of a docking area, pumphouse, and some kind of storage facilities. For solids, conveyor devices are typically used to transport incoming waste. Smaller scale units that burn municipal solid waste or hazardous waste (such as infectious and hazardous waste incinerators at hospitals) may require more direct handling of the materials by facility personnel. Units that are batch-loaded require the waste to be placed on the grate prior to operation and may involve manually dumping waste from a container or shoveling waste from a container onto the grate. See Figure 3-12 for a typical incineration process.

[1] https://etc.org/advanced-technologies/high-temperature-incineration/ (accessed October 21, 2025)

[2] https://www.heritage-enviro.com/services/incineration (accessed October 21, 2025)

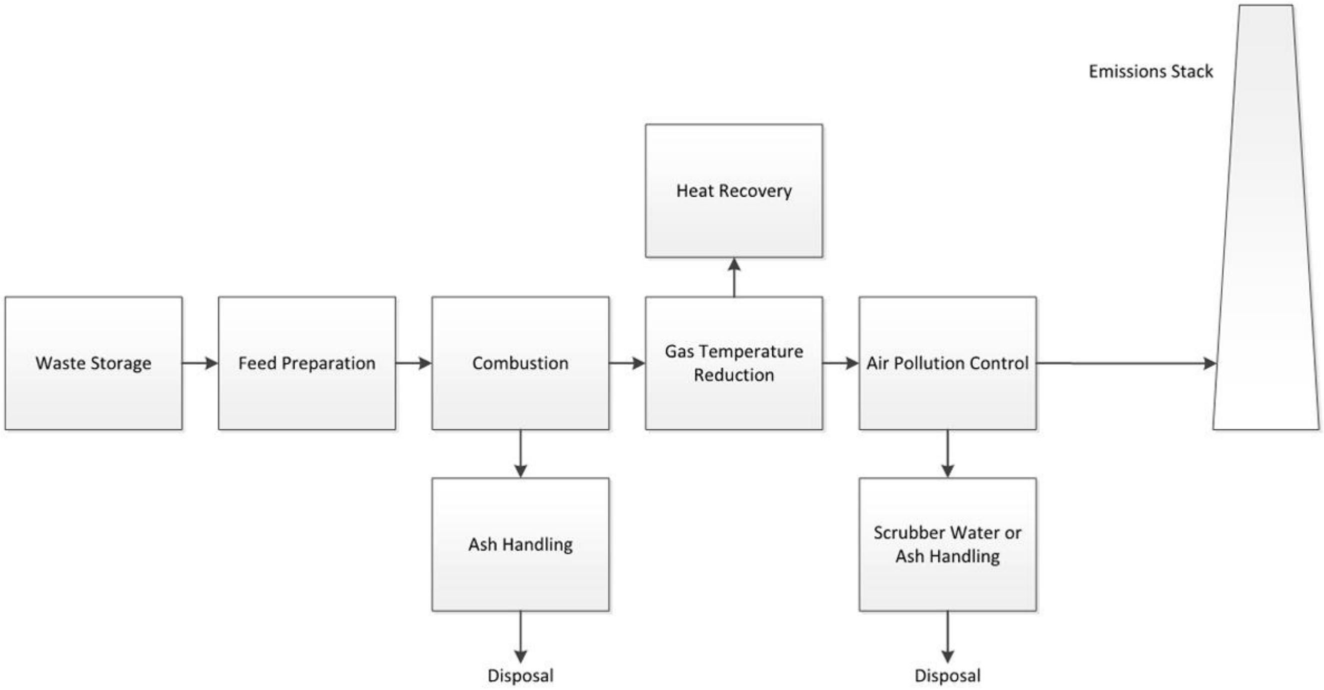


Figure 3-12. Typical Industrial Incineration Process

Municipal Waste Landfill

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

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

Hazardous Waste Landfill

Hazardous waste landfills are excavated or engineered sites specifically designed for the final disposal of non-liquid hazardous wastes. Design standards for these landfills require double liner, double leachate collection and removal systems, leak detection system, run on, runoff and wind dispersal controls, and construction quality assurance program.[3] There are also requirements for closure and post-closure, such as the addition of a final cover over the landfill and continued monitoring and maintenance. These standards and requirements prevent potential contamination of groundwater and nearby surface water resources. Hazardous waste landfills are regulated under 40 CFR part 264/265, Subpart N.

3.18.2 Facility Estimates

EPA assessed the number of sites that are associated with this COU from TRI data. EPA mapped 11 TRI sites to this COU. These facilities in TRI were identified as possibly disposing TBBPA based on site names and their reported NAICS codes. NAICS codes of the facilities mapped to this COU include "Hazardous Waste Treatment and Disposal" (NAICS 562211) and "All Other Miscellaneous Chemical

[3] https://www.epa.gov/hwpermitting/hazardous-waste-management-facilities-and-units (accessed October 21, 2025)

Product and Preparation Manufacturing" (NAICS 325998).

In conclusion, EPA assessed the number of sites of this COU to be equal to 11 sites per TRI. EPA did not identify data on facility operating schedules; thus, EPA assumes 250 days per year of operation as discussed in Section 2.2.2.

3.18.3 Water Release Assessment

The names of the TRI sites that EPA associated with TBBPA Disposal COU are listed below. Each of these sites reported zero annual water releases for each of the reporting years of 2019 to 2023 (U.S. EPA, 2023b). Therefore, TBBPA is not released to water at the mapped facilities.

- 3M CHEMICAL OPERATIONS' COTTAGE GROVE FACILITY
- CLEAN HARBORS ARAGONITE LLC
- CLEAN HARBORS DEER PARK LLC
- CLEAN HARBORS EL DORADO LLC
- CLEAN HARBORS ENVIRONMENTAL SERVICES INC
- EQ DETROIT INC
- ROSS INCINERATION SERVICES INC
- TRADEBE TREATMENT & RECYCLING LLC
- U.S. ECOLOGY IDAHO INC
- U.S. ECOLOGY NEVADA INC
- U.S. ECOLOGY TEXAS INC

4 WEIGHT OF SCIENTIFIC EVIDENCE CONCLUSIONS FOR RELEASE ASSESSMENT

EPA determined the weight of scientific evidence in accordance with the 2021 Draft Systematic Review Protocol (U.S. EPA, 2021a). Judgment on the weight of scientific evidence is based on the strengths, limitations, and uncertainties associated with the exposure estimates. The Agency considers factors that increase or decrease the strength of the evidence supporting the exposure estimate. Factors that increase or decrease the strength of evidence are given in Table 7-6 of the 2021 Draft Systematic Review Protocol (U.S. EPA, 2021a) and Table 7-7 of that document provides examples of judgements. The best professional judgment about the weight of scientific evidence is summarized using the descriptors of robust, moderate, slight, or indeterminate (U.S. EPA, 2021a).

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

EPA estimated environmental releases of TBBPA that result from 15 COUs based on TBBPA TRI data; the following discussion is pertinent in the case of these estimates.

Strengths

The data quality rating of the TRI release data to air, land, and water is high according to EPA's systematic review. The reason for this data quality rating is that TRI annual release rates of chemicals in general are chemical-specific and site-specific. Apart from this, the TRI reporting threshold in terms of amounts manufactured, processed or otherwise used is 100 lb or approximately 45 kg in the case of TBBPA specifically because TBBPA is designated as PBT in TRI (U.S. EPA, 2023b). Also, all of the TRI data of this release assessment are TRI Form R data. Finally, approximately 62% of the TBBPA annual releases were determined by mass balance, continuous or periodic monitoring, or published or on-site emission factors (U.S. EPA, 2023b). EPA estimated TBBPA daily release rates from TRI TBBPA annual release rates.

Limitations

TRI data about chemical substances in general may not include data about all pertinent sites because of the various TRI reporting criteria, which include criteria related to NAICS codes, chemical substance throughput, or number of employees. The TRI TBBPA reporting threshold of 100 lb, which is mentioned under strengths, may preclude non-reporting by sites as a result of the TRI reporting criteria related to chemical substance throughput and number of employees. EPA compared the numbers TBBPA manufacturing, processing or use sites that are reported in TRI and CDR as shown in Table 4-1. These numbers are mostly comparable given uncertainty in the number of sites reported in CDR. The exception is the case of the COU of Processing – Incorporation into formulation, mixture of reaction product – Flame retardant in: Plastic material and resin manufacturing; Plastics product manufacturing; Custom compounding of purchased resins; Paint and coating manufacturing. In this case, the range of CDR sites is 83 to 297 while the number of sites that EPA associated with this COU is only 16. The reason may be that the number of CDR sites includes downstream sites and not just the sites associated with the particular COU given that in principle the reported number of CDR sites includes pertinent sites of the entire supply chain and not just the sites to which the CDR reporter provides products to. This is supported by the fact that the total number of TRI sites, which is 86, is comparable to the lower end of the range of the totals of CDR sites, which is 106 to 372. Alternatively, the reason for this discrepancy may be that small quantities of TBBPA that are less than the threshold related to throughput are occasionally processed at some facilities (*e.g.,* custom compounders of purchased resin).

Assumptions

EPA estimated a TBBPA daily water release rate as the ratio of a TBBPA TRI annual water release rate and a number of release days. EPA assumed that the number of facility operating days is equal to the number of release days. The Agency has developed generic estimates of operating days for each COU, as described in Section 2.2.2 and equated the number of TBBPA water release days to these values.

Uncertainties

The following factors result in uncertainty in the assessment results: (a) uncertainty about the number of days of release to water, (b) the uncertainty about the accuracy of the TRI releases to water in the case of the release data that is associated with "other" as the basis of estimate, and (c) uncertain association (mapping) of TRI sites with COUs. With regard to factor (a), With regard to factor (a), EPA calculated a site's rate of daily release of TBBPA to water from a number of release days that may be less than the actual number of days of release as discussed in Section 2.2.2. Therefore, the assessed release rates may be less than actual release rates. With regard to factor (b), approximately 54% of reported releases to water were determined by a method other than monitoring, mass balance and emission factors. Therefore, there is uncertainty about the quality of 54% of the reported annual releases. Releases to water were mostly reported to TRI as zero release as shown in Table 4-1. TBBPA releases to water from processing are reported in the literature (VECAP, 2012, 2010; ECB, 2008). Also, a TRI report of zero release to a given environmental medium may mean that release to the medium is possible but has been prevented by, for example, the release of the waste stream to another medium. For example, an aqueous waste containing TBBPA was disposed in a Class V injection well (Albemarle, 2015). In conclusion, there is uncertainty about the accuracy of releases to water reported to TRI as zero release. With regard to factor (c), the number of operating days in the case of the sites of some COUs is less than the number assessed by EPA as discussed in Section 2.2.2. With regard to factor (d), EPA's mapping of sites reporting to TRI to a specific COU may be uncertain in some cases.

Table 4-1. Numbers of Assessed Sites and TRI Sites by COU and Number of TRI Sites That Reported Zero Release Each Release Medium

<table>
<tr><th>COU Abbreviation</th><th>Number of Sites According to CDR</th><th>Number of TRI Sites That EPA Associated with the COU</th><th>Number of TRI Sites That Reported Zero Release to Water</th><th>Number of TRI Sites That Reported Zero Release to Air</th><th>Number of TRI Sites That Reported Zero Release to Land</th></tr>
<tr><td>Manufacturing</td><td>1–3</td><td>1</td><td>1</td><td>0</td><td>0</td></tr>
<tr><td>Repackaging</td><td>N/A[a]</td><td>2</td><td>2</td><td>2</td><td>0</td></tr>
<tr><td>Processing as a reactant in plastic material and resin manufacturing</td><td rowspan="2">3–27</td><td rowspan="2">10</td><td rowspan="2">9</td><td rowspan="2">1</td><td rowspan="2">7</td></tr>
<tr><td>Processing as a reactant in all other chemical product and preparation manufacturing</td></tr>
<tr><td>Processing: Additive flame retardant in plastic, resin, and paints and coatings</td><td>83–297</td><td>16</td><td>13</td><td>4</td><td>5</td></tr>
<tr><td>Processing: Adhesive manufacturing</td><td>10–24</td><td>8</td><td>8</td><td>4</td><td>6</td></tr>
</table>

COU Abbreviation	Number of Sites According to CDR	Number of TRI Sites That EPA Associated with the COU	Number of TRI Sites That Reported Zero Release to Water	Number of TRI Sites That Reported Zero Release to Air	Number of TRI Sites That Reported Zero Release to Land
Processing: Reactive flame retardant in computer and electronic product manufacturing	10–24	4	4	2	2
Processing: Reactive flame retardant in transportation equipment manufacturing	N/A[a]	13	13	11	10
Processing: Additive flame retardant in plastic products	N/A[a]	8	8	6	5
Reactive use in electrical and electronic articles Additive use in electrical and electronic articles	N/A[a]	3	3	2	1
Reactive use in automotive and aviation articles	N/A[a]	9	9	7	5
Use in building and construction materials	N/A[a]	1	1	1	0
Disposal	N/A[a]	11	11	3	6

[a] CDR data was lacking in the case of these COUs.

4.2 Overall Confidence in Release Estimates by COU

Table 4-2 summarizes EPA's overall confidence in the release estimates for each COU.

Table 4-2. Summary of Assumptions, Uncertainty, and Overall Confidence in Water Release Estimates by COU

COU	Weight of Scientific Evidence Conclusion in Water Release Estimates
All COUs that are assessed based on TRI data (all COUs except Recycling, Use in plastic and rubber products, and Laboratory chemical use)	EPA has concluded that the weight of scientific evidence for this assessment is moderate based on the strengths, limitations, assumptions and uncertainties associated with the TBBPA TRI data that are the basis of the assessments of these COUs as presented in Section 4.1. Because TRI data with water releases were available, relevant flow data for the specific receiving water body were collected using NPDES permits. This minimized uncertainties are associated with estimating the flow rate of a receiving water body using modeling and regression approaches. Furthermore, the number of operating days for COUs with TRI data were determined using either an EPA standard approach or test order data from the ACC. Industry-specific data on the number of operating days reduced uncertainties in the daily releases per site.
Recycling	EPA assessed releases based on measured TBBPA emission factors pertaining to a WEEE recyling site in Switzerland and estimates of WEEE throughput per site. The literature data received a high data quality rating in systematic review. The strength of the assessment is the estimation of releases based on empirically determined TBBPA concentrations in e-waste recycling output streams and release rates from a WEEE recycling facility. Information about the empirical determination of these quantities, including the sampled process streams of the WEEE recycling facility, the number of samples, TBBPA sampling and analysis method and measured concentrations of TBBPA are given in Appendix A. There is uncertainty in the assessed TBBPA release rates because the TBBPA concentration data and the maximum annual e-waste recycling rate per site are based on information from Switzerland and Canada, which may not be representative of e-waste recycling facilities in the United States. The data that EPA has presented is reasonably available public information, meeting the TSCA standard under section 26(k). Based on this information, EPA has concluded that the weight of scientific evidence for this assessment is moderate.
Use in plastic and rubber products	For this COU, EPA had no release information from standard sources, so the Agency assessed water releases qualitatively. Based on this information, EPA has concluded that the weight of scientific evidence for this assessment is moderate.
Laboratory chemical use	EPA assessed releases based on estimate throughput that is based on package size and based on the laboratory use Generic Scenario. Based on this information, EPA has concluded that the weight of scientific evidence for this assessment is moderate.

5 RELEASE ASSESSMENT CONCLUSIONS

EPA considered all reasonably available information identified by the Agency through its systematic review process under TSCA to characterize the environmental release of TBBPA. TBBPA has a total PV in the United States between 10 to 50 million lb of TBBPA from the 2024 CDR reporting period (U.S. EPA, 2026a). It is primarily used as a flame retardant in various plastics material and resin manufacturing. Secondary uses include incorporation into formulations such as adhesives, and incorporation into articles such as building and construction materials and electronics. TBBPA is mostly released to land. Most releases to water are reported as zero releases.

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APPENDICES

Appendix A RECYCLING MODEL APPROACH AND PARAMETERS

TBBPA is used in a variety of electronics products, including PCBs, laminates, plastic housings for computer jacks, terminal boards, and as a component in the resin used in refrigerators and other appliances, business machines and telephones (Panduit, 2017; U.S. EPA, 2015a; EC, 2013). Some of the e-waste generated from these products may be recycled. EPA estimated TBBPA releases from electronic waste (e-waste) recycling sites using the same methodology as that in EPA's risk evaluation for HBCD (U.S. EPA, 2020c), another flame retardant in electronics. Specifically, EPA estimated TBBPA releases from e-waste recycling sites to be equal to the following values as discussed below:

- 0.19 to 0.54 kg/day-site (central tendency estimate); and
- 5.1 to 14.7 kg/day-site (high-end estimate).

EPA is uncertain of the media of release and therefore assesses these rates as rates of releases to air or to landfill or to incineration or to some combination of these methods of release, disposal, or treatment methods.

