



## **EPA'S EXPOSURE FACTORS INTERACTIVE RESOURCE FOR SCENARIOS TOOL**

### **INSTRUCTIONAL NOTES**

This document includes all of the notes that appear in ExpoFIRST. For each selection users make in ExpoFIRST notes with supporting documentation are provided on the right-hand side of the ExpoFIRST screen.

Additional supporting documentation for ExpoFIRST users is provided in the tool. From the ExpoFIRST homepage select 'User's Guide and Other Resources' to access all ExpoFIRST user resources.

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## ExpoFIRST OVERVIEW

Exposure scenarios are tools to help the assessor develop estimates of exposure, dose, and risk. An exposure scenario generally includes facts, data, assumptions, inferences, and sometimes professional judgment about how the exposure takes place. The human physiological and behavioral data necessary to construct exposure scenarios can be obtained from the Exposure Factors Handbook: 2011 Edition (EFH; U.S. EPA, 2011). The EFH provides data on drinking water consumption; soil ingestion; inhalation rates; dermal factors including skin area and soil adherence factors; intake of fruits and vegetables, fish, meats, dairy products, homegrown foods, and breast milk; activity patterns; body weight; consumer product use; and life expectancy. The 2011 EFH provides recommended values for use in exposure assessment.

U.S. EPA's 2004 Example Exposure Scenarios document was developed by the Office of Research and Development's (ORD) National Center for Environmental Assessment (NCEA) to illustrate a representative sampling of scenarios for various exposure pathways applying data from the 1997 version of the Exposure Factors Handbook. This 1997 edition of the Exposure Factors Handbook was superseded by the 2011 edition. In September 2014, U.S. EPA finalized the Child-Specific Exposure Scenarios Examples report, which is intended to be a companion document to the 2011 EFH. The scenarios presented in this report promote the use of the standard set of age groups for children recommended by U.S. EPA.

Since publication of the 2011 EFH, U.S. EPA has continued to gather current exposure factor data from the scientific literature. Chapters of the EFH have been updated and published online individually, and EPA will continue revising EFH chapters periodically.<sup>1</sup> In this document, "EFH" refers to the 2011 EFH as updated as of April 2019 which include updates to the following chapters:

- Chapter 3. Ingestion of Water and Other Select Liquids (updated February 2019);
- Chapter 5. Soil and Dust Ingestion (updated October 2017);
- Chapter 9. Intake of Fruits and Vegetables (updated August 2018);
- Chapter 11. Intake of Meats, Dairy Products, and Fats (updated June 2018);
- Chapter 12. Intake of Grain Products (updated July 2018); and
- Chapter 19. Building Characteristics (updated July 2018).

The purpose of the Exposure Factors Interactive Resource for Scenarios Tool (ExpoFIRST) is to allow users to draw on EFH data to develop user-defined scenarios based on route of exposure, medium, receptor(s), timeframe, and dose metric for a contaminant of concern. Assessors can modify initial parameters pulled from the EFH as appropriate to account for assessment-specific knowledge and use the tool to calculate deterministic dose estimates as point estimates. The 2004 and 2014 Scenarios documents are only able to effectively present a limited number of scenarios as examples, whereas, the interactive tool allows users to develop an almost unlimited number of scenarios that address a wide range of receptor populations and lifestages. ExpoFIRST was designed to incorporate exposure factor data from the EFH—chemical-specific information must be entered by the user.

Users should be aware that ExpoFIRST was not designed to incorporate default exposure assumptions used under specific legislation or by specific EPA programs, offices, or regions. Users should refer to specific legislation or specific EPA program offices or regions regarding decisions for specific exposure factors. ExpoFIRST was designed with maximum flexibility in mind to allow users to change exposure factors to meet their needs.

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<sup>1</sup> Current EFH chapters are available at <https://www.epa.gov/expobox/about-exposure-factors-handbook>



ExpoFIRST was designed for exposure assessors in estimating human dose associated with commonly encountered exposure pathways using key data sets in the EFH. An understanding of general concepts of exposure assessment is assumed. For additional information on exposure assessment and related concepts, users are encouraged to see the 'Definitions' and 'User's Guide and Other Resources' links on the ExpoFIRST homepage. Definitions for many of the key terms used in exposure assessment are provided. Many of these definitions are taken directly from EPA's Guidelines for Exposure Assessment (U.S. EPA, 1992) or EPA's Exposure Factors Handbook (U.S. EPA, 2011). A comprehensive list of EPA resources (with hyperlinks) is available from the 'User's Guide and Other Resources' link to help users in conducting exposure and risk assessments.

## GETTING STARTED

ExpoFIRST is a standalone tool available for download from the Exposure Factors module of the EPA-Expo-Box website. The tool was designed for exposure assessors who have an understanding of general concepts of exposure assessment. ExpoFIRST was developed using Microsoft Access and Visual Basic for Applications (VBA), and the tool is compatible with 2007 and later versions of Microsoft Office. A freely-available Microsoft Access runtime environment is available on the Microsoft website for users that do not have Microsoft Access installed on their computer.

**Note:** If your ExpoFIRST screen looks distorted or text is cut off try reducing the font size on your computer or reducing the screen display to 100 percent to correct the problem.