EPA calculated the TBBPA release rates in accordance with the following equations:

Equation_Apx A-1. TBBPA Release Rate from an E-Waste Recycling Site

$$R = X \times \left(\frac{V_y}{N_d}\right) \times \sum f_i$$

Equation_Apx A-2. Average Recycling Rate of Consumer Electronics Per E-Waste Recycling Site

$$V_y = \frac{V_t}{N_s}$$

Equation_Apx A-3. Total Number of E-Waste Recycling Sites

$$N_s = N_{sc} \times \alpha$$

Where:

R	=	Amount of TBBPA released per day from an e-waste recycling site to the environment or to disposal or treatment (kg/day/site)
X	=	Amount of TBBPA contained in recycled consumer electronics (kg TBBPA/kg recycled electronics)
V_y	=	Annual recycling rate of consumer electronics per site (kg recycled electronics/year/site)
N_d	=	Number of TBBPA release days per year from a site (days/yr)
f_i	=	Emission factor for the release of TBBPA to the environment or to disposal or treatment from a particular source at an e-waste recycling site (kg TBBPA released/kg TBBPA contained in the recycled electronics)
V_t	=	Annual recycling rate of consumer electronics in the United States (kg recycled electronics/yr)

N_s	=	Total number of e-waste recycling sites in the United States (sites)
N_{sc}	=	Number of certified e-waste recycling sites in the United States (sites)
α	=	Ratio of total number of e-waste recycling sites and number of certified e-waste recycling sites

EPA calculated the central tendency and high-end TBBPA releases rates from central tendency and high-end values of the annual recycling rate of consumer electronics per site (V_y), respectively. To account for measurement error in the values of the amount of TBBPA contained in recycled consumer electronics (X) and the values of the various emission factors for release of TBBPA to the environment or to disposal or treatment (f_i), EPA calculated each of the central tendency and the high-end release rates as a range of values. The values of the input variables of Equation_Apx A-1, Equation_Apx A-2, and Equation_Apx A-3 are presented in Equation_Apx A-1.

EPA determined the values of the input variables of Equation_Apx A-1, Equation_Apx A-2, and Equation_Apx A-3, as follows:

Amount of TBBPA Contained in Recycled Consumer Electronics (X) and TBBPA Emission Factors (f_i)
Morf et al. (2005b) prepared a mass balance of TBBPA in a "modern state-of-the-art" waste electrical and electronic equipment (WEEE) recycling facility located in Switzerland. They accomplished this by measuring: (1) the mass of WEEE fed to the facility, (2) the masses of the output streams, and (3) the concentrations of TBBPA in all relevant output streams of the facility. To measure the concentration of TBBPA in all relevant output streams, 16 to 20 samples per stream were collected. These samples were analyzed for TBBPA by gas chromatography/mass spectrometry (GC/MS) with electron impact (EI) ionization. TBBPA was detected in all sampled streams although some streams were not sampled because they contained very little plastics. They calculated the mass of TBBPA per kg of the recycled WEEE on average, including the parts of the WEEE that are not flame retarded, to be equal to 1,420 ± 90 mg of TBBPA per kg recycled WEEE. The feed WEEE was comprised of "small household appliances (*e.g.,* toasters and vacuum cleaners), office and communication appliances (*e.g.,* personal computers and monitors, printers, phones, and fax and photocopy machines), entertainment electronics (*e.g.,* television [TV] sets, videos, camcorders, radios, and portable compact disk [CD players], and small size electrical and electronic [E&E] equipment such as plugs and mobile phones)."

Morf et al. (2005b) reported the ratio of the mass of TBBPA in an output stream and the mass of TBBPA in the WEEE feed of the facility. These mass ratios and the output streams associated with them are as follows: the fine-grained plastic fractions (0.571 ± 8%), plastics and wooded castings (PC/TV) (0.35 ± 10%), fine-grained metal fractions (0.047 ± 15%), dust collected in bag filters (0.032 ± 86%), copper cables (6.0×10^{-5} ± 39%), PCBs (5.0×10^{-4} ± 41%) and air emitted from these bag filters (0.002%). EPA's assessment is that the TBBPA contained in the following output streams is released to the environment or to disposal or treatment: the dust collected in bag filters, the air emitted from the bag filters, and the fine-grained metal fractions. EPA's rationale for assessing the release, disposal or treatment of the TBBPA in the fine-grained metal fractions is that e-waste recycling in the United States may include metal extraction and this output stream contains plastic impurities which may be separated and/or emitted during the processing of this output steam for the purpose of metal extraction (NIOSH, 2014a; Morf et al., 2005b).

Environmental Media of Release and Treatment and Disposal Methods
EPA's expectation is that waste streams comprising solid material in filters are disposed of in landfills or treated via incineration. Also, there may be significant releases to the environment from e-waste recycling processes that do not include efficient air pollution control devices (Morf et al., 2005b, a).

Hence, EPA's assessment is that the dust collected in bag filters, and the fine-grained metal fractions are released to air, to landfill or to incineration or to some combination of this environmental medium or disposal or treatment methods. EPA expects that releases to water directly from e-waste recycling sites is unlikely. At the vast majority of sites surveyed by the National Institute for Occupational Safety and Health (NIOSH), e-waste is disassembled and separated (NIOSH, 2014b), and these processes do not include aqueous process streams (NIOSH, 2014b). The facility examined by Morf et al. does not include aqueous process streams (Morf et al., 2005b). EPA expects that cleaning of equipment with water between batches is unlikely based on the lack of aqueous process streams at the sites surveyed by NIOSH (2014b) and Morf et al. (2005b). Cleaning surfaces such as floors to remove settled dust is done by vacuuming or compressed air or dry brushing although wet mopping and wet brushing are superior to the use of compressed air or dry brushing as cleaning methods for industrial hygiene reasons (NIOSH, 2014b; Rosenberg et al., 2011).

Consumer Electronics Recycling Rates (V_y) and Number of Release Days (N_d)

The annual recycling rate of selected consumer electronics during 2015 in the United States was equal to 1.04×10^6 U.S. tons (U.S. EPA, 2019c). Selected consumer electronics "includes products such as TVs, VCRs, DVD players, video cameras, stereo systems, telephones and computer equipment." EPA selected the value pertaining to the year 2018 because this is most recent reported value. The total number of e-waste recycling facilities in the United States is estimated to be 860 in 2026 (e-Stewards, 2026; Sustainable Electronics, 2026; U.S. EPA, 2016). This includes 796 certified sites and 19 sites with suspended certifications from Sustainable Electronics and 45 certified sites from e-Stewards (e-Stewards, 2026; Sustainable Electronics, 2026). EPA recognizes that the recycling rate is from 2018 and the number of sites from 2026; however, these are the most recent data readily available.

The capacity of a state-of-the-art WEEE recycling facility in Switzerland is 30,000 metric tons per year (Morf et al., 2005a)and the capacity of a state-of-the-art e-waste recycling facility in Canada is also 30,000 metric tons per year (Tomko and McDonald, 2013; Morf et al., 2005b). Accordingly, EPA assumed the high-end value of the rate of recycle of consumer electronics per site in the United States to be equal to 30,000 metric tons per year. Based on the volume of e-waste recycled per year, EPA assumed that an e-waste recycling facility is operated continuously with two weeks of annual downtime for maintenance, for a total of 350 days per year. This assumption is consistent with EPA's Draft GS for EV Battery Manufacturing and Recycling (U.S. EPA, 2026l).

Appendix B CONDITIONS OF USE MAPPING APPROACHES

This methodology was developed for mapping data to occupational exposure scenarios (OESs). EPA mapped release data directly to COUs for TBBPA, so the methodology was repurposed for that approach. However, the methodology presented here has not been updated, as it is a standard methodology.

B.1 Condition of Use and Occupational Exposure Scenario

Condition of Use (COU)

TSCA section 3(4) defines COUs as "the circumstances, as determined by the Administrator, under which a chemical substance is intended, known, or reasonably foreseen to be manufactured, processed, distributed in commerce, used, or disposed of." COUs included in the scope of EPA's risk evaluations are typically tabulated in scope documents and risk evaluation documents as summaries of life cycle stages, categories, and subcategories of use, as shown in Table_Apx B-1. Therefore, a COU is defined as a combination of life cycle stage, category, and subcategory. The Agency identifies COUs for chemicals during the scoping phase; this process is not discussed in this document.

Occupational Exposure Scenario (OES)

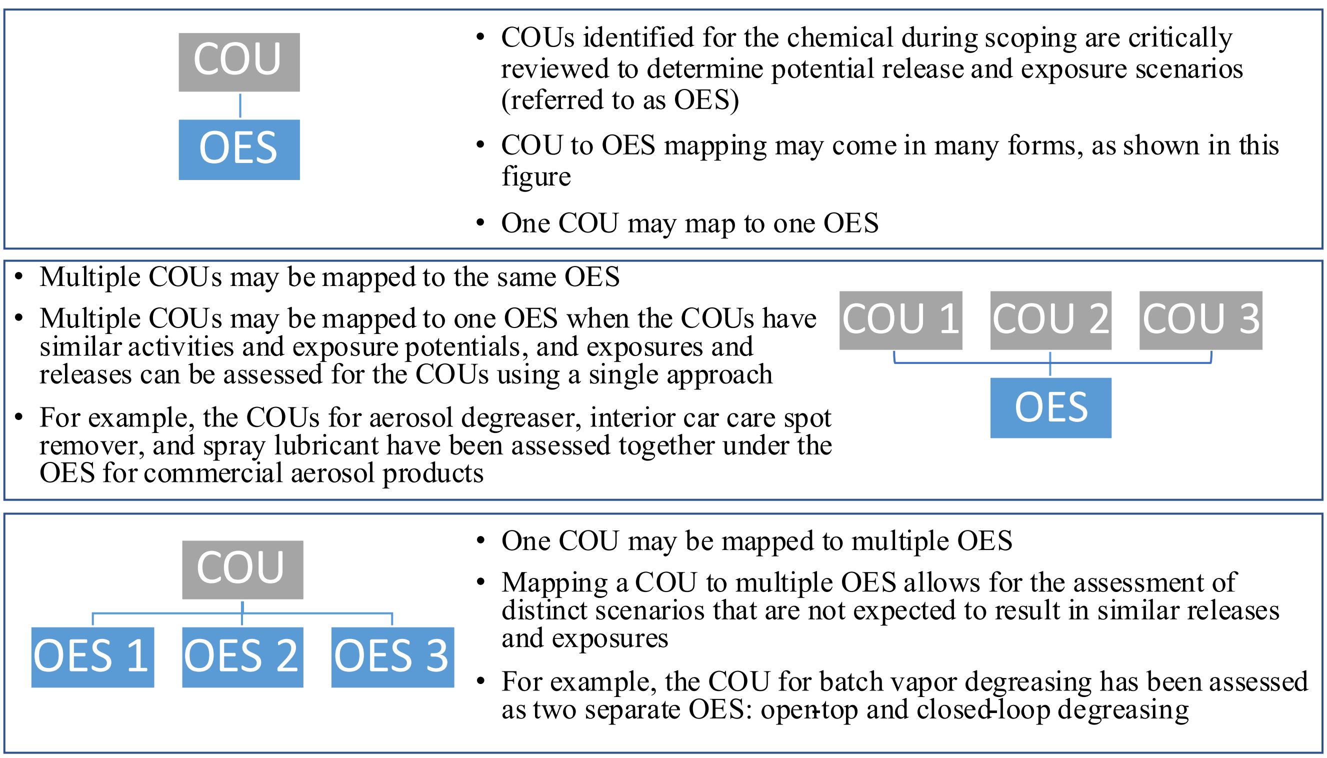
Thus far, EPA has not adopted a standardized definition for OES. The purpose of an OES is to group or segment COUs for assessment of releases and exposures based on similarity of the operations and data availability for each COU. For example, EPA may assess a group of multiple COUs together as one OES due to similarities in release and exposure potential (*e.g.,* the COUs for formulation of paints, formulation of cleaning solutions, and formulation of other products may be assessed together as a single OES). Alternatively, EPA may assess multiple OES for one COU because there are different release and exposure potentials for a given COU (*e.g.,* the COU for batch vapor degreasing may be assessed as separate OES for open-top vapor degreasing and closed-loop vapor degreasing). OES determinations are also largely driven by the availability of data and modeling approaches to assess occupational releases and exposures. For example, even if there are similarities between multiple COUs, if there is sufficient data to separately assess releases and exposures for each COU, and evidence that the exposure scenarios are distinct enough that it would be appropriate to assess them separately, EPA would not group them into the same OES. This is depicted in Figure_Apx B-1.

For chemicals undergoing risk evaluation, EPA maps each industrial and commercial COU to one or more OESs based on reasonably available data and information (*e.g.,* CDR, use reports, process information, public and stakeholder comments), assumptions, and inferences that describe how release and exposure take place within a COU. The Agency identify OESs for COUs—not vice-versa (*i.e.,* COUs are not altered during OES mapping). The mapping of COUs to OES is separate from and occurs after the identification of COUs. Both the identification of COUs and subsequent mapping of COUs to OESs occur early in the risk evaluation process and are described in Section 1.2. This section is intended to just provide background context on COUs and OESs.

Table_Apx B-1. Example COU Table with Mapped OES

COU			OES
Life Cycle Stage	**Category**[a]	**Subcategory**[b]	
Manufacturing	Domestic manufacturing	Domestic manufacturing	Manufacturing
	Import	Import	Repackaging
Processing	Processing as a reactant	Intermediate in all other basic organic chemical manufacturing	Processing as a Reactant
	Processing – incorporation into formulation, mixture, or reaction product	Solvents (for cleaning or degreasing)	Formulation
		Adhesives and sealant chemicals	
	Repackaging	Solvents (for cleaning or degreasing)	Repackaging
	Etc.		

COU = condition of use; OES = occupational exposure scenario
[a] Categories reflect CDR codes and broadly represent the industrial and/or commercial settings of the COU.
[b] The subcategories reflect more specific COUs.



Figure_Apx B-1. COU to OES Mapping Option

B.2 Condition of Use and Occupational Exposure Scenario

EPA utilizes release data from EPA programmatic databases and exposure data from standard sources to complete occupational exposure and environmental release assessments, which are described below:

- Chemical Data Reporting (CDR) (accessed May 21, 2026), to which import and manufacturing sites producing the chemical at or above a specified threshold must report. EPA uses CDR to identify COUs, OES, sites that import or manufacture the chemical, and for information on physical form and concentration of the chemical. In addition, EPA is currently developing the Tiered Data Reporting (TDR) rule, which would establish reporting requirements, including changes to CDR, to collect information that better meets data needs for the TSCA existing chemical program. The rule is expected to have reporting requirements tiered to specific stages of existing chemical assessments (*e.g.,* prioritization, risk evaluation) and harmonized to the Organization for Economic Co-operation and Development (OECD) risk assessment framework, which would help to better inform uses of chemicals and improve upon the OES mapping procedures in this document.
- Toxics Release Inventory (TRI) (accessed May 21, 2026), to which facilities handling a chemical covered by the TRI program at or above a specified threshold must report. EPA uses TRI data to quantify air, water, and land releases of the chemical undergoing risk evaluation.

To utilize the data from these sources, the facilities that report to each must first be mapped to an OES. There may be other sources of data for specific facilities that require mapping the facilities to an OES; however, this document covers the most common data sources. Additionally, EPA often uses data from sources such as public and stakeholder comments, generic scenarios, and process data that are usually not specific to an individual site; therefore, unlike the above sources, they do not involve the mapping of specific sites to an OES.

Mapping procedures for the above sources are discussed in detail in the subsequent sections; however, Table_Apx B-2 includes a summary of the type of information reported by companies in each database that helps to inform OES and COU mapping. This includes industrial classification codes such as those associated with the North American Industry Classification System (NAICS) and Standard Industrial Classification (SIC) system (both URLs accessed August 11, 2025). Note that the U.S. government replaced SIC codes with NAICS codes in 1997; however, SIC codes are still used in DMR and are applicable for data from all listed sources for years prior to 1997. Additionally, some of the sources in Table_Apx B-2 have specific reporting requirements that include flags for the type of processes that occur at the site.

Assessors should be sure that a facility that reports to multiple databases/sources is consistently mapped to the same OES, as applicable. This is not applicable if the facility reports separately for different areas/processes of their facility (*e.g.,* a large chemical plant may report 1 block of unit operations separate from another such that they have different OESs).

Table_Apx B-2. EPA Programmatic Database Information That Aids OES/COU Mapping

Source	Reported Information Useful for Mapping OES/COU	Reporting Frequency	Notes
CDR	• Indication if the chemical is imported or domestically manufactured • Indication if the chemical is imported but never at the site, used on-site, or exported	• Facilities must report to CDR every four years • New datasets take years to become publicly available • Latest reporting year with available data: 2024	• While CDR also includes information on downstream processing and use, it does not include site identities for these operations; thus, it does not inform reporting site OES/COU mapping. • Claims of CBI can limit data utility in risk evaluations.
TRI	• NAICS codes • Flags for uses and sub-uses of the chemical • Release media information	• Facilities must report to TRI annually • New datasets become publicly available in October for the previous year • Latest reporting year with available data: 2023	• Reporters must select from specific uses (*e.g.,* manufacture, import, processing) and sub-uses (*e.g.,* formulation additive, degreaser, lubricant). • Sub-use information is only available in data sets starting in 2018. • Facilities may report with a Form A under certain circumstances [a]; Form A's do not require use/sub-use reporting.

CDR = Chemical Data Reporting; COU = condition of use; CBI = confidential business information; NAICS = North American Industry Classification System; OES = occupational exposure scenario; TRI = Toxics Release Inventory

[a] Facilities may report using a Form A if the annual reportable release amount of the chemical did not exceed 500 lb for the reporting year, and the amounts manufactured, or processed, or otherwise used did not exceed 1 million lb for that year.

B.3 Occupational Exposure Scenario Mapping Procedures

This section contains procedures for mapping facilities to OES for each source discussed in Appendix Subsection B.3.

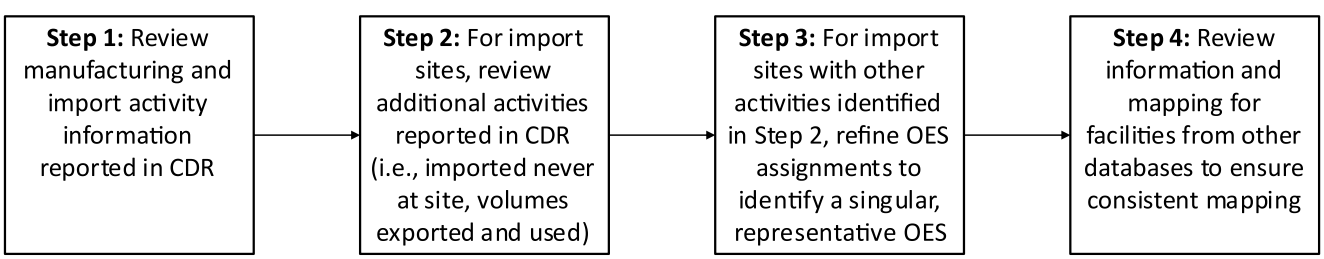
B.3.1 Chemical Data Reporting (CDR)

The only facilities required to report to CDR are those that manufacture or import specific chemicals at or above a specified threshold.[4] Therefore, sites that report for the chemical of interest in CDR will generally be mapped to either the Manufacturing or Import/repackaging OES. These sites must also report the processing and uses of the chemical; however, these procedures are specific to mapping of the reporting site and not downstream processing or use sites.

CDR, under TSCA, requires manufacturers (including importers) to provide EPA with information on the production and use of chemicals in commerce. These facilities must report to CDR every four years. For risk evaluations conducted under the amended TSCA, EPA has primarily used 2016 and 2020 CDR. The procedures in this document are applicable to both 2016 and 2020 CDR data; however, there are some data elements that are only applicable to 2020 CDR, which are called out in the procedures where applicable. These procedures should be applicable to future CDR reporting, depending on changes to reporting requirements. If the TDR rule is promulgated, these procedures will be updated accordingly.

Chemical data reported under CDR is classified using Industrial Function Category (IFC) codes and/or commercial/consumer use product categories (PCs). CDR IFC codes describe the "intended physical or chemical characteristics for which a chemical substance or mixture is consumed as a reactant; incorporated into a formulation, mixture, reaction product, or article, repackaged; or used." Alternatively, PCs describe the consumer and commercial products in which each reportable chemical is used. EPA typically uses these CDR codes to identify the COUs for the chemical in the published scope documents.

Figure_Apx B-2 depicts the steps that should be followed to map CDR reporting sites to OES. Each step is explained in the text below the figure. Additionally, Appendix Subsection B.5.1 shows step-by-step examples for using the mapping procedures to determine the OES for three example CDR reporting facilities.



Figure_Apx B-2. OES Mapping Procedures for CDR

To map sites reporting to CDR, the following procedures should be used with the non-CBI CDR:

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[4] See 2020 CDR reporting instructions (accessed May 21, 2026) for further information, including descriptions on the information required to be reported.

1. **Review Manufacturing and Import Activity Information:** The first step in the process is to review the reported activity information to identify if the facility imports or manufactures the chemical.
    a. If the facility reports domestic manufacturing, the manufacturing OES should be assigned, even if the facility also reports importation or the facility may conduct other operations with the chemical. This is because manufacturing of the chemical is expected to be the primary operation, with any other processing or uses being ancillary operations.
    b. If the chemical is being manufactured as a byproduct (this is a voluntary reporting element starting in 2020 CDR), this may need to be considered separately from non-byproduct manufacturing depending on assessment needs for the chemical.
    c. If the facility does not manufacture the chemical and only imports the chemical, check if additional processes occur at the site as described in the subsequent steps.
2. **For Importation Sites, Review Fields for "Imported Never at Site", "Volume Exported", and "Volume Used":** The next step is to review these additional fields to determine if the reporting facility conducts more than just importation activities.
    a. If the facility imports the chemical, they must report if it is imported but never physically at the reporting site. If the facility indicates the chemical is imported and never at site, the facility does not handle the chemical and the only applicable OES is importation. In such cases, the assessor should proceed to Step #4. If the facility does not indicate the chemical is imported and never at site, proceed to Step #2b.
    b. If the facility reports a quantity for "volume exported" and this quantity is the same as that imported, no additional OES occurs at the site beyond importation. In such cases, the assessor should proceed to Step #4. If the exported quantity is not equal to volume imported, assessors should check if any of the chemical is used at the reporting site per Step #2c.
    c. If the facility reports a quantity for "volume used", additional OES may be applicable to the facility beyond manufacturing or importation. Proceed to Step #3 to identify and refine additional OES.
3. **Refine OES Assignments:** If multiple OES were identified from the previous steps, a single primary OES must be selected using additional facility information. OES determinations should be made with the following considerations:
    a. 6-digit NAICS code reported by the facility in CDR – note that this is only a requirement starting in 2020 CDR (*e.g.,* for a facility that reported NAICS code was 325520, Adhesive Manufacturing, the incorporation into a formulation, mixture, or reaction product OES may be appropriate; for a facility reporting a NAICS code starting in 424690, Other Chemical and Allied Products Merchant Wholesalers, only the repackaging OES is likely applicable).
    b. Downstream processing and use information reported in CDR. The reporting site must provide information on downstream processing and use of the chemical for all sites, meaning it cannot be distinguished which processing and use information includes the reporting site operations versus downstream site operations. However, this information may still help inform the operations at the reporting site and should be reviewed. Specifically, for a given processing/use activity, if the submitter reports "Fewer than 10 sites" for the "number of sites" field (which is the lowest number of sites that can be reported), there is a likelihood that the facility's operations may be included in this

processing/use activity. In such cases, review the corresponding fields for "type of processing or use operation," "industrial sector," and "function category" to help identify the OES. The greater number of sites that are reported, the more likely that the associated processing and use information includes information from downstream sites and the less reliable the information is for mapping OES to the reporting site.

   c. Internet research of the types of products made at the facility (*e.g.,* if a facility's website indicates the facility manufactures plastic products, the chemical may be used as a processing aid or component in the plastic products, depending on the known uses of the chemical within the plastics industry).
   d. Information from other reporting databases as described in Step #2c.
   e. An evaluation of the OES that is most likely to result in a release (*e.g.,* for facilities that reported importation and may also conduct formulation per the reported NAICS code, the formulation OES may be assigned, because, in most cases, importation would have a lower likelihood of a release).
   f. Grouped OES for similar uses (*e.g.,* multiple facilities that may conduct formulation operations based on the reported NAICS code may be assigned a grouped formulation OES that covers all types of formulation [*e.g.,* adhesives, paints, cleaning products]).

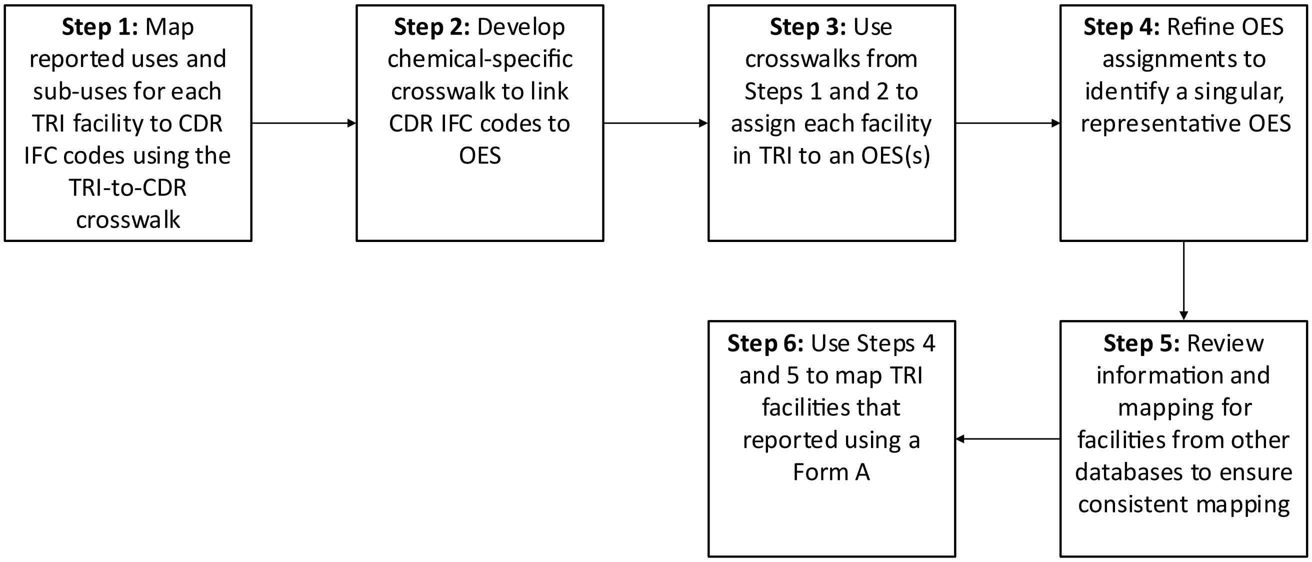
4. **Review Information from Other Databases:** Other databases/sources (such as TRI, NEI, and DMR) should be checked to see if the facility has reported to these. If so, the OES determined from the mapping procedures for those databases (discussed in other sections of this document) should also be used. It is important that the same facility is mapped consistently across multiple databases/sources. The facility's TRI identification number (TRFID) and Facility Registry Services identification number (FRS ID) can be used to identify sites that report to TRI, DMR, and NEI. If the facility does not report to these databases, but additional OES are possible per Step #2, the assessor should search available facility information on the internet.

Given the information available in CDR, ERG/EPA expects that, for most chemicals, 100% of the sites reporting to CDR can feasibly be mapped to an OES.

B.3.2 Toxics Release Inventory (TRI)

TRI reporting is required for facilities that manufacture (including import), process, or otherwise use any TRI-listed chemical in quantities greater than the established threshold in the calendar year AND have 10 or more full-time employee equivalents (*i.e.,* a total of 20,000+ hours) and are included in a covered NAICS code. Therefore, unlike CDR reporters that are primarily manufacturers and importers, TRI reporters can be mapped to a variety of different OES.

Figure_Apx B-3 depicts the steps that should be followed to map TRI reporting sites to OES. Each step is explained in the text below the figure. Additionally, Appendix Subsection B.5.2 shows step-by-step examples for using the mapping procedures to determine the OES for three example TRI reporting facilities.



Figure_Apx B-3. OES Mapping Procedures for TRI

To map sites reporting to TRI, the following procedures should be used:

1. **Assign Chemical Data Reporting Codes Using TRI-to-CDR Crosswalk:** The first step in the TRI mapping process is to map the uses and sub-uses reported by each facility to one or more 2016 CDR IFC codes. To do this, first compile all TRI uses/sub-uses for the reporting facility into a single column, then map them to CDR IFC codes using the TRI-to-CDR Use Mapping crosswalk. This is a universal crosswalk that applies to all chemicals.
2. **Develop Chemical-Specific Crosswalk to Link CDR Codes to OES:** The next step is to develop a separate CDR IFC code-to-OES crosswalk that links CDR IFC codes to OES for the chemical. To create this crosswalk, match the COU categories and subcategories from the COU table in the published scope documents (such as the example provided in Table 1-1) to the list of 2016 CDR IFC codes in the CDR reporting instructions.[5] The categories and subcategories of COUs typically match the IFC code category. Recent examples of already completed CDR IFC code-to-OES crosswalk can be found for the fenceline chemicals (1-bromopropane, methylene chloride, n-Methylpyrrolidone, carbon tetrachloride, perchloroethylene, trichloroethylene, and 1,4-dioxane).
3. **Assign OESs:** Each TRI facility is then mapped to one or more OES using the CDR IFC codes assigned to each facility in Step #1 and the CDR IFC code-to-OES crosswalk developed in Step #2.
4. **Refine OES Assignments:** If a facility maps to more than one OES in Step #3, a single primary OES must be selected using additional facility information. OES determinations should be made with the following considerations:
    a. 6-digit NAICS codes reported by the facility in TRI (*e.g.,* for a facility that reported TRI uses for both formulation and use as cleaner, EPA assigned the Formulation OES if the NAICS code was 325199, All Other Basic Organic Chemical Manufacturing; another

[5] IFC codes and their definitions can be found in Table 4-11 of the CDR reporting instructions: https://www.epa.gov/chemical-data-reporting/instructions-reporting-2016-tsca-chemical-data-reporting (accessed May 21, 2026).

example is NAICS codes 562211, Hazardous Waste Treatment and Disposal, and 327310, Cement Manufacturing, almost always correspond to the disposal OES, regardless of the reported TRI uses and sub-uses).

b. Internet research of the types of products made at the facility (*e.g.,* if a facility's website indicates the facility manufactures metal parts, the facility is likely to use chemicals for degreasing or in a metalworking fluid) and information from sources cited in the COU table and scoping document, such as public and stakeholder comments (*i.e.,* EPA/ERG will review sources cited in the COU table and scoping document to see if there is any information specific to the reporting site that can be used to inform the mapping).

c. Information from other reporting databases as described in Step #5.

d. An evaluation of the OES that is most likely to result in a release (*e.g.,* facilities that reported both importation and formulation may be assigned a formulation OES, because, in most cases, importation would have a lower likelihood of a release).

e. Grouped OES for similar uses/sub-uses (*e.g.,* facilities that reported cleaner and degreaser sub-uses may be assigned a grouped OES that covers both cleaning and degreasing because the specific cleaning/degreasing operation cannot be determined from the TRI data).

5. **Review Information from Other Databases:** Other databases/sources (including CDR, NEI, and DMR) should be checked to see whether the facility has reported to these. If so, the OES determined from the mapping procedures for those databases (discussed in other sections of this document) should also be used. It is important that the same facility is mapped consistently across multiple databases/sources. The facility's TRFID and FRS ID can be used to identify sites that report to TRI, DMR, and NEI.

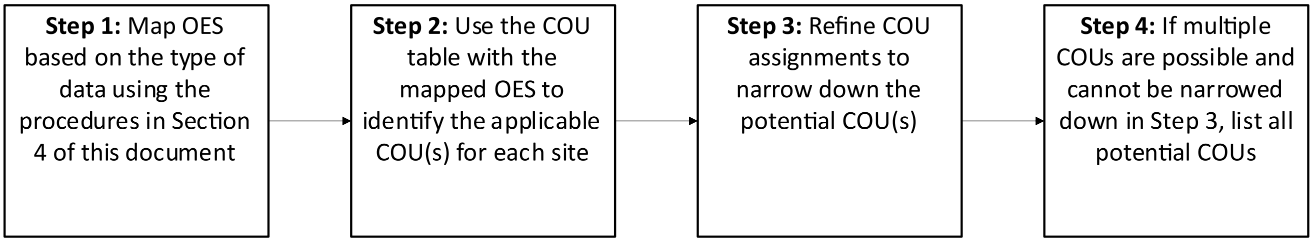
6. Note that facilities that submit using a TRI Form A do not report TRI uses/sub-uses. To determine the OES for these facilities, EPA will use information from Steps #4 and 5 above.

Given the information available in TRI, ERG/EPA expects that, for most chemicals, 100% of the sites reporting to TRI can feasibly be mapped to an OES.

B.4 Condition of Use Mapping Procedures

As discussed in Appendix Subsection B.1, there is not always a one-to-one mapping between COUs and OESs.

Figure_Apx B-4 depicts the steps that should be followed to map sites from the standard sources discussed in this document to COUs, using the OES mapping completed in Appendix B.3. Each step is explained in the text below the figure. Additionally, Appendix Subsection B.5.3 shows step-by-step examples for using the mapping procedures to determine the COU for three example facilities.



Figure_Apx B-4. COU Mapping Procedures for Standard Sources Already Mapped to OES

To map facilities from standard sources (*i.e.,* CDR, TRI, NEI, DMR, OSHA CEHD, NIOSH HHE) to COUs, the following procedures should be used:

1. **Map the Facility to an OES:** To map a facility from a standard source to a COU, the facility should first be mapped to an OES following the procedures for the specific source of data (discussed in Appendix Subsection B.3).
2. **Use the COU Table with Mapped OES to Assign COUs:** At the point of the risk evaluation process where EPA are mapping data from standard sources to OES and COU, EPA have already mapped OES to each of the COUs from the scope document, like is shown in Table 1-1. This crosswalk between COUs and OES should be used to identify the COU(s) for the facility using the OES mapped per Appendix Subsection B.3.
3. **Refine the COU Assignment:** In some instances, more than one COU may map to the facility. In such cases, the following information should be used to try to narrow down the list of potentially applicable COUs:
    a. Information from the standard sources (*e.g.,* if ERG/EPA assigned a grouped OES like “Industrial Processing Aid” and the facility’s NAICS code in TRI or NEI is related to battery manufacturing, the COU can be identified as the “Processing Aid” category and Process solvent used in battery manufacture” subcategory).
    b. Internet research of the types of products made at the facility (*e.g.,* if a facility’s website indicates the facility makes adhesives, the COU category of “Processing – Incorporation into formulation, mixture or reaction product” and subcategory of “Adhesives and sealant chemicals” can be assigned and the remaining subcategories [*e.g.,* solvents for cleaning or degreasing, solvents which become part of the product formulation or mixture] are not applicable) and information from sources cited in the COU table and scoping document, such as public and stakeholder comments (*i.e.,* EPA/ERG will review sources cited in the COU table and scoping document to see if there is any information specific to the reporting site that can be used to inform the mapping).
4. **List all Potential COUs:** Where the above information does not narrow down the list of potentially applicable COUs, EPA/ERG will list all the potential COUs and will not attempt to select just one from the list where there is insufficient information to do so.

B.5 Example of Case Studies

This section contains step-by-step examples of how to implement the OES and COU mapping procedures listed in Appendix Subsections B.3 and B.4 to determine OES for facilities that report to standard engineering sources.

B.5.1 CDR Mapping Examples

This section includes examples of how to implement the OES mapping procedures for sites reporting to CDR, as listed in Appendix Subsection B.3.1. Specifically, this section includes examples for three example sites that reported to 2020 CDR for the chemical, diisononyl phthalate (DINP). These example sites are referred to as Facility A, Facility B, and Facility C.

To map Facilities A, B, and C to an OES, the following procedures are used with the non-CBI 2020 CDR database.