### Start a New Scenario

Move through a series of five tabs in the tool to develop a new exposure scenario, including:

- **Tab 1: Scenario Description**—Enter the scenario name and description, and select the route of exposure, dose metric, and exposure descriptor on this screen. Make these selections before continuing to Tab 2. The tool will display the appropriate algorithm for the dose metric of interest based on your selections.
- **Tab 2: Media & Receptors**—Select options to characterize medium and receptors, based on the exposure route that you selected on Tab 1.
  - For ingestion, the media choices include water, various types of food, and unintentional or activity-related (soil, dust, soil-pica, geophagy, swimming); additional selections are required for media subgroups. Receptor characteristics choices include: consumer type, gender, and age bins and/or other population groups; other population groups include race/ethnicity, pregnancy/lactation, health status, socioeconomic status, geographic location, etc. Make these selections before continuing to Tab 3.
  - For inhalation ADR/ADD/LADD, the media type is air; additional selections are required for inhalation rate type (e.g., long-term [daily], short-term [activity-specific]); you must also select intensity level when short-term is selected. Make additional selections pertaining to location/activity and receptor characteristics (gender, age bins, and/or other population groups) before continuing to Tab 3.
  - For inhalation adjAir concentration, the media type is air; make additional selections for location/activity and receptor characteristics (gender, age bins, and/or other population groups) before continuing to Tab 3.
  - For dermal contact, the media choices include solids or water; make additional selections for location/activity, skin surface area, and receptor characteristics (gender, age bins, and/or other population groups) before continuing to Tab 3.
- **Tab 3: Contaminants**—All chemical-specific information must be entered by the user. After entering the chemical-specific information select the contaminant and enter the contaminant concentration and units. If the algorithm requires additional chemical-specific parameter values, you should define those values here. If the units of contaminant concentration need to be converted, you can use the 'unit conversions' feature.
- **Tab 4: Exposure Factors**—This tab lists each receptor group based on age and/or other population groups; click on the receptor group of interest to view exposure factors, exposure factor values, and factor-specific notes. On this screen, you can modify exposure factor values to be more site-specific and provide your own pertinent notes for the modified factor values in the 'Description' field.



- **Tab 5: Results**—A summary of dose estimates by contaminant and receptor group is provided based on the exposure scenario that you defined; from this tab, you can export detailed results to an MS Excel ExpoFIRST report.

Instructional notes are included for fields within ExpoFIRST. These field-specific notes provide examples and are designed to guide you through the various aspects of the tool. Notes appear to the right of the input screen when a field is selected to assist you with entering data or making selections unless a help button is provided. Where available click the help button for additional guidance on certain parameters.

A ‘Record Scenario Notes’ button is available on each tab of ExpoFIRST. The user can add notes to a single location at any stage of developing an exposure scenario. All scenario-specific notes are exported to the MS Excel ExpoFIRST report.

## My Saved Scenarios

New scenarios are saved automatically by ExpoFIRST. A list of all of your saved scenarios can be viewed under ‘My Saved Scenarios’.

Under ‘My Saved Scenarios’, you can view a list of all saved scenarios along with the exposure route, medium, dose metric, and exposure descriptor that you selected for each scenario. A keyword search can be performed to help you identify saved scenario(s) of interest.

From this screen, you can export results of one or more scenarios of interest. Scenarios of interest can be selected by clicking the check boxes to the left of each scenario name. Use ‘select all’ to select all saved scenarios or ‘clear all’ to clear all selections. After all scenarios of interest are selected, click ‘Export’ to view the results summaries in an MS Excel ExpoFIRST report. Also, at this screen, you can ‘view’ or ‘delete’ saved scenarios.

You can access your saved scenarios from the ExpoFIRST home page (left-hand side) or from any of the five ‘current scenario’ tabs (upper right portion of screen).

## Exporting Results

You can export your saved scenarios to an MS Excel ExpoFIRST report from two locations in the tool: the ‘Results’ tab for a current scenario and from the ‘My Saved Scenarios’ screen accessible from the ExpoFIRST home page. Exports provide: scenario name and description; a summary of all of your inputs and selections; the dose metric algorithm; exposure factor values, sources, assumptions, and other important notes; and calculated dose estimates for all receptors.

## Other Help

The following supporting documentation and resources are available in ExpoFIRST:

Documentation	How to Access
Annotated Screenshots	<ul style="list-style-type: none"> <li>▪ User’s Guide and Other Resources button on ExpoFIRST home page</li> </ul>
Frequently Asked Questions	<ul style="list-style-type: none"> <li>▪ User’s Guide and Other Resources button on ExpoFIRST home page</li> </ul>
Glossary	<ul style="list-style-type: none"> <li>▪ ExpoFIRST home page</li> </ul>