1. **Review Manufacturing and Import Activity Information**: The first step in the process is to review the reported activity information to identify if the facility imports or manufactures the chemical. Table_Apx B-3 summarizes the information gathered from 2020 CDR for the three example sites for this step.

Table_Apx B-3. Step #1 for CDR Mapping Facilities Example

Facility Name	Step #1a: Reported Activity	Step #1b: Byproduct Information	Step #1c: Check Other Activities?	OES Determination
Facility A	Domestically manufactured/imported	Not known or reasonably ascertainable	Not needed – per Step #1 in Appendix B.3.1	Per Step #1a, this site maps to the Manufacturing OES
Facility B	Imported	CBI	Yes	Cannot be determined in Step #1, proceed with Step #2
Facility C	Imported	Not known or reasonably ascertainable	Yes	Cannot be determined in Step #1, proceed with Step #2

2. **For Importation Sites, Review Fields for "Imported Never at Site", "Volume Exported", and "Volume Used":** The next step is to review these additional fields to determine if the reporting facility conducts more than just importation activities. Table_Apx B-4 summarizes the information gathered from 2020 CDR for the three example sites for this step.

Table_Apx B-4. Step #2 for CDR Mapping Facilities Example

Facility Name	Step #2a: Imported Never at Site	Step #2b: Volume Exported	Step #2c: Volume Used	OES Determination
Facility A	N/A – OES determined in Step #1			
Facility B	CBI	CBI	CBI	Cannot be determined in Step #2, proceed with Step #3
Facility C	Yes	0	0	Because the facility only imports and does not use DINP, this site maps to the Import/Repackaging OES

3. **Refine OES Assignments:** If multiple OES were identified from the previous steps, a single primary OES must be selected using additional facility information as discussed in Steps #3a to 3f. Table_Apx B-5 summarizes the information gathered from 2020 CDR for the three example sites for this step.

Table_Apx B-5. Step #3 for CDR Mapping Facilities Example

Facility Name	Step #3a: NAICS	Step #3b: Processing/Use Information	Step #3c: Internet Research	Step #3d-e: Other Databases and OES Grouping	OES Determination
Facility A	N/A – OES determined in Step #1				
Facility B	325110, Petrochemical Manufacturing	CBI	Research indicates the facility is a petrochemical plant and does not indicate how DINP is used	Check other databases per Step #4	Cannot be determined in Step #2, proceed with Step #4
Facility C	N/A – OES determined in Step #2				

4. **Review Information from Other Databases:** Lastly, other databases/sources (such as TRI, NEI, and DMR) should be checked to see if the facility has reported to these. If the facility does not report to these databases, but additional OES are possible per Step #2, search available facility information on the internet. Table_Apx B-6 summarizes the information gathered from 2020 CDR for the three example sites for this step.

Table_Apx B-6. Step #4 for CDR Mapping Facilities Example

Facility Name	Step #4: Other Databases	OES Determination
Facility A	N/A – OES determined in Step #1	
Facility B	Using the FRS ID reported in CDR, this facility does not report to TRI, NEI, or DMR. The Agency searched the facility in EPA's ECHO database and found that the facility does not have any listed NAICS codes, SIC codes, or permits, and appears to be a warehouse from aerial imagery. Therefore, this facility is likely just an importer.	Using the information from Step #4, this site maps to the Import/Repackaging OES.
Facility C	N/A – OES determined in Step #2	

B.5.2 TRI Mapping Examples

This appendix includes examples of how to implement the OES mapping procedures for sites reporting to TRI, as listed in Appendix Subsection B.3.2. Specifically, this appendix includes examples for three example sites that reported to TRI for 1,2-dichloroethane. These example sites are referred to as Facility D, Facility E, and Facility F.

To map Facilities D, E, and F to an OES, the following procedures are used with information from TRI.

1. **Assign Chemical Data Reporting Codes using TRI-to-CDR Crosswalk:** The first step in the TRI mapping process is to map the uses and sub-uses reported by each facility to one or more 2016 CDR IFC codes. The uses and sub-uses reported to TRI by each example site are compiled in Table_Apx B-7.

Table_Apx B-7. Step #1 for TRI Mapping Facilities Example

Facility Name	TRI Form Type	TRI Uses (Sub-uses)	2016 CDR IFC Codes
Facility D	R	Manufacture: produce, import, for onsite use/processing, for sale/distribution, as a byproduct Processing: As a reactant, as a formulation component (P299 Other) Otherwise Used: Ancillary or other use (Z399 Other)	PK, U001, U003, U016, U013, U014, U018, U019, U020, U023, U027, U028, or U999
Facility E	R	Otherwise Used: Ancillary or other use (Z399 Other)	U001, U013, U014, U018, U020, or U023
Facility F	A	None, not reported in Form A submissions	

2. **Develop Chemical-Specific Crosswalk to Link CDR Codes to OES:** The next step is to develop a separate CDR IFC code-to-OES crosswalk that links CDR IFC codes to OES for the chemical. To create this crosswalk, match the COU and OES from the COU table in the published scope documents to the list of 2016 CDR IFC codes. The categories and subcategories of COUs typically match the IFC code category. See Table_Apx B-8 for the completed crosswalk for TBBPA.

Table_Apx B-8. Step #2 for TRI Mapping Facilities Example

COU and OES from Published Scope Document				Mapping		
Life Cycle Stage	**Category**	**Subcategory**	**OES**	**2016 CDR IFC Code**	**2016 CDR IFC Code Name**	**Rationale**
Manufacturing	Domestic manufacturing	Domestic manufacturing	Manufacturing	None	None	Per Appendix Subsection B.5.1, there is no corresponding CDR code for this COU/OES.
Repackaging	Repackaging	Repackaging	Repackaging	PK	Processing-repackaging	Category matches CDR code
Processing	Processing – As a reactant	Intermediate in petrochemical manufacturing	Processing as a Reactant	U015; U016; U019; U024	Processing as a reactant	Category matches CDR code
		Plastic material and resin manufacturing				
		All other basic organic chemical manufacturing				
Processing	Processing – Incorporation into formulation, mixture, or reaction product	Fuels and fuel additives: All other petroleum and coal products manufacturing	Incorporated Into Formulation, Mixture, or Reaction Product	U012	Fuel and fuel additives	Category matches CDR code
		Formulation of adhesives and sealants		U002	Adhesives and sealant chemicals	Category matches CDR code
		Processing aids: Specific to petroleum production		U025	Processing aids: specific to petroleum production	Category matches CDR code
Distribution in commerce	Distribution in commerce	Distribution in commerce	Distribution in Commerce	None	None	Per Appendix Subsection B.5.1, there is no corresponding CDR code for this COU/OES.

COU and OES from Published Scope Document				Mapping		
Life Cycle Stage	**Category**	**Subcategory**	**OES**	**2016 CDR IFC Code**	**2016 CDR IFC Code Name**	**Rationale**
Industrial use	Adhesives and sealants	Adhesives and sealants	Adhesives and Sealants	U002	Adhesives and sealant chemicals	Category matches CDR code
	Functional fluids (closed systems)	Engine coolant additive	Functional Fluids (Closed Systems)	U013	Functional fluids (closed systems)	Category matches CDR code
	Lubricants and greases	Paste lubricants and greases	Lubricants and Greases	U017	Lubricants and lubricant additives	Category matches CDR code
	Oxidizing/ reducing agents	Oxidation inhibitor in controlled oxidative chemical reactions	Oxidizing/Reducing Agents	U019	Oxidizing/reducing agents	Category matches CDR code
	Cleaning and degreasing	Industrial and commercial non-aerosol cleaning/ degreasing	Solvents (for Cleaning and Degreasing)	U029	Solvents (for cleaning or degreasing)	Category matches CDR code
		Vapor degreasing				
Commercial use	Cleaning and degreasing	Commercial aerosol products (aerosol degreasing, aerosol lubricants, automotive care products)	Solvents (for Cleaning and Degreasing)	U029	Solvents (for cleaning or degreasing)	Category matches CDR code
	Plastic and rubber products	Products such as: Plastic and rubber products	Plastics and Rubber products	None	None	Per Appendix Subsection B.5.1, there is no corresponding CDR code for this COU/OES.
	Fuels and related products	Fuels and related products	Fuels and Related Products	U012	Fuels and Fuel Additives	Category matches CDR code
	Other use	Laboratory chemical	Other Use	None	Use-non-incorporative activities	This use does not match any other CDR codes and is non-incorporative
		Embalming agent				

COU and OES from Published Scope Document				Mapping		
Life Cycle Stage	**Category**	**Subcategory**	**OES**	**2016 CDR IFC Code**	**2016 CDR IFC Code Name**	**Rationale**
Waste handling, disposal, treatment, and recycling	Waste handling, disposal, treatment, and recycling	Waste handling, disposal, treatment, and recycling	Waste Handling, Disposal, Treatment, and Recycling	None	None	Per Appendix Subsection B.5.1, there is no corresponding CDR code for this COU/OES.

3. **Assign OES:** Each TRI facility is then mapped to one or more OES using the CDR IFC codes assigned to each facility in Step #1 and the CDR IFC code-to-OES crosswalk developed in Step #2. Table_Apx B-9 includes the potential OES for each example facility per this step.

Table_Apx B-9. Step #3 for TRI Mapping Facilities Example

Facility Name	TRI Form Type	2016 CDR IFC Codes	Crosswalked OES	OES Determination
Facility D	R	PK, U001, U003, U016, U013, U014, U018, U019, U020, U023, U027, U028, or U999	Repackaging, processing as a reactant, functional fluids (closed systems), or Oxidizing/reducing agents	Cannot be determined in Step #3, proceed to Step #4
Facility E	R	U001, U013, U014, U018, U020, or U023	Functional fluids (closed systems)	Since the facility maps to only one OES, the OES is Functional fluids (closed systems)
Facility F	A	None – not reported in Form A submissions		Cannot be determined in Step #3, proceed to Step #4

4. **Refine OES Assignments:** If a facility maps to more than one OES in Step #3, a single primary OES must be selected using additional facility information per Steps #4a to 4e. Table_Apx B-10 summarizes the information gathered for the three example sites for this step.

Table_Apx B-10. Step #4 for TRI Mapping Facilities Example

Facility Name	Step #4a: NAICS Code	Step #4b: Internet Research	Step #4c: Other Databases	Step #4d-e: Most Likely OES or OES Grouping	OES Determination
Facility D	486990, All Other Pipeline Transportation	The facility is a large chemical manufacturing plant	Check databases per Step #5	Based on the type of facility, the Processing as a Reactant OES seems the most likely OES from Step #3	Most likely Processing as a reactant OES. Check other databases in Step #5 to verify.
Facility E	N/A – OES determined in Step #3				
Facility F	325199, All Other Basic Organic Chemical Manufacturing	The facility is a chemical supplier that does not appear to produce chemicals	Check databases per Step #5	Based on the NAICS code and type of facility, the Repackaging OES seems the most likely	Most likely Repackaging OES. Check other databases in Step #5 to verify.

5. **Review Information from Other Databases:** Other databases/sources (including CDR, NEI, and DMR) should be checked to see if the facility has reported to these. If so, the OES determined from the mapping procedures for those databases (discussed in other sections of this document) should also be used. It is important that the same facility is mapped consistently across multiple databases/sources. The facility's TRFID and FRS ID can be used to identify sites

that report to TRI, DMR, and NEI. Table_Apx B-11 summarizes the information gathered from other databases for the three example sites for this step.

Table_Apx B-11. Step #5 for TRI Mapping Facilities Example

Facility Name	Step #5: Other Databases	OES Determination
Facility D	The facility did not report to 2016 or 2020 CDR. The facility reported to 2020 NEI, reporting emissions of 1,2-dichloroethane from storage tanks and process equipment from chemical manufacturing processes and storage/transfer operations. The facility reported DMRs for the past few years but reported no releases of 1,2-dichloroethane to DMR.	The NEI information corroborates the most likely OES determined in Step #4d. Therefore, this site maps to the Processing as a Reactant OES.
Facility E	N/A – OES determined in Step #3	
Facility F	The facility did not report to 2016 or 2020 CDR, 2020 NEI, or the past few years of DMR.	Since no additional information was determined in Step #5, the site maps to the Repackaging OES per Step #4d.

B.5.3 COU Mapping Examples

This appendix includes examples of how to implement the COU mapping procedures for sites from standard sources (*i.e.,* CDR, TRI, NEI, DMR, OSHA CEHD, NIOSH HHE, as listed in Appendix Subsection B.4. Specifically, this appendix uses the same example facilities (Facility D, Facility E, and Facility F) for the TRI examples in Appendix Subsection B.5.2.

To map Facilities D, E, and F to an COUs, the following procedures should be used:

1. **Map the Facility to an OES:** To map a facility from a standard source to a COU, the facility should first be mapped to an OES following the procedures for the specific source of data (discussed in Appendix Subsection B.3). This mapping was completed in completed in Appendix Subsection B.5.2 and is summarized in Table_Apx B-12.

Table_Apx B-12. Step #1 for COU Mapping Facilities Example

Facility Name	Step #1: OES Determination from Appendix Subsection A.2
Facility D	Processing as a Reactant
Facility E	Functional Fluids (Closed Systems)
Facility F	Repackaging

2. **Use the COU Table with Mapped OES to Assign COUs:** At the point of the risk evaluation process where EPA/ERG are mapping data from standard sources to OES and COU, EPA/ERG have already mapped OES to each of the COUs from the scope document. This crosswalk between COUs and OES, which is in Table_Apx B-8, for the example facilities should be used to identify the COU(s). See

3. Table_Apx B-13 for completed Step #2 for the example facilities.

Table_Apx B-13. Step #2 for COU Mapping Facilities Example

<table>
<tr><th>Facility Name</th><th>OES Determination from Appendix A.2</th><th>Step #2: Mapped COUs</th></tr>
<tr><td>Facility D</td><td>Processing as a Reactant</td><td>Using the COU to OES crosswalk previously developed, the COUs that map to this OES are:
<table>
<tr><th>Life Cycle Stage</th><th>Category</th><th>Subcategory</th></tr>
<tr><td rowspan="3">Processing</td><td rowspan="3">Processing – As a reactant</td><td>Intermediate in Petrochemical manufacturing</td></tr>
<tr><td>Plastic material and resin manufacturing</td></tr>
<tr><td>All other basic organic chemical manufacturing</td></tr>
</table></td></tr>
<tr><td>Facility E</td><td>Functional Fluids (Closed Systems)</td><td>Using the COU to OES crosswalk previously developed, only one COU maps to this OES:
<table>
<tr><th>Life Cycle Stage</th><th>Category</th><th>Subcategory</th></tr>
<tr><td>Industrial use</td><td>Functional fluids (closed systems)</td><td>Engine coolant additive</td></tr>
</table></td></tr>
<tr><td>Facility F</td><td>Repackaging</td><td>Using the COU to OES crosswalk previously developed, only one COU maps to this OES:
<table>
<tr><th>Life Cycle Stage</th><th>Category</th><th>Subcategory</th></tr>
<tr><td>Repackaging</td><td>Repackaging</td><td>Repackaging</td></tr>
</table></td></tr>
</table>

4. **Refine the COU Assignment:** In some instances, more than one COU may map to the facility. In such cases, the reported NAICS code and internet research should be used to try to narrow down the list of potentially applicable COUs, per Steps #3a to 3b. See Table_Apx B-14 for completed Step #3 for the example facilities.

Table_Apx B-14. Step #3 for COU Mapping Facilities Example

<table>
<tr><th>Facility Name</th><th>Step #3a: NAICS Code</th><th>Step #3b: Internet Research</th><th>COU Determination</th></tr>
<tr><td>Facility D</td><td>486990, All Other Pipeline Transportation</td><td>The facility is a large chemical manufacturing plant.</td><td>The COU subcategory for “Plastic material and resin manufacturing” can be eliminated. However, the COU cannot be narrowed down between the remaining two subcategories of use. Proceed to Step #4.</td></tr>
<tr><td>Facility E</td><td colspan="3">N/A – COU determined in Step #2</td></tr>
<tr><td>Facility F</td><td colspan="3">N/A – COU determined in Step #2</td></tr>
</table>

4. **List all Potential COUs:** Where the above information does not narrow down the list of potentially applicable COUs, EPA/ERG will list all the potential COUs and will not attempt to select just one from the list where there is insufficient information to do so. Because a singular OES was identified for Facility D and F, this step is not applicable to those facilities. For Facility F, there are two possible COUs that are listed in Table_Apx B-15. While a COU consists of a life

cycle stage, category, and subcategory, all three should be presented in this step.

Table_Apx B-15. Step #4 for COU Mapping Facilities Example

<table>
<tr><th>Facility Name</th><th>Step #4: All Potential COUs</th></tr>
<tr><td>Facility D</td><td>All potential COUs for this facility are as follows:
<table>
<tr><th>Life Cycle Stage</th><th>Category</th><th>Subcategory</th></tr>
<tr><td rowspan="2">Processing</td><td rowspan="2">Processing – As a reactant</td><td>Intermediate in petrochemical manufacturing</td></tr>
<tr><td>All other basic organic chemical manufacturing</td></tr>
</table>
</td></tr>
</table>

B.6 TRI to CDR Use Mapping Crosswalk

Table_Apx B-16 presents the TRI-CDR Crosswalk used to map facilities to the OES for each chemical. “N/A” in the 2016 CDR code column indicates there is no corresponding CDR code that matches the TRI code. 2020 CDR introduced new codes for chemicals designated as high priority for risk evaluation; however, reporters may still use the same 2016 CDR codes listed in Table_Apx B-16 for all other chemicals. For 2020 CDR reporting facilities using the new codes, the crosswalk between 2016 CDR codes and 2020 CDR codes in Table 4-15 of the 2020 CDR reporting instructions should be used with Table_Apx B-16.

2601 **Table_Apx B-16. TRI-CDR Use Code Crosswalk**

TRI Section	TRI Description	TRI Sub-Use Code	TRI Sub-Use Code Name	2016 CDR Code	2016 CDR Code Name	2016 CDR Functional Use Definition
3.1.a	Manufacture: Produce	N/A	N/A	N/A	N/A	N/A
3.1.b	Manufacture: Import	N/A	N/A	N/A	N/A	N/A
3.1.c	Manufacture: For on-site use/processing	N/A	N/A	N/A	N/A	N/A
3.1.d	Manufacture: For sale/distribution	N/A	N/A	N/A	N/A	N/A
3.1.e	Manufacture: As a byproduct	N/A	N/A	N/A	N/A	N/A
3.1.f	Manufacture: As an impurity	N/A	N/A	N/A	N/A	N/A
3.2.a	Processing: As a reactant	N/A	N/A	PC	Processing as a reactant	Chemical substance is used in chemical reactions for the manufacturing of another chemical substance or product
3.2.a	Processing: As a reactant	P101	Feedstocks	N/A	N/A	N/A
3.2.a	Processing: As a reactant	P102	Raw materials	N/A	N/A	N/A
3.2.a	Processing: As a reactant	P103	Intermediates	U015	Intermediates	Chemical substances consumed in a reaction to produce other chemical substances for commercial advantage. A residual of the intermediate chemical substance which has no separate function may remain in the reaction product.
3.2.a	Processing: As a reactant	P104	Initiators	U024	Process regulators	Chemical substances used to change the rate of a chemical reaction, start or stop the reaction, or otherwise influence the course of the reaction. Process regulators may be consumed or become part of the reaction product.
3.2.a	Processing: As a reactant	P199	Other	U016	Ion exchange agents	Chemical substances, usually in the form of a solid matrix, are used to selectively remove targeted ions from a solution. Examples generally consist of an inert hydrophobic matrix such as styrene divinylbenzene or phenol-formaldehyde, cross-linking polymer such as divinylbenzene, and ionic functional groups including sulfonic, carboxylic or phosphonic acids. This code also includes aluminosilicate zeolites.

TRI Section	TRI Description	TRI Sub-Use Code	TRI Sub-Use Code Name	2016 CDR Code	2016 CDR Code Name	2016 CDR Functional Use Definition
3.2.a	Processing: As a reactant	P199	Other	U019	Oxidizing/ reducing agent	Chemical substances used to alter the valence state of another substance by donating or accepting electrons or by the addition or removal of hydrogen to a substance. Examples of oxidizing agents include nitric acid, perchlorates, hexavalent chromium compounds, and peroxydisulfuric acid salts. Examples of reducing agents include hydrazine, sodium thiosulfate, and coke produced from coal.
3.2.a	Processing: As a reactant	P199	Other	U999	Other (Specify)	Chemical substances used in a way other than those described by other codes.
3.2.b	Processing: As a formulation component	N/A	N/A	PF	Processing – incorporation into formulation, mixture, or reaction product	Chemical substance is added to a product (or product mixture) prior to further distribution of the product.
3.2.b	Processing: As a formulation component	P201	Additives	U007	Corrosion inhibitors and antiscaling agents	Chemical substances used to prevent or retard corrosion or the formation of scale. Examples include phenylenediamine, chromates, nitrates, phosphates, and hydrazine.
3.2.b	Processing: As a formulation component	P201	Additives	U009	Fillers	Chemical substances used to provide bulk, increase strength, increase hardness, or improve resistance to impact. Fillers incorporated in a matrix reduce production costs by minimizing the amount of more expensive substances used in the production of articles. Examples include calcium carbonate, barium sulfate, silicates, clays, zinc oxide and aluminum oxide.
3.2.b	Processing: As a formulation component	P201	Additives	U010	Finishing agents	Chemical substances used to impart such functions as softening, static proofing, wrinkle resistance, and water repellence. Substances may be applied to textiles, paper, and leather. Examples include quaternary ammonium compounds, ethoxylated amines, and silicone compounds.
3.2.b	Processing: As a formulation component	P201	Additives	U017	Lubricants and lubricant additives	Chemical substances used to reduce friction, heat, or wear between moving parts or adjacent solid surfaces, or that enhance the lubricity of other substances. Examples

TRI Section	TRI Description	TRI Sub-Use Code	TRI Sub-Use Code Name	2016 CDR Code	2016 CDR Code Name	2016 CDR Functional Use Definition
						of lubricants include mineral oils, silicate and phosphate esters, silicone oil, greases, and solid film lubricants such as graphite and PTFE. Examples of lubricant additives include molybdenum disulphide and tungsten disulphide.
3.2.b	Processing: As a formulation component	P201	Additives	U034	Paint additives and coating additives not described by other codes	Chemical substances used in a paint or coating formulation to enhance properties such as water repellence, increased gloss, improved fade resistance, ease of application, foam prevention, etc. Examples of paint additives and coating additives include polyols, amines, vinyl acetate ethylene emulsions, and aliphatic polyisocyanates.
3.2.b	Processing: As a formulation component	P202	Dyes	U008	Dyes	Chemical substances used to impart color to other materials or mixtures (*i.e.,* substrates) by penetrating the surface of the substrate. Example types include azo, anthraquinone, amino azo, aniline, eosin, stilbene, acid, basic or cationic, reactive, dispersive, and natural dyes.
3.2.b	Processing: As a formulation component	P202	Dyes	U021	Pigments	Chemical substances used to impart color to other materials or mixtures (*i.e.,* substrates) by attaching themselves to the surface of the substrate through binding or adhesion. This code includes fluorescent agents, luminescent agents, whitening agents, pearlizing agents, and opacifiers. Examples include metallic oxides of iron, titanium, zinc, cobalt, and chromium; metal powder suspensions; lead chromates; vegetable and animal products; and synthetic organic pigments.
3.2.b	Processing: As a formulation component	P203	Reaction Diluents	U030	Solvents (which become part of product formulation or mixture)	Chemical substances used to dissolve another substance (solute) to form a uniformly dispersed mixture (solution) at the molecular level. Examples include diluents used to reduce the concentration of an active material to achieve a specified effect and low gravity materials added to reduce cost.
3.2.b	Processing: As a formulation component	P203	Reaction Diluents	U032	Viscosity adjustors	Chemical substances used to alter the viscosity of another substance. Examples include viscosity index (VI) improvers, pour point depressants, and thickeners.

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3.2.b	Processing: As a formulation component	P204	Initiators	U024	Process regulators	Chemical substances used to change the rate of a chemical reaction, start, or stop the reaction, or otherwise influence the course of the reaction. Process regulators may be consumed or become part of the reaction product.
3.2.b	Processing: As a formulation component	P205	Solvents	U030	Solvents (which become part of product formulation or mixture)	Chemical substances used to dissolve another substance (solute) to form a uniformly dispersed mixture (solution) at the molecular level. Examples include diluents used to reduce the concentration of an active material to achieve a specified effect and low gravity materials added to reduce cost.
3.2.b	Processing: As a formulation component	P206	Inhibitors	U024	Process regulators	Chemical substances used to change the rate of a chemical reaction, start, or stop the reaction, or otherwise influence the course of the reaction. Process regulators may be consumed or become part of the reaction product.
3.2.b	Processing: As a formulation component	P207	Emulsifiers	U003	Adsorbents and absorbents	Chemical substances used to retain other substances by accumulation on their surface or by assimilation. Examples of adsorbents include silica gel, activated alumina, and activated carbon. Examples of absorbents include straw oil, alkaline solutions, and kerosene.
3.2.b	Processing: As a formulation component	P208	Surfactants	U002	Adhesives and sealant chemicals	Chemical substances used to promote bonding between other substances, promote adhesion of surfaces, or prevent seepage of moisture or air. Examples include epoxides, isocyanates, acrylamides, phenol, urea, melamine, and formaldehyde.
3.2.b	Processing: As a formulation component	P208	Surfactants	U023	Plating agents and surface treating agents	Chemical substances applied to metal, plastic, or other surfaces to alter physical or chemical properties of the surface. Examples include metal surface treating agents, strippers, etchants, rust and tarnish removers, and descaling agents.
3.2.b	Processing: As a formulation component	P208	Surfactants	U031	Surface active agents	Chemical substances used to modify surface tension when dissolved in water or water solutions or reduce interfacial tension between two liquids or between a liquid and a solid or between liquid and air. Examples include carboxylates, sulfonates, phosphates, carboxylic acid, esters, and quaternary ammonium salts.

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3.2.b	Processing: As a formulation component	P209	Lubricants	U017	Lubricants and lubricant additives	Chemical substances used to reduce friction, heat, or wear between moving parts or adjacent solid surfaces, or that enhance the lubricity of other substances. Examples of lubricants include mineral oils, silicate and phosphate esters, silicone oil, greases, and solid film lubricants such as graphite and PTFE. Examples of lubricant additives include molybdenum disulphide and tungsten disulphide.
3.2.b	Processing: As a formulation component	P210	Flame retardants	U011	Flame retardants	Chemical substances used on the surface of or incorporated into combustible materials to reduce or eliminate their tendency to ignite when exposed to heat or a flame for a short period of time. Examples include inorganic salts, chlorinated, or brominated organic compounds, and organic phosphates/phosphonates.
3.2.b	Processing: As a formulation component	P211	Rheological modifiers	U022	Plasticizers	Chemical substances used in plastics, cement, concrete, wallboard, clay bodies, or other materials to increase their plasticity or fluidity. Examples include phthalates, trimellitates, adipates, maleates, and lignosulphonates.
3.2.b	Processing: As a formulation component	P211	Rheological modifiers	U032	Viscosity adjustors	Chemical substances used to alter the viscosity of another substance. Examples include viscosity index (VI) improvers, pour point depressants, and thickeners.
3.2.b	Processing: As a formulation component	P299	Other	U003	Adsorbents and absorbents	Chemical substances used to retain other substances by accumulation on their surface or by assimilation. Examples of adsorbents include silica gel, activated alumina, and activated carbon. Examples of absorbents include straw oil, alkaline solutions, and kerosene.
3.2.b	Processing: As a formulation component	P299	Other	U016	Ion exchange agents	Chemical substances, usually in the form of a solid matrix, are used to selectively remove targeted ions from a solution. Examples generally consist of an inert hydrophobic matrix such as styrene divinylbenzene or phenol-formaldehyde, cross-linking polymer such as divinylbenzene, and ionic functional groups including sulfonic, carboxylic or phosphonic acids. This code also includes aluminosilicate zeolites.

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3.2.b	Processing: As a formulation component	P299	Other	U018	Odor agents	Chemical substances used to control odors, remove odors, mask odors, or impart odors. Examples include benzenoids, terpenes and terpenoids, musk chemicals, aliphatic aldehydes, aliphatic cyanides, and mercaptans.
3.2.b	Processing: As a formulation component	P299	Other	U019	Oxidizing/reducing agent	Chemical substances used to alter the valence state of another substance by donating or accepting electrons or by the addition or removal of hydrogen to a substance. Examples of oxidizing agents include nitric acid, perchlorates, hexavalent chromium compounds, and peroxydisulfuric acid salts. Examples of reducing agents include hydrazine, sodium thiosulfate, and coke produced from coal.
3.2.b	Processing: As a formulation component	P299	Other	U020	Photosensitive Chemicals	Chemical substances used for their ability to alter their physical or chemical structure through absorption of light, resulting in the emission of light, dissociation, discoloration, or other chemical reactions. Examples include sensitizers, fluorescents, photovoltaic agents, ultraviolet absorbers, and ultraviolet stabilizers.
3.2.b	Processing: As a formulation component	P299	Other	U027	Propellants and blowing agents	Chemical substances used to dissolve or suspend other substances and either to expel those substances from a container in the form of an aerosol or to impart a cellular structure to plastics, rubber, or thermos set resins. Examples include compressed gasses and liquids and substances which release ammonia, carbon dioxide, or nitrogen.
3.2.b	Processing: As a formulation component	P299	Other	U028	Solid separation agents	Chemical substances used to promote the separation of suspended solids from a liquid. Examples include flotation aids, flocculants, coagulants, dewatering aids, and drainage aids.
3.2.b	Processing: As a formulation component	P299	Other	U999	Other (specify)	Chemical substances used in a way other than those described by other codes.
3.2.c	Processing: As an article component	N/A	N/A	PA	Processing – incorporation into article	Chemical substance becomes an integral component of an article distributed for industrial, trade, or consumer use.

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3.2.c	Processing: As an article component	N/A	N/A	U008	Dyes	Chemical substances used to impart color to other materials or mixtures (*i.e.,* substrates) by penetrating the surface of the substrate. Example types include azo, anthraquinone, amino azo, aniline, eosin, stilbene, acid, basic or cationic, reactive, dispersive, and natural dyes.
3.2.c	Processing: As an article component	N/A	N/A	U009	Fillers	Chemical substances used to provide bulk, increase strength, increase hardness, or improve resistance to impact. Fillers incorporated in a matrix reduce production costs by minimizing the amount of more expensive substances used in the production of articles. Examples include calcium carbonate, barium sulfate, silicates, clays, zinc oxide and aluminum oxide.
3.2.c	Processing: As an article component	N/A	N/A	U021	Pigments	Chemical substances used to impart color to other materials or mixtures (*i.e.,* substrates) by attaching themselves to the surface of the substrate through binding or adhesion. This code includes fluorescent agents, luminescent agents, whitening agents, pearlizing agents, and opacifiers. Examples include metallic oxides of iron, titanium, zinc, cobalt, and chromium; metal powder suspensions; lead chromates; vegetable and animal products; and synthetic organic pigments.
3.2.c	Processing: As an article component	N/A	N/A	U034	Paint additives and coating additives not described by other codes	Chemical substances used in a paint or coating formulation to enhance properties such as water repellence, increased gloss, improved fade resistance, ease of application, foam prevention, etc. Examples of paint additives and coating additives include polyols, amines, vinyl acetate ethylene emulsions, and aliphatic polyisocyanates.
3.2.c	Processing: As an article component	N/A	N/A	U999	Other (specify)	Chemical substances used in a way other than those described by other codes.
3.2.d	Processing: Repackaging	N/A	N/A	PK	Processing – repackaging	Preparation of a chemical substance for distribution in commerce in a different form, state, or quantity. This includes transferring the chemical substance from a bulk container into smaller containers. This definition does not apply to sites that only relabel or redistribute the

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						reportable chemical substance without removing the chemical substance from the container in which it is received or purchased.
3.2.e	Processing: As an impurity	N/A	N/A	N/A	N/A	N/A
3.2.f	Processing: Recycling	N/A	N/A	N/A	N/A	N/A
3.3.a	Otherwise use: As a chemical processing aid	N/A	N/A	U	Use – non-incorporative activities	Chemical substance is otherwise used (*e.g.,* as a chemical processing or manufacturing aid).
3.3.a	Otherwise use: As a chemical processing aid	Z101	Process Solvents	U029	Solvents (for cleaning or degreasing)	Chemical substances used to dissolve oils, greases, and similar materials from textiles, glassware, metal surfaces, and other articles. Examples include trichloroethylene, perchloroethylene, methylene chloride, liquid carbon dioxide, and n-propyl bromide.
3.3.a	Otherwise use: As a chemical processing aid	Z102	Catalysts	U020	Photosensitive chemicals	Chemical substances used for their ability to alter their physical or chemical structure through absorption of light, resulting in the emission of light, dissociation, discoloration, or other chemical reactions. Examples include sensitizers, fluorescents, photovoltaic agents, ultraviolet absorbers, and ultraviolet stabilizers.
3.3.a	Otherwise use: As a chemical processing aid	Z102	Catalysts	U025	Processing aids, specific to petroleum production	Chemical substances added to water-, oil-, or synthetic drilling muds or other petroleum production fluids to control viscosity, foaming, corrosion, alkalinity and pH, microbiological growth, hydrate formation, etc., during the production of oil, gas, and other products from beneath the earth's surface.
3.3.a	Otherwise use: As a chemical processing aid	Z102	Catalysts	U026	Processing aids, not otherwise listed	Chemical substances used to improve the processing characteristics or the operation of process equipment or to alter or buffer the pH of the substance or mixture, when added to a process or to a substance or mixture to be processed. Processing agents do not become a part of the reaction product and are not intended to affect the function of a substance or article created. Examples include buffers, dehumidifiers, dehydrating agents, sequestering agents, and chelators.