Documentation	How to Access
Instructional Notes	<ul style="list-style-type: none"> <li>▪ User’s Guide and Other Resources button on ExpoFIRST home page</li> <li>▪ Throughout ExpoFIRST in panel on right-hand side of screen</li> </ul>
Links to EPA Resources and Guidance Documents	<ul style="list-style-type: none"> <li>▪ User’s Guide and Other Resources button on ExpoFIRST home page</li> </ul>
References Cited in 2011 EFH Tables and updates to 2011 EFH Tables Included in ExpoFIRST	<ul style="list-style-type: none"> <li>▪ User’s Guide and Other Resources button on ExpoFIRST home page</li> </ul>
Report Notes	<ul style="list-style-type: none"> <li>▪ User’s Guide and Other Resources button on ExpoFIRST home page</li> <li>▪ ReadMe Tab of all ExpoFIRST MS Excel Reports</li> </ul>

EPA's technical contact for ExpoFIRST is Linda Phillips who may be reached at (202) 564-8252 or [Phillips.Linda@epa.gov](mailto:Phillips.Linda@epa.gov). For technical support, you may contact NCEA's webmaster at [webmaster.risk@epa.gov](mailto:webmaster.risk@epa.gov).





Field	Instruction
<b>All ROUTES (Scenario Description tab)</b>	
<b>Scenario Name</b>	<b>Enter a unique title by which the current scenario can be easily identified.</b> Scenario names must be less than 25 characters including spaces.
<b>Scenario Description</b>	<b>Enter a brief description of the scenario.</b>
<b>Route of Exposure</b>	<b>Define a single route of exposure</b> —ingestion, inhalation, or dermal. For the ‘dermal contact’ route, you can select either ‘dermal–solids’ or dermal–water’. Dermal–solids is used to estimate exposures to solid materials (e.g., soil, dust, sediment) that may adhere to the surface of the skin. Dermal–water uses an algorithm that includes a permeability coefficient to estimate exposure from aqueous substances that may be absorbed through the skin. You must enter the permeability coefficient for the chemical of interest in the ‘Contaminant’ page.
<b>Dose Metric</b>	<b>Select the dose metric that the tool will calculate.</b> <ul style="list-style-type: none"> <li>• Acute dose rate (ADR)</li> <li>• Average daily dose (ADD; noncancer)</li> <li>• Lifetime average daily dose (LADD; cancer)</li> <li>• Adjusted air concentration—<b>inhalation only: less-than-lifetime</b></li> <li>• Adjusted air concentration—<b>inhalation only: lifetime</b></li> </ul>



Field	Instruction
<p><b>Exposure Descriptor</b></p>	<p><b>Choose the exposure descriptor of interest</b>—central tendency, high-end, or bounding.</p> <ul style="list-style-type: none"> <li>• Central tendency: tool uses central tendency values for all input values in the algorithm</li> <li>• High-end: you must specify which parameters in the algorithm will use central tendency and which will use upper percentile estimates; a mix of central tendency and upper percentile estimates should be selected</li> <li>• Bounding: tool uses upper percentile values for all input values in the numerator of the algorithm; often used in screening-level assessments</li> </ul> <p>Where needed in the exposure algorithm, body weight and skin surface area are set to central tendency values for all exposure descriptors.</p> <p><u>Note:</u> You must remember to enter contaminant concentration on the ‘Contaminants’ page based on selection of central tendency or high-end on the ‘Scenario Description’ page.</p>
<p><b>INGESTION (Media &amp; Receptors tab)</b></p>	
<p><b>Media Type</b></p>	<p><b>Define the exposure medium type</b>—water, various types of food, or unintentional/activity-related.</p>
<p><b>Media Subgroup</b></p>	<p><b>Define the exposure medium subgroup</b>—for some of the ingestion media types, media subgroups other than ‘total’ are added for refinement. These include water (e.g., community water, bottled water, pool water [unintentional]) and food (e.g., protected fruits/vegetables, exposed fruits/vegetables, home-produced, finfish (freshwater/estuarine or marine), shellfish (freshwater/estuarine or marine), recreational fish). Recreational fish intake is further refined by state (freshwater) or region (marine).</p>



Field	Instruction
<p><b>INGESTION—Media Subgroup Notes</b></p>	
<p><b>Dairy</b></p>	<p><b>Select the desired category:</b></p> <ul style="list-style-type: none"> <li>• Home-Produced (Farming Population) – The farming population that consumes home-produced foods refers to those households who answered yes to the following question from the survey questionnaire from which the data were derived: “Did anyone in the household operate a farm or a ranch?” No preparation or post-cooking losses are assumed for home-produced dairy products. (Per Capita or Consumer-Only)</li> <li>• Home-Produced (Population the Raises Animals) – The population that raises animals and consumes home-produced animal products refers to those households who answered yes to the following question from the survey questionnaire from which the data were derived: “Did anyone in the household produce any animal products such as milk, eggs, meat, or poultry for home use in your household?” No preparation or post-cooking losses are assumed for home-produced dairy products. (Per Capita or Consumer-Only)</li> <li>• Home-Produced (Total Population) – Home-produced dairy products are consumed in the same form that they are brought into the household. No preparation or post-cooking losses are assumed for home-produced dairy products. These data are based on a 7-day recall survey. (Consumer-Only)</li> <li>• Total – Total dairy products includes the sum of all dairy products consumed including milk (whole, lowfat, skim), yogurt, milk desserts, and cheese. Intake represents edible portion, uncooked weight. (Per Capita or Consumer-Only)</li> </ul>
<p><b>Fat</b></p>	<p>Fat intake rates include fat intrinsic in foods as well as fat added during food preparation.</p>