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3.3.a	Otherwise use: As a chemical processing aid	Z103	Inhibitors	U024	Process regulators	Chemical substances used to change the rate of a chemical reaction, start or stop the reaction, or otherwise influence the course of the reaction. Process regulators may be consumed or become part of the reaction product.
3.3.a	Otherwise use: As a chemical processing aid	Z103	Inhibitors	U025	Processing aids, specific to petroleum production	Chemical substances added to water-, oil-, or synthetic drilling muds or other petroleum production fluids to control viscosity, foaming, corrosion, alkalinity and pH, microbiological growth, hydrate formation, etc., during the production of oil, gas, and other products from beneath the earth's surface.
3.3.a	Otherwise use: As a chemical processing aid	Z103	Inhibitors	U026	Processing aids, not otherwise listed	Chemical substances used to improve the processing characteristics or the operation of process equipment or to alter or buffer the pH of the substance or mixture, when added to a process or to a substance or mixture to be processed. Processing agents do not become a part of the reaction product and are not intended to affect the function of a substance or article created. Examples include buffers, dehumidifiers, dehydrating agents, sequestering agents, and chelators.
3.3.a	Otherwise use: As a chemical processing aid	Z104	Initiators	U024	Process regulators	Chemical substances used to change the rate of a chemical reaction, start, or stop the reaction, or otherwise influence the course of the reaction. Process regulators may be consumed or become part of the reaction product.
3.3.a	Otherwise use: As a chemical processing aid	Z104	Initiators	U025	Processing aids, specific to petroleum production	Chemical substances added to water-, oil-, or synthetic drilling muds or other petroleum production fluids to control viscosity, foaming, corrosion, alkalinity and pH, microbiological growth, hydrate formation, etc., during the production of oil, gas, and other products from beneath the earth's surface.
3.3.a	Otherwise use: As a chemical processing aid	Z104	Initiators	U026	Processing aids, not otherwise listed	Chemical substances used to improve the processing characteristics or the operation of process equipment or to alter or buffer the pH of the substance or mixture, when added to a process or to a substance or mixture to be processed. Processing agents do not become a part of the reaction product and are not intended to affect the

TRI Section	TRI Description	TRI Sub-Use Code	TRI Sub-Use Code Name	2016 CDR Code	2016 CDR Code Name	2016 CDR Functional Use Definition
						function of a substance or article created. Examples include buffers, dehumidifiers, dehydrating agents, sequestering agents, and chelators.
3.3.a	Otherwise use: As a chemical processing aid	Z105	Reaction terminators	U024	Process regulators	Chemical substances used to change the rate of a chemical reaction, start, or stop the reaction, or otherwise influence the course of the reaction. Process regulators may be consumed or become part of the reaction product.
3.3.a	Otherwise use: As a chemical processing aid	Z105	Reaction terminators	U025	Processing aids, specific to petroleum production	Chemical substances added to water-, oil-, or synthetic drilling muds or other petroleum production fluids to control viscosity, foaming, corrosion, alkalinity and pH, microbiological growth, hydrate formation, etc., during the production of oil, gas, and other products from beneath the earth's surface.
3.3.a	Otherwise use: As a chemical processing aid	Z105	Reaction terminators	U026	Processing aids, not otherwise listed	Chemical substances used to improve the processing characteristics or the operation of process equipment or to alter or buffer the pH of the substance or mixture, when added to a process or to a substance or mixture to be processed. Processing agents do not become a part of the reaction product and are not intended to affect the function of a substance or article created. Examples include buffers, dehumidifiers, dehydrating agents, sequestering agents, and chelators.
3.3.a	Otherwise use: As a chemical processing aid	Z106	Solution buffers	U026	Processing aids, not otherwise listed	Chemical substances used to improve the processing characteristics or the operation of process equipment or to alter or buffer the pH of the substance or mixture, when added to a process or to a substance or mixture to be processed. Processing agents do not become a part of the reaction product and are not intended to affect the function of a substance or article created. Examples include buffers, dehumidifiers, dehydrating agents, sequestering agents, and chelators.
3.3.a	Otherwise use: As a chemical processing aid	Z199	Other	U002	Adhesives and sealant chemicals	Chemical substances used to promote bonding between other substances, promote adhesion of surfaces, or prevent seepage of moisture or air. Examples include

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						epoxides, isocyanates, acrylamides, phenol, urea, melamine, and formaldehyde.
3.3.a	Otherwise use: As a chemical processing aid	Z199	Other	U006	Bleaching agents	Chemical substances used to lighten or whiten a substrate through chemical reaction, usually an oxidative process which degrades the color system. Examples generally fall into one of two groups: chlorine containing bleaching agents (*e.g.,* chlorine, hypochlorite, N-chloro compounds and chlorine dioxide); and peroxygen bleaching agents (*e.g.,* hydrogen peroxide, potassium permanganate, and sodium perborate).
3.3.a	Otherwise use: As a chemical processing aid	Z199	Other	U018	Odor agents	Chemical substances used to control odors, remove odors, mask odors, or impart odors. Examples include benzenoids, terpenes and terpenoids, musk chemicals, aliphatic aldehydes, aliphatic cyanides, and mercaptans.
3.3.a	Otherwise use: As a chemical processing aid	Z199	Other	U023	Plating agents and surface treating agents	Chemical substances applied to metal, plastic, or other surfaces to alter physical or chemical properties of the surface. Examples include metal surface treating agents, strippers, etchants, rust and tarnish removers, and descaling agents.
3.3.a	Otherwise use: As a chemical processing aid	Z199	Other	U025	Processing aids, specific to petroleum production	Chemical substances added to water-, oil-, or synthetic drilling muds or other petroleum production fluids to control viscosity, foaming, corrosion, alkalinity and pH, microbiological growth, hydrate formation, etc., during the production of oil, gas, and other products from beneath the earth's surface.
3.3.a	Otherwise use: As a chemical processing aid	Z199	Other	U026	Processing aids, not otherwise listed	Chemical substances used to improve the processing characteristics or the operation of process equipment or to alter or buffer the pH of the substance or mixture, when added to a process or to a substance or mixture to be processed. Processing agents do not become a part of the reaction product and are not intended to affect the function of a substance or article created. Examples include buffers, dehumidifiers, dehydrating agents, sequestering agents, and chelators.

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3.3.a	Otherwise use: As a chemical processing aid	Z199	Other	U028	Solid separation agents	Chemical substances used to promote the separation of suspended solids from a liquid. Examples include flotation aids, flocculants, coagulants, dewatering aids, and drainage aids.
3.3.b	Otherwise use: As a manufacturing aid	N/A	N/A	U	Use – Non-incorporative activities	Chemical substance is otherwise used (*e.g.,* as a chemical processing or manufacturing aid).
3.3.b	Otherwise use: As a manufacturing aid	Z201	Process lubricants	U017	Lubricants and lubricant additives	Chemical substances used to reduce friction, heat, or wear between moving parts or adjacent solid surfaces, or that enhance the lubricity of other substances. Examples of lubricants include mineral oils, silicate and phosphate esters, silicone oil, greases, and solid film lubricants such as graphite and PTFE. Examples of lubricant additives include molybdenum disulphide and tungsten disulphide.
3.3.b	Otherwise use: As a manufacturing aid	Z202	Metalworking fluids	U007	Corrosion inhibitors and antiscaling agents	Chemical substances used to prevent or retard corrosion or the formation of scale. Examples include phenylenediamine, chromates, nitrates, phosphates, and hydrazine.
3.3.b	Otherwise use: As a manufacturing aid	Z202	Metalworking fluids	U014	Functional fluids (open systems)	Liquid or gaseous chemical substances used for one or more operational properties in an open system. Examples include antifreezes and de–icing fluids such as ethylene and propylene glycol, sodium formate, potassium acetate, and sodium acetate. This code also includes substances incorporated into metal working fluids.
3.3.b	Otherwise use: As a manufacturing aid	Z203	Coolants	U013	Functional fluids (closed systems)	Liquid or gaseous chemical substances used for one or more operational properties in a closed system. Examples include heat transfer agents (*e.g.,* coolants and refrigerants) such as polyalkylene glycols, silicone oils, liquified propane, and carbon dioxide; hydraulic/transmission fluids such as mineral oils, organophosphate esters, silicone, and propylene glycol; and dielectric fluids such as mineral insulating oil and high flash point kerosene. This code does not include fluids used as lubricants.

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3.3.b	Otherwise use: As a manufacturing aid	Z204	Refrigerants	U013	Functional fluids (closed systems)	Liquid or gaseous chemical substances used for one or more operational properties in a closed system. Examples include heat transfer agents (*e.g.,* coolants and refrigerants) such as polyalkylene glycols, silicone oils, liquified propane, and carbon dioxide; hydraulic/transmission fluids such as mineral oils, organophosphate esters, silicone, and propylene glycol; and dielectric fluids such as mineral insulating oil and high flash point kerosene. This code does not include fluids used as lubricants.
3.3.b	Otherwise use: As a manufacturing aid	Z205	Hydraulic fluids	U013	Functional fluids (closed systems)	Liquid or gaseous chemical substances used for one or more operational properties in a closed system. Examples include: heat transfer agents (*e.g.,* coolants and refrigerants) such as polyalkylene glycols, silicone oils, liquified propane, and carbon dioxide; hydraulic/transmission fluids such as mineral oils, organophosphate esters, silicone, and propylene glycol; and dielectric fluids such as mineral insulating oil and high flash point kerosene. This code does not include fluids used as lubricants.
3.3.b	Otherwise use: As a manufacturing aid	Z299	Other	U013	Functional fluids (closed systems)	Liquid or gaseous chemical substances used for one or more operational properties in a closed system. Examples include: heat transfer agents (*e.g.,* coolants and refrigerants) such as polyalkylene glycols, silicone oils, liquified propane, and carbon dioxide; hydraulic/transmission fluids such as mineral oils, organophosphate esters, silicone, and propylene glycol; and dielectric fluids such as mineral insulating oil and high flash point kerosene. This code does not include fluids used as lubricants.
3.3.b	Otherwise use: As a manufacturing aid	Z299	Other	U023	Plating agents and surface treating agents	Chemical substances applied to metal, plastic, or other surfaces to alter physical or chemical properties of the surface. Examples include metal surface treating agents, strippers, etchants, rust and tarnish removers, and descaling agents.

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3.3.c	Otherwise use: Ancillary or other use	N/A	N/A	U	Use − Non incorporative activities	Chemical substance is otherwise used (*e.g.,* as a chemical processing or manufacturing aid).
3.3.c	Otherwise use: Ancillary or other use	Z301	Cleaner	U007	Corrosion inhibitors and antiscaling agents	Chemical substances used to prevent or retard corrosion or the formation of scale. Examples include phenylenediamine, chromates, nitrates, phosphates, and hydrazine.
3.3.c	Otherwise use: Ancillary or other use	Z301	Cleaner	U029	Solvents (for cleaning or degreasing)	Chemical substances used to dissolve oils, greases, and similar materials from textiles, glassware, metal surfaces, and other articles. Examples include trichloroethylene, perchloroethylene, methylene chloride, liquid carbon dioxide, and n-propyl bromide.
3.3.c	Otherwise use: Ancillary or other use	Z302	Degreaser	U003	Adsorbents and absorbents	Chemical substances used to retain other substances by accumulation on their surface or by assimilation. Examples of adsorbents include silica gel, activated alumina, and activated carbon. Examples of absorbents include straw oil, alkaline solutions, and kerosene.
3.3.c	Otherwise use: Ancillary or other use	Z302	Degreaser	U029	Solvents (for cleaning or degreasing)	Chemical substances used to dissolve oils, greases, and similar materials from textiles, glassware, metal surfaces, and other articles. Examples include trichloroethylene, perchloroethylene, methylene chloride, liquid carbon dioxide, and n-propyl bromide.
3.3.c	Otherwise use: Ancillary or other use	Z303	Lubricant	U017	Lubricants and lubricant additives	Chemical substances used to reduce friction, heat, or wear between moving parts or adjacent solid surfaces, or that enhance the lubricity of other substances. Examples of lubricants include mineral oils, silicate and phosphate esters, silicone oil, greases, and solid film lubricants such as graphite and PTFE. Examples of lubricant additives include molybdenum disulphide and tungsten disulphide.
3.3.c	Otherwise use: Ancillary or other use	Z304	Fuel	U012	Fuels and fuel additives	Chemical substances used to create mechanical or thermal energy through chemical reactions, or which are added to a fuel for the purpose of controlling the rate of reaction or limiting the production of undesirable combustion products, or which provide other benefits such as corrosion inhibition, lubrication, or detergency.

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						Examples of fuels include coal, oil, gasoline, and various grades of diesel fuel. Examples of fuel additives include oxygenated compound such as ethers and alcohols, antioxidants such as phenylenediamines and hindered phenols, corrosion inhibitors such as carboxylic acids, amines, and amine salts, and blending agents such as ethanol.
3.3.c	Otherwise use: Ancillary or other use	Z305	Flame retardant	U011	Flame retardants	Chemical substances used on the surface of or incorporated into combustible materials to reduce or eliminate their tendency to ignite when exposed to heat or a flame for a short period of time. Examples include inorganic salts, chlorinated, or brominated organic compounds, and organic phosphates/phosphonates.
3.3.c	Otherwise use: Ancillary or other use	Z306	Waste treatment	U006	Bleaching agents	Chemical substances used to lighten or whiten a substrate through chemical reaction, usually an oxidative process which degrades the color system. Examples generally fall into one of two groups: chlorine containing bleaching agents (*e.g.,* chlorine, hypochlorites, N-chloro compounds and chlorine dioxide); and peroxygen bleaching agents (*e.g.,* hydrogen peroxide, potassium permanganate, and sodium perborate).
3.3.c	Otherwise use: Ancillary or other use	Z306	Waste treatment	U018	Odor agents	Chemical substances used to control odors, remove odors, mask odors, or impart odors. Examples include benzenoids, terpenes and terpenoids, musk chemicals, aliphatic aldehydes, aliphatic cyanides, and mercaptans.
3.3.c	Otherwise use: Ancillary or other use	Z306	Waste treatment	U019	Oxidizing/ reducing agent	Chemical substances used to alter the valence state of another substance by donating or accepting electrons or by the addition or removal of hydrogen to a substance. Examples of oxidizing agents include nitric acid, perchlorates, hexavalent chromium compounds, and peroxydisulfuric acid salts. Examples of reducing agents include hydrazine, sodium thiosulfate, and coke produced from coal.
3.3.c	Otherwise use: Ancillary or other use	Z306	Waste treatment	U028	Solid separation agents	Chemical substances used to promote the separation of suspended solids from a liquid. Examples include

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						flotation aids, flocculants, coagulants, dewatering aids, and drainage aids.
3.3.c	Otherwise use: Ancillary or other use	Z307	Water treatment	U006	Bleaching agents	Chemical substances used to lighten or whiten a substrate through chemical reaction, usually an oxidative process which degrades the color system. Examples generally fall into one of two groups: chlorine containing bleaching agents (*e.g.,* chlorine, hypochlorites, N-chloro compounds and chlorine dioxide); and peroxygen bleaching agents (*e.g.,* hydrogen peroxide, potassium permanganate, and sodium perborate).
3.3.c	Otherwise use: Ancillary or other use	Z307	Water treatment	U018	Odor agents	Chemical substances used to control odors, remove odors, mask odors, or impart odors. Examples include benzenoids, terpenes and terpenoids, musk chemicals, aliphatic aldehydes, aliphatic cyanides, and mercaptans.
3.3.c	Otherwise use: Ancillary or other use	Z307	Water treatment	U019	Oxidizing/reducing agent	Chemical substances used to alter the valence state of another substance by donating or accepting electrons or by the addition or removal of hydrogen to a substance. Examples of oxidizing agents include nitric acid, perchlorates, hexavalent chromium compounds, and peroxydisulfuric acid salts. Examples of reducing agents include hydrazine, sodium thiosulfate, and coke produced from coal.
3.3.c	Otherwise use: Ancillary or other use	Z307	Water treatment	U028	Solid separation agents	Chemical substances used to promote the separation of suspended solids from a liquid. Examples include flotation aids, flocculants, coagulants, dewatering aids, and drainage aids.
3.3.c	Otherwise use: Ancillary or other use	Z308	Construction materials	N/A	N/A	N/A
3.3.c	Otherwise use: Ancillary or other use	Z399	Other	U001	Abrasives	Chemical substances used to wear down or polish surfaces by rubbing against the surface. Examples include sandstones, pumice, silex, quartz, silicates, aluminum oxides, and glass.
3.3.c	Otherwise use: Ancillary or other use	Z399	Other	U013	Functional fluids (closed systems)	Liquid or gaseous chemical substances used for one or more operational properties in a closed system. Examples include heat transfer agents (*e.g.,* coolants and

TRI Section	TRI Description	TRI Sub-Use Code	TRI Sub-Use Code Name	2016 CDR Code	2016 CDR Code Name	2016 CDR Functional Use Definition
						refrigerants) such as polyalkylene glycols, silicone oils, liquified propane, and carbon dioxide; hydraulic/transmission fluids such as mineral oils, organophosphate esters, silicone, and propylene glycol; and dielectric fluids such as mineral insulating oil and high flash point kerosene. This code does not include fluids used as lubricants.
3.3.c	Otherwise use: Ancillary or other use	Z399	Other	U014	Functional fluids (open systems)	Liquid or gaseous chemical substances used for one or more operational properties in an open system. Examples include antifreezes and de-icing fluids such as ethylene and propylene glycol, sodium formate, potassium acetate, and sodium acetate. This code also includes substances incorporated into metal working fluids.
3.3.c	Otherwise use: Ancillary or other use	Z399	Other	U018	Odor agents	Chemical substances used to control odors, remove odors, mask odors, or impart odors. Examples include benzenoids, terpenes and terpenoids, musk chemicals, aliphatic aldehydes, aliphatic cyanides, and mercaptans.
3.3.c	Otherwise use: Ancillary or other use	Z399	Other	U020	Photosensitive chemicals	Chemical substances used for their ability to alter their physical or chemical structure through absorption of light, resulting in the emission of light, dissociation, discoloration, or other chemical reactions. Examples include sensitizers, fluorescents, photovoltaic agents, ultraviolet absorbers, and ultraviolet stabilizers.
3.3.c	Otherwise use: Ancillary or other use	Z399	Other	U023	Plating agents and surface treating agents	Chemical substances applied to metal, plastic, or other surfaces to alter physical or chemical properties of the surface. Examples include metal surface treating agents, strippers, etchants, rust and tarnish removers, and descaling agents.

Appendix C ESTIMATING DAILY WASTEWATER DISCHARGES FROM TOXICS RELEASE INVENTORY DATA

This section provides steps and examples for estimating daily wastewater discharges from industrial and commercial facilities manufacturing, processing, or using chemicals undergoing risk evaluation under TSCA. Wastewater discharges are reported either via DMRs under NPDES or the Toxics Release Inventory (TRI).

Estimation Methods are provided:

- Average Daily Wastewater Discharge Rate (kg/site-day); and
- Trends over five years for a facility including the Maximum, Median, and Most Recent annual wastewater discharge rate that has occurred for a facility within the past 5 years.

These estimates were used in modeling to estimate surface water concentrations in receiving waters for the assessment of risks to aquatic species and to the general population from drinking water.

C.1 Collecting and Mapping Wastewater Discharge Data to COU

The first step in estimating daily releases is obtaining and mapping the relevant data to the conditions of use (COUs) for the chemical that were identified in the scoping document. Some COUs may be broad categories of use and additional steps may be taken in the risk evaluation to further define the COUs. A methodology for how to do this mapping step has been developed and the key steps are described below.

1. Query the Loading Tool and TRI for each of the past five years, starting with the most recent calendar year for which TRI data are available.
2. Map each facility to a COU. The COU will inform estimates of average operating days per year for the facility.

C.2 Estimating the Number of Facility Operating Days per Year

The number of operating days per year for each facility that reports wastewater discharges may be available but will most likely be unknown. Section 2.2.2 of this report describes approach for estimating number of days.

C.3 Approach for Estimating Daily Discharge

After the initial steps of selecting and mapping of the water discharge data and estimating the number of facility operating days per year have been completed, the next steps in the analysis are to make estimates of daily wastewater discharges.

The following steps should be taken to estimate the average daily wastewater discharge for each facility for each year:

1. Obtain reported annual surface water discharges in TRI.
2. Divide the annual discharge over the number of estimated operating days for the COU to which the facility has been mapped. The number of operating days will differ for each COU and chemical but typically ranges from 200 to 350 days per year (see Section 2.2.2 for approach to estimating operating days per year).

This approach can be used for both direct discharges to surface water and indirect discharges to POTW or non-POTW WWT.

C.4 Trends in Wastewater Discharge Data: 5-Year Data Characterization

Wastewater discharge data may vary from year to year for a facility due to factors including the economy. A trend of the releases from each facility can be used to characterize results and develop a range of potential discharges from each site. A 5-year period will be used for this analysis. Prior to calculating the 5-year statistics, it is recommended that an evaluation be done of whether the 5-year range includes any outlier years and remove them from the analysis to ensure no atypical years are being included in the statistics. The interquartile rule for outliers can be used for this analysis.

The interquartile rule for outliers states that if the distance between a data point and the first or third quartile is greater than 1.5 times the interquartile range (IQR), the data point is an outlier. The IQR is the difference between the third quartile (*i.e.,* 75th percentile) and first quartile (*i.e.,* 25th percentile) of a data set. Therefore, any values less than 25th percentile − 1.5IQR or values greater than 75th percentile + 1.5IQR would be considered outliers.

After any outliers are removed, the 5-year maximum, median, and most recent (if different than the maximum) annual discharge and associated daily discharge (using the method in Appendix Subsection C.3 should be determined for each facility.

C.5 Example Facilities

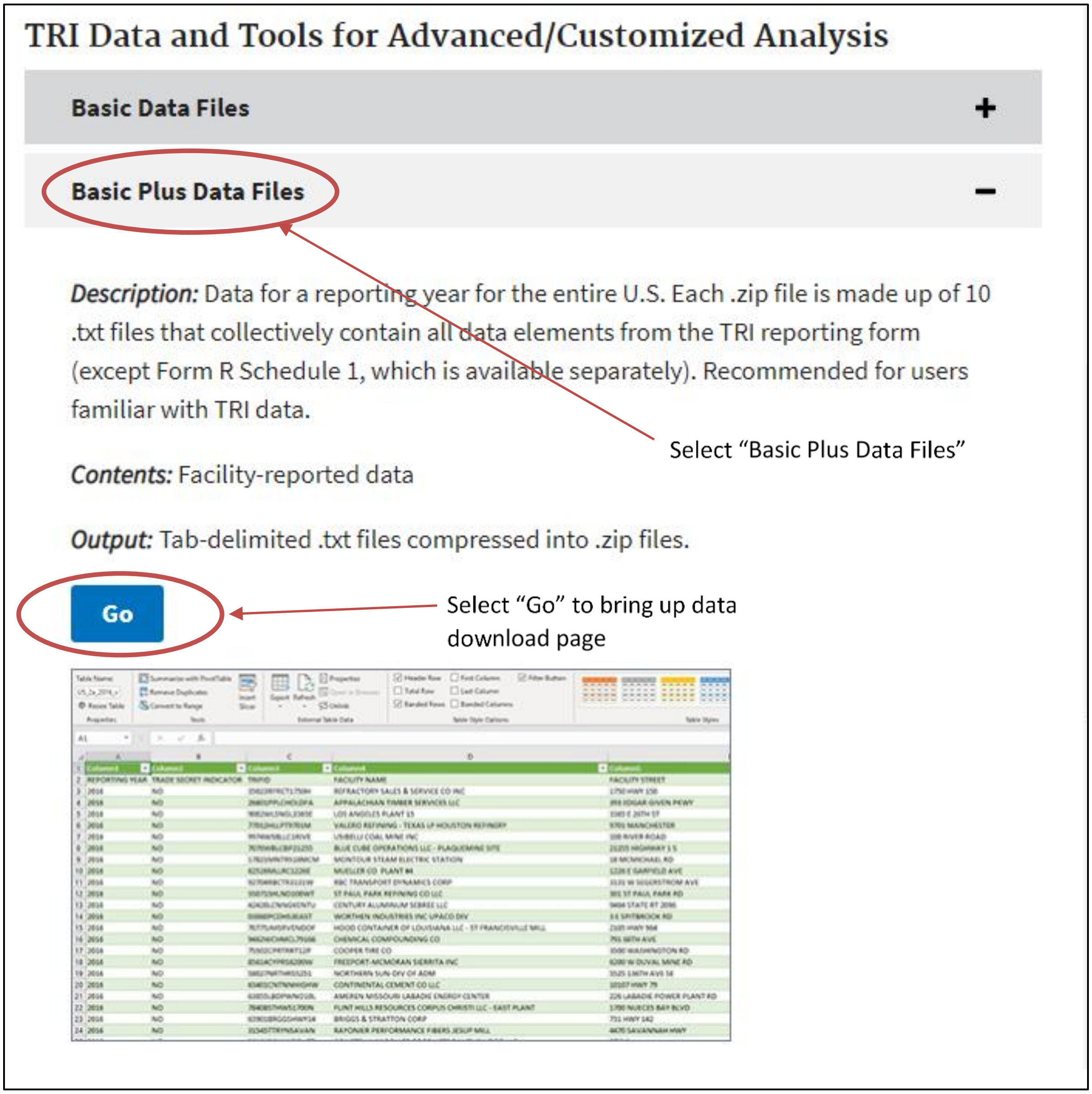
This section illustrates how to calculate average daily discharges. The example provided is for one facility reporting for TBBPA:

1. Sabic Innovative Plastics Mt. Vernon LLC in Mount Vernon, Indiana, reports to TRI only.

For purposes of this example, only a single year for each database is presented.

Obtaining TRI Data

TRI data is available in several formats with various levels of detail depending on the type of information a user intends to use. For this analysis, the “Basic Plus Data Files” were used. This data can be obtained by going to the following website: https://www.epa.gov/toxics-release-inventory-tri-program/tri-data-and-tools, selecting “Basic Plus Data Files”, then “Go” as shown in Figure_Apx C-1.

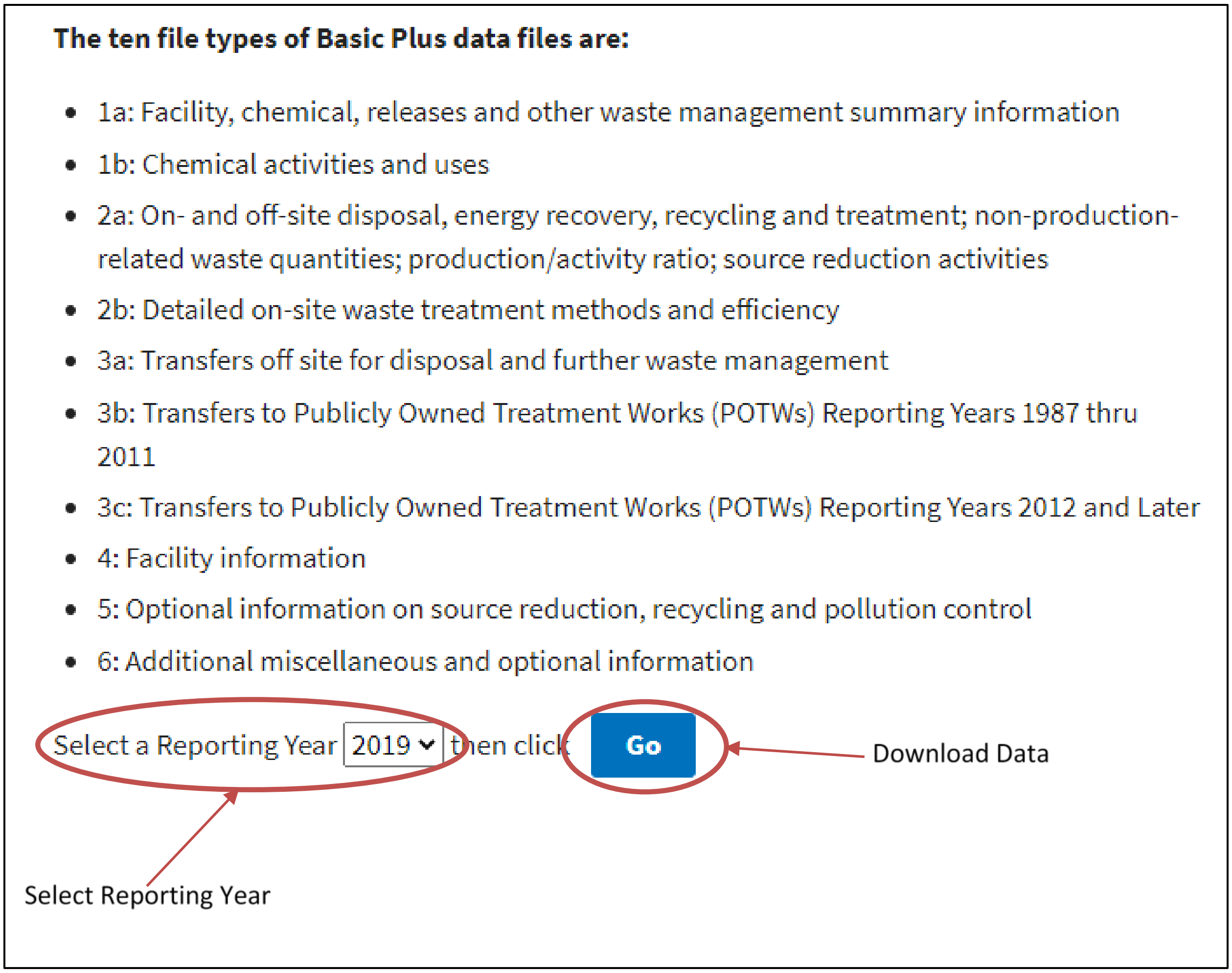


Figure_Apx C-1. Accessing Basic Plus Data Files

Guides for accessing, downloading, and importing the Basic Plus Data files can be found on [EPA's website]() (accessed May 21, 2026).

The subsequent webpage can then be used to select the reporting year of interest and download the data files as shown in Figure_Apx C-2. This will provide a zip file containing multiple tab-delimited .txt files, which can be imported into Excel Spreadsheets and contain all the 2023 TRI data for all chemicals, including annual direct and indirect wastewater discharges. The files can then be filtered for the chemical of interest and facilities with non-zero discharges.[6] Table_Apx C-1 provides a list of key data fields and which Basic Plus data file they can be obtained from.

[6] Facilities using a Form A rather than a Form R to report to TRI do not report any release information; therefore, the wastewater discharges for these facilities will be shown as "0" in the TRI data files. However, these may not be true zero discharges. Discharges from these facilities may need to be estimated separately and is outside the scope of this TSD.



Figure_Apx C-2. Downloading Basic Data Plus Files on TRI

Table_Apx C-1. List of Key Data Fields from TRI Basic Plus Data

TRI Basic Plus Data File	Field Name
US_1a_[Year]	1. FORM TYPE
US_1a_[Year]	2. REPORTING YEAR
US_1a_[Year]	9. TRIFD
US_1a_[Year]	10. FACILITY NAME
US_1a_[Year]	11. FACILITY STREET
US_1a_[Year]	12. FACILITY CITY
US_1a_[Year]	13. FACILITY COUNTY
US_1a_[Year]	14. FACILITY STATE
US_1a_[Year]	15. FACILITY ZIP CODE
US_1a_[Year]	41. PRIMARY NAICS CODE
US_1a_[Year]	47. LATITUDE
US_1a_[Year]	48. LONGITUDE
US_1a_[Year]	74. FRS FACILITY ID

TRI Basic Plus Data File	Field Name
US_1a_[Year]	76. CAS NUMBER
US_1a_[Year]	77. CHEMICAL NAME
US_1a_[Year]	81. UNIT OF MEASURE
US_1a_[Year]	112. DISCHARGES TO STREAM A—STREAM NAME
US_1a_[Year]	113. DISCHARGES TO STREAM A—RELEASE POUNDS
US_1a_[Year]	114. DISCHARGES TO STREAM A—RELEASE RANGE CODE
US_1a_[Year]	115. TOTAL DISCHARGES TO STREAM A
US_1a_[Year]	116. DISCHARGES TO STREAM A—BASIS OF ESTIMATE
US_1a_[Year]	117. DISCHARGES TO STREAM A—% FROM STORMWATER
US_1a_[Year]	118. DISCHARGES TO STREAM B—STREAM NAME
US_1a_[Year]	119. DISCHARGES TO STREAM B—RELEASE POUNDS
US_1a_[Year]	120. DISCHARGES TO STREAM B—RELEASE RANGE CODE
US_1a_[Year]	121. TOTAL DISCHARGES TO STREAM B
US_1a_[Year]	122. DISCHARGES TO STREAM B—BASIS OF ESTIMATE
US_1a_[Year]	123. DISCHARGES TO STREAM B—% FROM STORMWATER
US_1a_[Year]	124. DISCHARGES TO STREAM C—STREAM NAME
US_1a_[Year]	125. DISCHARGES TO STREAM C—RELEASE POUNDS
US_1a_[Year]	126. DISCHARGES TO STREAM C—RELEASE RANGE CODE
US_1a_[Year]	127. TOTAL DISCHARGES TO STREAM C
US_1a_[Year]	128. DISCHARGES TO STREAM C—BASIS OF ESTIMATE
US_1a_[Year]	129. DISCHARGES TO STREAM C—% FROM STORMWATER
US_1a_[Year]	130. DISCHARGES TO STREAM D—STREAM NAME
US_1a_[Year]	131. DISCHARGES TO STREAM D—RELEASE POUNDS
US_1a_[Year]	132. DISCHARGES TO STREAM D—RELEASE RANGE CODE
US_1a_[Year]	133. TOTAL DISCHARGES TO STREAM D
US_1a_[Year]	134. DISCHARGES TO STREAM D—BASIS OF ESTIMATE
US_1a_[Year]	135. DISCHARGES TO STREAM D—% FROM STORMWATER
US_1a_[Year]	136. DISCHARGES TO STREAM E—STREAM NAME
US_1a_[Year]	137. DISCHARGES TO STREAM E—RELEASE POUNDS
US_1a_[Year]	138. DISCHARGES TO STREAM E—RELEASE RANGE CODE
US_1a_[Year]	139. TOTAL DISCHARGES TO STREAM E
US_1a_[Year]	140. DISCHARGES TO STREAM E—BASIS OF ESTIMATE
US_1a_[Year]	141. DISCHARGES TO STREAM E—% FROM STORMWATER
US_1a_[Year]	142. DISCHARGES TO STREAM F—STREAM NAME
US_1a_[Year]	143. DISCHARGES TO STREAM F—RELEASE POUNDS
US_1a_[Year]	144. DISCHARGES TO STREAM F—RELEASE RANGE CODE
US_1a_[Year]	145 TOTAL DISCHARGES TO STREAM F
US_1a_[Year]	146 DISCHARGES TO STREAM F—BASIS FOR ESTIMATE
US_1a_[Year]	147. DISCHARGES TO STREAM F—% FROM STORMWATER
US_1a_[Year]	148. DISCHARGES TO STREAM G—STREAM NAME