Field	Instruction
<p><b>Fish by Location/Tribe</b></p>	<p><b>Select the desired location/tribe:</b></p> <ul style="list-style-type: none"> <li>• AK – Intake rates were derived from harvest data and adjusted to dressed weight (cleaned with head on) using values between 70 and 75% of total fish weight depending on the fish species. Values were further adjusted to account for edible portion using a factor of 0.5.</li> <li>• FL, MN, or ND – Intake rates are based on uncooked fish weight.</li> <li>• Fish by location/tribe/NY and Canada (Mohawk Tribe)/ females – Intake rates represent consumption by Mohawk women &gt;1 year before pregnancy. Value estimated by multiplying number of fish meals/year by the 90<sup>th</sup> percentile meal size of 209 g/meal for general population females 20–39 years old from Smiciklas-Wright et al. (2002).</li> <li>• OR – Intake rates based on a fish consumption survey of the Umatilla, Nez Perce, Yakama, and Warm Springs tribes of the Columbia River Basin.</li> <li>• WA – Intake rates based on fish consumption surveys of the Squaxin Island, Suquamish, and Tulalip tribes of Washington</li> <li>• WI – All respondents (Chippewa Indians) consumed fish caught in Northern Wisconsin lakes.</li> </ul>
<p><b>Fish by Region (Recreational Marine)</b></p>	<p><b>Select the desired region:</b></p> <p>Intake rates represent the recreational fishing population only. Data from U.S. EPA analysis of NMFS (1993) assumed to represent adults &gt;18 years. Values represent both survey anglers who ate recreational fish during the survey period and those that did not, but may eat recreationally-caught fish during other periods. Intake rates for children were estimated based on the ratios of marine fish intake for general population children to that of adults using data from U.S. EPA’s analysis of Continuing Survey of Food Intake by Individuals (CSFII) data (see Table 10-31 EFH), multiplied by the adult recreational marine fish intake rates for the Atlantic using data from National Marine Fisheries Service (NMFS) (1993) (see Table 10-50 EFH). The ratios of each age group to adults &gt;18 years were calculated separately for the means and 95<sup>th</sup> percentiles</p> <ul style="list-style-type: none"> <li>• Atlantic region included: CT, ME, MA, NH, RI, DE, MD, NJ, NY, VA, FL, GA, NC, and SC.</li> <li>• Gulf region included: AL, FL, LA, and MS.</li> <li>• Pacific region included: Southern CA, Northern CA, and OR.</li> </ul>



Field	Instruction
<b>Fish: Finfish and Shellfish</b>	Includes fish (or shellfish or fish and shellfish) from all sources (e.g., store bought, self-caught, eaten at a restaurant, etc.). Intake values represent uncooked edible portion.
<b>Fish: Finfish Only</b>	Includes fish from all sources (e.g., store bought, self-caught, eaten at a restaurant, etc.). Intake values represent uncooked edible portion.
<b>Fish: Home-Caught</b>	Home-caught fish refers to fish and shellfish that has been caught by any member of the household for consumption.
<b>Fish: Shellfish Only</b>	Includes shellfish from all sources (e.g., store bought, self-caught, eaten at a restaurant, etc.). Intake values represent uncooked edible portion.



Field	Instruction
<p><b>Fish by U.S. State (Recreational Freshwater)</b></p>	<p><b>Select the desired U.S. State:</b></p> <ul style="list-style-type: none"> <li>• AL – Intake rates are based on the average of two methods: (1) using harvest data and (2) using 4-ounce serving size method. Consumer-only value represents anglers who consumed recreationally-caught fish during the survey period, calculated by dividing all respondents by the percent consuming of 83%.</li> <li>• CT – Intake rates include consumption of both freshwater and marine fish. Consumer-only value is calculated by dividing all respondents by the percent consuming of 97%.</li> <li>• GA – Intake rates are calculated as amount eaten per year divided by 365 days per year. They represent fish eaten from the Savannah River that was self-caught and store bought.</li> <li>• IN – Intake rates represent self-caught fish by licensed anglers in IN. The study did not distinguish between marine and freshwater fish.</li> <li>• ME – Fish consumed by anglers was calculated by first multiplying the estimated weight of the fish by the edible fraction and then dividing this product by the number of intended consumers in the household.</li> <li>• MI – Intake rates represent individuals who eat fish and who reside in households reporting some recreational fish consumption during the previous year. The intake rates are based on a U.S. EPA reanalysis of the West et al. (1989) data.</li> <li>• MN and ND – Intake rates represent individuals who eat sport-caught fish. The intake rates are based on a U.S. EPA reanalysis of the Benson et al. (2001) data.</li> <li>• NY (Lake Ontario) – Intake rates represent individuals who eat sport-caught fish. The consumer-only value was calculated by dividing all respondents by the percent consuming of 84%.</li> <li>• TN (Clinch River) – Intake rates were calculated as amount eaten per year divided by 365 days per year. Values included consumption of both self-caught and store-bought fish from the study area.</li> <li>• WA (Kinds County) – Intake rates represent individuals who eat sport-caught fish in Kings County, WA. Consumer-only value was calculated by dividing all respondents by the percent consuming of 66%.</li> <li>• WI – Intake rates represent individuals who eat sport-caught fish in 10 counties in WI. Intake rates were estimated by Fiore et al. (1989) assuming that each fish meal consists of 8 ounces (227 grams).</li> </ul>