TRI Basic Plus Data File	Field Name
US_1a_[Year]	149. DISCHARGES TO STREAM G—RELEASE POUNDS
US_1a_[Year]	150. DISCHARGES TO STREAM G—RELEASE RANGE CODE
US_1a_[Year]	151. TOTAL DISCHARGES TO STREAM G
US_1a_[Year]	152. DISCHARGES TO STREAM G—BASIS FOR ESTIMATE
US_1a_[Year]	153. DISCHARGES TO STREAM G—% FROM STORMWATER
US_1a_[Year]	154. DISCHARGES TO STREAM H—STREAM NAME
US_1a_[Year]	155. DISCHARGES TO STREAM H—RELEASE POUNDS
US_1a_[Year]	156. DISCHARGES TO STREAM H—RELEASE RANGE CODE
US_1a_[Year]	157. TOTAL DISCHARGES TO STREAM H
US_1a_[Year]	158. DISCHARGES TO STREAM H—BASIS FOR ESTIMATE
US_1a_[Year]	159. DISCHARGES TO STREAM H—% FROM STORMWATER
US_1a_[Year]	160. DISCHARGES TO STREAM I—STREAM NAME
US_1a_[Year]	161. DISCHARGES TO STREAM I—RELEASE POUNDS
US_1a_[Year]	162. DISCHARGES TO STREAM I—RELEASE RANGE CODE
US_1a_[Year]	163. TOTAL DISCHARGES TO STREAM I
US_1a_[Year]	164. DISCHARGES TO STREAM I—BASIS FOR ESTIMATE
US_1a_[Year]	165. DISCHARGES TO STREAM I—% FROM STORMWATER
US_1a_[Year]	166. TOTAL NUMBER OF RECEIVING STREAMS
US_1a_[Year]	167. TOTAL SURFACE WATER DISCHARGE
US_1a_[Year]	217. OFF SITE—POTW RELEASES 81C
US_1a_[Year]	218. OFF SITE—POTW RELEASES 81D
US_1a_[Year]	219. OFF SITE—POTW RELEASES
US_1a_[Year]	222. OFF-SITE—WASTEWATER TREATMENT RELEASE (EXCLUDING POTWs)—METALS AND METAL COMPOUNDS ONLY
US_1a_[Year]	224. OFF-SITE—WASTEWATER TREATMENT (EXCLUDING POTWS) METALS AND METAL COMPOUNDS ONLY
US_1a_[Year]	249. OFF-SITE—POTW TREATMENT
US_1a_[Year]	253. OFF-SITE—WASTEWATER TREATMENT (EXCLUDING POTWs)—NON-METALS ONLY
US_1a_[Year]	259. TOTAL POTW TRANSFER
US_1b_[Year]	1. FORM TYPE
US_1b_[Year]	2. REPORTING YEAR
US_1b_[Year]	3. TRADE SECRET INDICATOR
US_1b_[Year]	4. SANITIZED INDICATOR
US_1b_[Year]	5. TITLE OF CERTIFYING OFFICIAL
US_1b_[Year]	6. NAME OF CERTIFYING OFFICIAL
US_1b_[Year]	7. CERTIFYING OFFICIAL'S SIGNATURE INDICATOR
US_1b_[Year]	8. DATE SIGNED
US_1b_[Year]	9. TRIFD
US_1b_[Year]	10. FACILITY NAME
US_1b_[Year]	11. FACILITY STREET

TRI Basic Plus Data File	Field Name
US_1b_[Year]	12. FACILITY CITY
US_1b_[Year]	13. FACILITY COUNTY
US_1b_[Year]	14. FACILITY STATE
US_1b_[Year]	15. FACILITY ZIP CODE
US_1b_[Year]	16. BIA CODE
US_1b_[Year]	17. TRIBE NAME
US_1b_[Year]	18. MAILING NAME
US_1b_[Year]	19. MAILING STREET
US_1b_[Year]	20. MAILING CITY
US_1b_[Year]	21. MAILING STATE
US_1b_[Year]	22. MAILING PROVINCE
US_1b_[Year]	23. MAILING ZIP CODE
US_1b_[Year]	24. ENTIRE FACILITY IND
US_1b_[Year]	25. PARTIAL FACILITY IND
US_1b_[Year]	26. FEDERAL FACILITY IND
US_1b_[Year]	27. GOCO FACILITY IND
US_1b_[Year]	28. ASSIGNED FED FACILITY FLAG
US_1b_[Year]	29. ASSIGNED PARTIAL FACILITY FLAG
US_1b_[Year]	30. PUBLIC CONTACT NAME
US_1b_[Year]	31. PUBLIC CONTACT PHONE
US_1b_[Year]	32. PUBLIC CONTACT PHONE EXT
US_1b_[Year]	33. PUBLIC CONTACT EMAIL
US_1b_[Year]	34. PRIMARY SIC CODE
US_1b_[Year]	35. SIC CODE 2
US_1b_[Year]	36. SIC CODE 3
US_1b_[Year]	37. SIC CODE 4
US_1b_[Year]	38. SIC CODE 5
US_1b_[Year]	39. SIC CODE 6
US_1b_[Year]	40. NAICS ORIGIN
US_1b_[Year]	41. PRIMARY NAICS CODE
US_1b_[Year]	42. NAICS CODE 2
US_1b_[Year]	43. NAICS CODE 3
US_1b_[Year]	44. NAICS CODE 4
US_1b_[Year]	45. NAICS CODE 5
US_1b_[Year]	46. NAICS CODE 6
US_1b_[Year]	47. LATITUDE
US_1b_[Year]	48. LONGITUDE
US_1b_[Year]	49. D and B NR A
US_1b_[Year]	50. D and B NR B
US_1b_[Year]	51. RCRA NR A

TRI Basic Plus Data File	Field Name
US_1b_[Year]	52. RCRA NR B
US_1b_[Year]	53. RCRA NR C
US_1b_[Year]	54. RCRA NR D
US_1b_[Year]	55. RCRA NR E
US_1b_[Year]	56. RCRA NR F
US_1b_[Year]	57. RCRA NR G
US_1b_[Year]	58. RCRA NR H
US_1b_[Year]	59. RCRA NR I
US_1b_[Year]	60. RCRA NR J
US_1b_[Year]	61. NPDES NR A
US_1b_[Year]	62. NPDES NR B
US_1b_[Year]	63. NPDES NR C
US_1b_[Year]	64. NPDES NR D
US_1b_[Year]	65. NPDES NR E
US_1b_[Year]	66. NPDES NR F
US_1b_[Year]	67. NPDES NR G
US_1b_[Year]	68. NPDES NR H
US_1b_[Year]	69. NPDES NR I
US_1b_[Year]	70. NPDES NR J
US_1b_[Year]	71. PARENT COMPANY NAME
US_1b_[Year]	72. PARENT COMPANY D and B NR
US_1b_[Year]	73. STANDARDIZED PARENT COMPANY NAME
US_1b_[Year]	74. FRS FACILITY ID
US_1b_[Year]	75. DOCUMENT CONTROL NUMBER
US_1b_[Year]	76. CAS NUMBER
US_1b_[Year]	77. CHEMICAL NAME
US_1b_[Year]	78. MIXTURE NAME
US_1b_[Year]	79. ELEMENTAL METAL INCLUDED
US_1b_[Year]	80. CLASSIFICATION
US_1b_[Year]	81. UNIT OF MEASURE
US_1b_[Year]	82. METAL IND
US_1b_[Year]	83. REVISION CODE 1
US_1b_[Year]	84. REVISION CODE 2
US_1b_[Year]	85. PRODUCE THE CHEMICAL
US_1b_[Year]	86. IMPORT THE CHEMICAL
US_1b_[Year]	87. ON-SITE USE OF THE CHEMICAL
US_1b_[Year]	88. SALE OR DISTRIBUTION OF THE CHEMICAL
US_1b_[Year]	89. AS A BYPRODUCT
US_1b_[Year]	90. AS A MANUFACTURED IMPURITY
US_1b_[Year]	91. USED AS A REACTANT

TRI Basic Plus Data File	Field Name
US_1b_[Year]	92. P101 FEEDSTOCKS
US_1b_[Year]	93. P102 RAW MATERIALS
US_1b_[Year]	94. P103 INTERMEDIATES
US_1b_[Year]	95. P104 INITIATORS
US_1b_[Year]	96. P199 OTHER
US_1b_[Year]	97. ADDED AS A FORMULATION COMPONENT
US_1b_[Year]	98. P201 ADDITIVES
US_1b_[Year]	99. P202 DYES
US_1b_[Year]	100. P203 REACTION DILUENTS
US_1b_[Year]	101. P204 INITIATORS
US_1b_[Year]	102. P205 SOLVENTS
US_1b_[Year]	103. P206 INHIBITORS
US_1b_[Year]	104. P207 EMULSIFIERS
US_1b_[Year]	105. P208 SURFACTANTS
US_1b_[Year]	106. P209 LUBRICANTS
US_1b_[Year]	107. P210 FLAME RETARDANTS
US_1b_[Year]	108. P211 RHEOLOGICAL MODIFIERS
US_1b_[Year]	109. P299 OTHER
US_1b_[Year]	110. USED AS AN ARTICLE COMPONENT
US_1b_[Year]	111. REPACKAGING
US_1b_[Year]	112. AS A PROCESS IMPURITY
US_1b_[Year]	113. PROCESSED / RECYCLING
US_1b_[Year]	114. USED AS A CHEMICAL PROCESSING AID
US_1b_[Year]	115. Z101 PROCESS SOLVENTS
US_1b_[Year]	116. Z102 CATALYSTS
US_1b_[Year]	117. Z103 INHIBITORS
US_1b_[Year]	118. Z104 INITIATORS
US_1b_[Year]	119. Z105 REACTION TERMINATORS
US_1b_[Year]	120. Z106 SOLUTION BUFFERS
US_1b_[Year]	121. Z199 OTHER
US_1b_[Year]	122. USED AS A MANUFACTURING AID
US_1b_[Year]	123. Z201 PROCESS LUBRICANTS
US_1b_[Year]	124. Z202 METALWORKING FLUIDS
US_1b_[Year]	125. Z203 COOLANTS
US_1b_[Year]	126. Z204 REFRIGERANTS
US_1b_[Year]	127. Z205 HYDRAULIC FLUIDS
US_1b_[Year]	128. Z299 OTHER
US_1b_[Year]	129. ANCILLARY OR OTHER USE
US_1b_[Year]	130. Z301 CLEANER
US_1b_[Year]	131. Z302 DEGREASER

TRI Basic Plus Data File	Field Name
US_1b_[Year]	132. Z303 LUBRICANT
US_1b_[Year]	133. Z304 FUEL
US_1b_[Year]	134. Z305 FLAME RETARDANT
US_1b_[Year]	135. Z306 WASTE TREATMENT
US_1b_[Year]	136. Z307 WATER TREATMENT
US_1b_[Year]	137. Z308 CONSTRUCTION MATERIALS
US_1b_[Year]	138. Z399 OTHER
US_3c_[Year]	1. FORM TYPE
US_3c_[Year]	2. TRIFID
US_3c_[Year]	3. DOCUMENT CONTROL NUMBER
US_3c_[Year]	4. CAS NUMBER
US_3c_[Year]	5. CHEMICAL NAME
US_3c_[Year]	7. MIXTURE NAME
US_3c_[Year]	6. ELEMENTAL METAL INCLUDED
US_3c_[Year]	8. CLASSIFICATION
US_3c_[Year]	9. UNIT OF MEASURE
US_3c_[Year]	10. METAL INDICATOR
US_3c_[Year]	11. REVISION CODE 1
US_3c_[Year]	12. REVISION CODE 2
US_3c_[Year]	13. REPORTING YEAR
US_3c_[Year]	14. TRADE SECRET INDICATOR
US_3c_[Year]	15. FACILITY NAME
US_3c_[Year]	16. FACILITY STREET
US_3c_[Year]	17. FACILITY CITY
US_3c_[Year]	18. FACILITY COUNTY
US_3c_[Year]	19. FACILITY STATE
US_3c_[Year]	20. FACILITY ZIP CODE
US_3c_[Year]	21. ASSIGNED FED FACILITY FLAG
US_3c_[Year]	22. ASSIGNED PARTIAL FACILITY FLAG
US_3c_[Year]	23. BIA CODE
US_3c_[Year]	24. TRIBE NAME
US_3c_[Year]	25. ENTIRE FACILITY IND
US_3c_[Year]	26. PARTIAL FACILITY IND
US_3c_[Year]	27. FEDERAL FACILITY IND
US_3c_[Year]	28. GOCO FACILITY IND
US_3c_[Year]	29. PUBLIC CONTACT NAME
US_3c_[Year]	30. PUBLIC CONTACT PHONE
US_3c_[Year]	31. PUBLIC CONTACT PHONE EXT
US_3c_[Year]	32. PUBLIC CONTACT EMAIL
US_3c_[Year]	33. PRIMARY SIC CODE

TRI Basic Plus Data File	Field Name
US_3c_[Year]	34. SIC CODE 2
US_3c_[Year]	35. SIC CODE 3
US_3c_[Year]	36. SIC CODE 4
US_3c_[Year]	37. SIC CODE 5
US_3c_[Year]	38. SIC CODE 6
US_3c_[Year]	39. NAICS ORIGIN
US_3c_[Year]	40. PRIMARY NAICS CODE
US_3c_[Year]	41. NAICS CODE 2
US_3c_[Year]	42. NAICS CODE 3
US_3c_[Year]	43. NAICS CODE 4
US_3c_[Year]	44. NAICS CODE 5
US_3c_[Year]	45. NAICS CODE 6
US_3c_[Year]	46. LATITUDE
US_3c_[Year]	47. LONGITUDE
US_3c_[Year]	48. DB NR A
US_3c_[Year]	49. DB NR B
US_3c_[Year]	50. RCRA NR A
US_3c_[Year]	51. RCRA NR B
US_3c_[Year]	52. RCRA NR C
US_3c_[Year]	53. RCRA NR D
US_3c_[Year]	54. RCRA NR E
US_3c_[Year]	55. RCRA NR F
US_3c_[Year]	56. RCRA NR G
US_3c_[Year]	57. RCRA NR H
US_3c_[Year]	58. RCRA NR I
US_3c_[Year]	59. RCRA NR J
US_3c_[Year]	60. NPDES NR A
US_3c_[Year]	61. NPDES NR B
US_3c_[Year]	62. NPDES NR C
US_3c_[Year]	63. NPDES NR D
US_3c_[Year]	64. NPDES NR E
US_3c_[Year]	65. NPDES NR F
US_3c_[Year]	66. NPDES NR G
US_3c_[Year]	67. NPDES NR H
US_3c_[Year]	68. NPDES NR I
US_3c_[Year]	69. NPDES NR J
US_3c_[Year]	70. PARENT COMPANY NAME
US_3c_[Year]	71. PARENT COMPANY DB NR
US_3c_[Year]	72. STANDARDIZED PARENT COMPANY NAME
US_3c_[Year]	73. FRS FACILITY ID

TRI Basic Plus Data File	Field Name
US_3c_[Year]	74. POTW NAME
US_3c_[Year]	75. POTW ADDRESS
US_3c_[Year]	76. POTW CITY
US_3c_[Year]	77. POTW STATE
US_3c_[Year]	78. POTW COUNTY
US_3c_[Year]	79. POTW ZIP
US_3c_[Year]	80. POTW REGISTRY ID
US_3c_[Year]	81. QUANTITY TRANSFERRED
US_3c_[Year]	82. BASIS OF ESTIMATE
US_3c_[Year]	83. DISCHARGES TO WATER STREAMS
US_3c_[Year]	84. DISCHARGES TO WATER STREAMS—BASIS OF ESTIMATE
US_3c_[Year]	85. DISCHARGES TO OTHER ACTIVITIES
US_3c_[Year]	86. DISCHARGES TO OTHER ACTIVITIES—BASIS OF ESTIMATE
US_3c_[Year]	87. RELEASED TO AIR
US_3c_[Year]	88. RELEASED TO AIR—BASIS OF ESTIMATE
US_3c_[Year]	89. SLUDGE TO DISPOSAL
US_3c_[Year]	90. SLUDGE TO DISPOSAL—BASIS OF ESTIMATE
US_3c_[Year]	91. SLUDGE TO INCINERATION—METALS
US_3c_[Year]	92. SLUDGE TO INCINERATION—METALS—BASIS OF ESTIMATE
US_3c_[Year]	93. SLUDGE TO AGRICULTURAL APPLICATIONS
US_3c_[Year]	94. SLUDGE TO AGRICULTURAL APPLICATIONS—BASIS OF ESTIMATE
US_3c_[Year]	95. OTHER OR UNKNOWN DISPOSAL
US_3c_[Year]	96. OTHER OR UNKNOWN DISPOSAL—BASIS OF ESTIMATE
US_3c_[Year]	97. OFF-SITE POTW RELEASES—8.1C
US_3c_[Year]	98. OFF-SITE POTW RELEASES—8.1D
US_3c_[Year]	99. OFF-SITE—POTW RELEASES
US_3c_[Year]	100. OTHER OR UNKNOWN TREATMENT
US_3c_[Year]	101. OTHER OR UNKNOWN TREATMENT—BASIS OF ESTIMATE
US_3c_[Year]	102. SLUDGE TO INCINERATION—NONMETALS
US_3c_[Year]	103. SLUDGE TO INCINERATION—NONMETALS—BASIS OF ESTIMATE
US_3c_[Year]	104. EXPERIMENTTAL AND ESTIMATED TREATMENT
US_3c_[Year]	105. EXPERIMENTTAL AND ESTIMATED TREATMENT—BASIS OF ESTIMATE
US_3c_[Year]	106. TOTAL TREATED

Mapping Facilities to a COU and Selecting the Number of Operating Days per Year

The facility in this example reported to TRI and reported NAICS code for Plastics Material and Resin Manufacturing (NAICS 325211). Therefore, they are mapped to the COU for Processing: Additive flame retardant in plastic, resin, and paints and coating manufacturing. Based on the revised Plastic Compounding GS, each facility is assumed to operate 246 days per year (U.S. EPA, 2021c).

Annual Facility Discharges

Annual facility discharges can be obtained directly from the Loading Tool and TRI data file downloads for each facility. The 2023 annual discharges for the facility in this example are provided in Table_Apx C-2.

Table_Apx C-2. A Facility's 2023 Annual Discharge Example

Facility	Annual Reported Discharge from TRI
SABIC INNOVATIVE PLASTICS MT. VERNON LLC	4.54 kg surface water

Average Daily Discharges

To calculate average daily discharges at each facility, the annual discharge, separated by type of reception (*i.e.,* surface water, POTW, non-POTW WWT) is averaged over the number of operating as shown in the calculations below:

Equation_Apx C-1.

$$ADR = \frac{YR}{OD}$$

Where:

ADR = Average daily discharge (kg/day)
YR = Annual discharge (kg/yr)
OD = Operating days (days/yr)

For this facility the average daily discharge for surface water using TRI is calculated as the 4.54 kg per year annual discharge over 246 days per year, as shown below:

$$ADR = \frac{YR}{OD} = \frac{4.54\ kg/yr}{246\ days/yr} = 0.018\ kg/day$$