Field	Instruction
<p><b>Fruit</b></p>	<p><b>Select the desired category:</b></p> <ul style="list-style-type: none"> <li>• Exposed– Fruits that are grown above ground. Intake represents the as-consumed rate. (Per Capita)</li> <li>• Home-Produced (Farming Population) – The farming population that consumes home-produced foods refers to those households who answered yes to the following question from the survey questionnaire from which the data were derived: “Did anyone in the household operate a farm or a ranch?” (Per Capita or Consumer-Only)</li> <li>• Home-Produced (Gardening Population) – The gardening population that consumes home-produced foods refers to those households who answered yes to the following question from the survey questionnaire from which the data were derived: “Did anyone in the household grow any vegetables or fruit for use in the household?”(Per Capita or Consumer-Only)</li> <li>• Home-Produced (Total Population) – Consumption of home-produced fruits by anyone in the surveyed population. These data are based on a 7-day recall survey. (Consumer-Only)</li> <li>• Protected – Fruits that have an outer protective coating that is typically removed before consumption. Intake represents the as-consumed rate. (Per Capita)</li> <li>• Total – The sum of all fruits consumed as fruits or as part of a recipe including canned, dried, frozen, and fresh fruits. Intake represents edible portion, uncooked weight. (Per Capita or Consumer-Only)</li> </ul> <p><u>Note:</u> Consumer-only home-produced food intake rates are based on foods as brought into the household and not in the form in which they are consumed; therefore, preparation loss factors should be applied as appropriate to convert intake rates to those that are representative of foods “as consumed.” Per capita data for farming and gardening populations do account for preparation and post-cooking losses. Paring or preparation losses include losses from removal of skin or peel, core or pit, stems or caps, seeds, and defects, or from draining of liquids from canned or frozen forms; post-cooking losses include losses from draining cooked forms.</p>
<p><b>Grains</b></p>	<p>The sum of all grains consumed as grains or as part of a recipe. Intake represents edible portion, uncooked weight.</p>



Field	Instruction
<p><b>Human Milk</b></p>	<p>Choose 'Human Milk' as the exposure medium if the contaminant being evaluated is hydrophilic (and likely to be passed to a nursing child via the aqueous portion of human milk) and enter contaminant concentrations in mg/mL.</p> <p>If the contaminant being evaluated is lipophilic (and likely to be passed to a nursing child via the lipid portion of human milk), you should choose 'Lipid Intake of Human Milk' as the exposure medium.</p> <p>Intake represents the population of exclusively-breastfed infants (those whose sole source of milk comes from human milk with no other milk substitutes).</p>
<p><b>Lipid Intake in Human Milk</b></p>	<p>Choose 'Lipid Intake of Human Milk' as the exposure medium if the contaminant being evaluated is lipophilic (and likely to be passed to a nursing child via the lipid portion of human milk) and enter contaminant concentrations in mg/g fat.</p> <p>If the contaminant being evaluated is hydrophilic (and likely to be passed to a nursing child via the aqueous portion of human milk), you should choose 'Human Milk' as the exposure medium.</p> <p>With the exception of the data from Butte et al. (1984), lipid intake rates were calculated as human milk intake rates multiplied by 4% lipid content. In the case of the Butte et al. (1984) study, lipid intake rates were provided and were used in place of estimated lipid intake rates.</p> <p>Note: Value reported in Table 15.1 has been converted from ml/kg-day to g/kg-day assuming the density of human milk is 1.03 g/mL (NAS, 1991). You must enter contaminant concentration in mg/g Fat.</p>





Field	Instruction
<p><b>Meat</b></p>	<p><b>Select the desired category:</b></p> <ul style="list-style-type: none"> <li>• Home-Produced (Farming Population) – The farming population that consumes home-produced foods refers to those households who answered yes to the following question from the survey questionnaire from which the data were derived: “Did anyone in the household operate a farm or a ranch?” (Per Capita)</li> <li>• Home-Produced (Population that Raises Animals) – The population that raises animals and consumes home-produced meats refers to those households who answered yes to the following question from the survey questionnaire from which the data were derived: “Did anyone in the household produce any animal products such as milk, eggs, meat, or poultry for home use in your household?” (Per Capita or Consumer-Only)</li> <li>• Home-Produced (Total Population) – This refers to individuals in the surveyed population that consumed home-produced foods. These data are based on a 7-day recall survey. (Consumer-Only)</li> <li>• Total – The sum of all meats consumed in a day. Intake represents edible portion, uncooked weight. (Per Capita or Consumer-Only)</li> </ul> <p><u>Note:</u> Consumer-only home-produced food intake rates are based on foods as brought into the household and not in the form in which they are consumed; therefore, preparation loss factors should be applied as appropriate to convert intake rates to those that are representative of foods “as consumed.” Per capita data for meats do account for cooking and post-cooking losses. Net cooking loss includes dripping and volatile losses, and net post cooking loss involves losses from cutting, bones, excess fat, scraps, and juices.</p>



Field	Instruction
<p><b>Unintentional or Activity-Related: Soil or Dust</b></p>	<p><b>Select the desired category:</b></p> <ul style="list-style-type: none"> <li>• Indoor Settled Dust – Includes indoor settled dust only defined as the particles in building interiors that have settled onto objects, surfaces, floors, and carpeting. These particles may include soil particles that have been tracked or blown into the indoor environment from outdoors as well as organic matter.</li> <li>• Soil – Includes soil and outdoor settled dust defined as particles that have settled onto outdoor objects and surfaces due to either wet or dry deposition. Note that it may not be possible to distinguish between soil and outdoor settled dust because outdoor settled dust generally would be present on the uppermost surface layer of soil.</li> <li>• Soil and Dust – Intake rates include soil, indoor settled dust, and outdoor settled dust.</li> <li>• Geophagy – The intentional ingestion of earths usually associated with cultural practices. Upper percentile intake rates are available in the EFH for individuals who exhibit geophagy. <b>(Only upper percentile data are available in the EFH.)</b></li> <li>• Soil-Pica – Soil-pica is the recurrent ingestion of unusually high amounts of soil (i.e., on the order of 1,000–5,000 mg/day or more). <b>(Only upper percentile data are available in the EFH.)</b></li> </ul>
<p><b>Unintentional Ingestion: Swimming</b></p>	<p>Incidental Ingestion while Swimming – Refers to the unintentional ingestion of water during swimming. Intake rates were derived from swimming pool experiments.</p>



Field	Instruction
<p><b>Vegetables</b></p>	<p><b>Select the desired category:</b></p> <ul style="list-style-type: none"> <li>• Exposed – Vegetables that are grown aboveground. Intake represents as-consumed. No outer protective coating that is typically removed before consumption. (Per Capita)</li> <li>• Home-Produced (Farming Population) – The farming population that consumes home-produced foods refers to those households who answered yes to the following question from the survey questionnaire from which the data were derived: “Did anyone in the household operate a farm or a ranch?” (Per Capita or Consumer-Only)</li> <li>• Home-Produced (Gardening Population) – The gardening population that consumes home-produced foods refers to those households who answered yes to the following question from the survey questionnaire from which the data were derived: “Did anyone in the household grow any vegetables or fruit for use in the household?” (Per Capita or Consumer-Only)</li> <li>• Home-Produced (Total Population) – Consumption of home-produced vegetables by anyone in the surveyed population. These data are based on a 7-day recall survey. (Consumer-Only)</li> <li>• Protected – Vegetables that have an outer protective coating that is typically removed before consumption. Intake represents as-consumed. (Per Capita)</li> <li>• Root – Plant roots used as vegetables (e.g., carrots, potatoes and radish). Intake represents as-consumed. (Per Capita)</li> <li>• Total – The sum of all vegetables consumed as vegetables or as part of a recipe including canned, dried, frozen, and fresh vegetables. Intake represents edible portion, uncooked weight. (Per Capita or Consumer-Only)</li> </ul> <p><u>Note:</u> Consumer-only home-produced food intake rates are based on foods as brought into the household and not in the form in which they are consumed; therefore, preparation loss factors should be applied as appropriate to convert intake rates to those that are representative of foods “as consumed.” Per capita data for farming and gardening populations do account for preparation and post-cooking losses. Paring or preparation losses include losses due to paring, trimming, flowering the stalk, thawing, draining, scraping, shelling, slicing, husking, chopping, and dicing and gains from the addition of water, fat, or other ingredients. These were averaged over various preparation methods. Excludes dehydrated forms of potatoes. Post-cooking losses include losses from draining or removal of skin and are based on potatoes only.</p>



Field	Instruction
<p><b>Water</b></p>	<p><b>Select the desired category:</b></p> <ul style="list-style-type: none"> <li>• Bottled – Intake rates include direct water. Direct water is defined as water ingested directly as a beverage. Indirect water, defined as water added in the preparation of food or beverages, was not accounted for in the estimation of bottled water intake. (Per Capita or Consumer-Only)</li> <li>• Community – Intake rates include direct and indirect water. Direct water is defined as water ingested directly as a beverage; indirect water is defined as water added in the preparation of food or beverages. (Per Capita or Consumer-Only)</li> </ul>
<p><b>Receptor Consumer Type</b></p>	<p><b>Select the receptor consumer type.</b></p> <p>For food or water media, select ‘per capita’ or ‘consumer-only’. For human milk and unintentional/activity-related, select ‘other’.</p> <p>Per capita (general population) intake rates include all survey participants whether or not they reported intake during the survey period. Per capita intake rates may be useful for estimating exposure to food contaminants over longer timeframes, if it can be assumed that the noneaters in the survey population may eat the foods at some other time during the year.</p> <p>Consumer-only intake rates exclude individuals who did not ingest the water or food from the source during the survey period. Consumer-only intake rates may be appropriate for estimating exposure among this population over the short term, but may overestimate exposures over longer time periods, particularly at the high end of the distribution because they do not account for the days on which these individuals did not consume the foods.</p>



**INHALATION (Media & Receptors Tab)**

<p><b>Media Type</b></p>	<p>Select the exposure medium type—air.</p>
<p><b>Location, Activity, or Product (Long-Term: Daily Rates for ADR, ADD, LADD scenarios)</b></p>	<p>Identify the general location, activity category, or product category associated with exposure. Based on this selection, you will be provided available options for a location/activity/product subgroup.</p> <p>For scenarios using daily inhalation rates, ExpoFIRST uses exposure time (ET) values for doers only from the National Human Activity Pattern Survey (NHAPS), as reported in the EFH. However, you can modify these ETs if desired. Data on exposure frequency (EF) are unavailable; therefore, you must enter EF data on the Exposure Factors tab. You may also define location type here; corresponding ETs and EFs will need to be entered on the Exposure Factors tab.</p> <p><u>Note:</u> The tool selects activity factors (such as ET) based on the best available match for a particular receptor group. For example, activity factor values for males and females might be used for a male- or female-only scenario if those are the only data available. On the Exposure Factors tab, you can view exposure factor values and factor-specific notes, and you can modify this information to be more scenario-specific.</p>
<p><b>Location, Activity, or Product (Short-Term: Activity Rates for ADR, ADD, LADD scenarios)</b></p>	<p>Identify the general location, activity category, or product category associated with exposure. Based on this selection, you will be provided available options for a location/activity/product subgroup.</p> <p>Subgroups are used to select exposure times (ETs) according to specific activities within this category. The ETs represent either the subset of the National Human Activity Pattern Survey (NHAPS) population that reported engaging in the activity in question (i.e., doers only) or doers only from household cleaning product surveys, as described in the EFH.</p> <p><u>Note:</u> The tool selects activity factors (such as ET) based on the best available match for a particular receptor group. For example, activity factor values for males and females might be used for a male- or female-only scenario if those are the only data available. On the Exposure Factors tab, you can view exposure factor values and factor-specific notes, and you can modify this information to be more scenario-specific.</p>
<p><b>Location, Activity, or Product (AdjAir Scenarios)</b></p>	<p>Identify the general location, activity category, or product category associated with exposure. Based on this selection, you will be provided available options for a location/activity/product subgroup.</p>



<p><b>Location, Activity, or Product Subgroup</b></p>	<p>These subgroups are used to select Exposure Times (ETs) according to specific activities or product types within the category. The ETs represent the subset of the National Human Activity Pattern Survey (NHAPS) population that reported doing the activity in question (i.e., doers only).</p> <p>For consumer products receptors could include both users of the product and those who are passively exposed during and/or after use of the product.</p> <p>Use the ‘Search Categories’ button to search the available options for location, activity, or product subgroups in ExpoFIRST.</p>
<p><b>Inhalation Rate Type</b></p>	<p><b>Select inhalation rate (IR) type</b>—long-term (average daily) IR or short-term (activity-specific) IR</p> <p>Long-term IRs are presented as daily rates (m<sup>3</sup>/day). Short-term inhalation rates are presented according to activity levels in m<sup>3</sup>/minute. When short-term inhalation rates are selected, you will need to define the intensity level of the selected activity.</p> <p>Inhalation rates provided in the EFH for males and females combined are unadjusted for body weight; body-weight-adjusted values are available by gender.</p>
<p><b>Intensity</b></p>	<p><b>Specify activity intensity.</b></p> <p>Short-term inhalation values are available for sleeping and napping and four metabolic equivalents of work (METs) activity categories based on oxygen consumed at various activity levels: sedentary/passive (includes sleep or nap) = METs less than or equal to 1.5; light intensity = METs greater than 1.5 and less than or equal to 3.0; moderate intensity = METs greater than 3.0 and less than or equal to 6.0; and high intensity = METs greater than 6.0.</p>



**DERMAL (Media & Receptors tab)**

**Media Type**

**Define the exposure medium type**—water or solids. ExpoFIRST will select the appropriate algorithm and parameters based on your selection. For dermal-water, select whether the contaminant in water is either an organic or inorganic chemical.

**Location/Activity**

**Select location/activity type.** For dermal-water, selections include bathing, showering, and swimming. This selection determines an exposure time (ET) used by ExpoFIRST. Alternatively, a user-defined location/activity can be entered. Event frequency (EV) is assumed to be 1 event/day and can be modified as needed.

For dermal-solids, selection of location/activity type determines the adherence factor (AF) used by ExpoFIRST. AF describes the amount of solid material that adheres to the skin per unit of surface area. AFs are provided in the EFH for the activities on this list. See Table 7-4 of the 2011 EFH for descriptions of how these activity-specific AFs were determined. Data on frequency (EV) and exposure frequency (EF) are unavailable; therefore, you must enter EV and EF on the *Exposure Factors* tab.

Note: The tool selects activity factors (such as ET, SA) based on the best available match for a particular receptor group. For example, activity factor values for males and females might be used for a male- or female-only scenario if those are the only data available. On the *Exposure Factors* tab, you can view exposure factor values and factor-specific notes, and you can modify this information to be more scenario-specific.

**Surface Area**

**Indicate skin surface area (SA) exposed.** For dermal-water, you can choose ‘total’ body or specific body parts. For dermal-solids, select the body parts exposed. Note that the product of SA and Adherence Factor (AF) for each body part are summed together and added to the equation.

Users should make selections for body parts based on professional judgment for the scenario of interest. For example, for Dermal: Water scenarios, users can select total body, one or more body parts, or enter a user-defined value. For Dermal: Solids scenarios, users can select one or more body parts based on the availability of soil adherence data in Table 7-4 or enter a user-defined value.

When user-defined is selected for surface area, the user will be required to enter a value for surface area of the skin on the *Exposure Factors* tab. Note that because the selection for surface area of the skin dictates the value for soil adherence factor that the tool will use in Dermal: Solids scenarios, the tool will also require the user to enter soil adherence factors on the *Exposure Factors* tab when selecting ‘user defined’ for surface area.



All ROUTES

Gender

Select the gender(s) of interest.

Note that for some gender-specific scenarios, only data for males and females combined are available in the EFH. ExpoFIRST uses these values in lieu of gender-specific data.

For example, an inhalation ADD scenario for females only attending school full-time uses gender-specific inhalation rates for females, but exposure time (ET) data for males and females combined because these are the best data available.

The source of data, including whether it is based on data for males, females, or both genders is indicated in the description field on the *Exposure Factors* tab. The user can modify these values if needed on the *Exposure Factors* tab.

Age Bins

Define the age range of your population and choose individual age bins where applicable.

- **Individual Age Bins.** For ADR, ADD, and Adjusted Air: Less than Lifetime scenarios, ExpoFIRST will calculate dose for each age bin defined here as well as the aggregate of the total population. ExpoFIRST uses EPA’s standardized age bins for children aged 0 to 21 years. Users can modify the ExpoFIRST standard age bins as needed for their scenario as long as they are continuous.
- **Age Groups and ‘Other Population Groups’ are independent of each other.** Users can choose age bins, other population groups, or both but results will be calculated for each group (i.e., age bin or population group) independently.
- **Age groups must be continuous.** The user cannot choose age bins that are discontinuous within a single scenario. Selections here will be used to determine Exposure Time (ET), Ingestion Rate (IR), Surface Area (SA), or Inhalation Rate as appropriate.
- **Age groups are not necessary with LADD scenarios.** When calculating LADD, individual age bins are not necessary as the tool will combine all age groups to calculate LADD. Similarly, individual age bins are not necessary when calculating Adjusted Air Concentration: Lifetime.
- **ExpoFIRST uses standard age bins.** ExpoFIRST uses the EPA standardized age bins for children (individuals <21 years of age). Users may override the standard age bins included in ExpoFIRST with age bins customized for their scenario. The standard ExpoFIRST age bins may be restored at any time.
- **Some parameters must be defined by the user when exposure spans more than 70 years.** If a scenario spans more than 70 years, AT will be blank and must be defined by the user.





<p><b>Other Population Groups</b></p>	<p>'Other population group' options available to you in the EFH are listed based on the user-defined scenario. The EFH contains data (e.g., Exposure Time, Ingestion Rate) for groups available to select here. Options may include additional age brackets. Other population groups include race/ethnicity, pregnancy/lactation, socioeconomic status, disease status, geographic location, etc.</p> <p>Add population factor categories of interest by clicking them one-by-one (or collectively using the &lt;ctrl&gt; button) and using the down arrow button so that your picks populate the box below. Remove unwanted selections by highlighting them in the box and clicking the up arrow button.</p> <p><b>Note:</b> Age groups and other population groups are independent of one another. Users can choose age bins, other population groups, or both but results will be calculated for each group independently.</p>
<p><b>Contaminant Tab</b></p>	<p><b>Ingestion:</b></p> <p>Choose the contaminant of interest from the list of previously-entered contaminants or enter a new contaminant name. Then enter the concentration and units for the contaminant. The 'Manage Contaminants' button can be used to add and delete contaminants and to enter additional physical-chemical data for contaminants (e.g., molecular weight).</p> <p>The units for other parameters in the dose algorithms must be expressed in units that are consistent with those used for contaminant concentration (e.g., units used for intake rates must be consistent with units for concentration data). In some cases, conversions may be needed to ensure that units are consistent. For example:</p> <p style="padding-left: 40px;">In the EFH, food intake data are reported in units of wet weight (WW). If you enter the contaminant concentration in dry weight (DW) or lipid weight (LW), you must also enter the conversion factor. Select a value from the appropriate table and enter it here; the tool will then make the appropriate conversion. The following tables are available for reference to determine moisture and lipid content: Table 9-53 (fruits/vegetables), Table 10-125 (fish), Table 11-42 (meat/dairy), or Table 12-38 (grains).</p> <p style="padding-left: 40px;">Enter the contaminant concentration for lipid intake in human milk as lipid weight (mg/g Fat). For scenarios using human milk, use mg/mL for the contaminant concentration.</p> <p style="padding-left: 40px;">In the EFH, soil and dust ingestion rates are represented on a DW basis. Thus, soil contaminant concentrations in should be provided in units of DW.</p> <p>The contaminant concentration (central tendency or upper percentile) entered here should be consistent with the 'Exposure Descriptor' selected on the <i>Scenario Description</i> tab.</p>



**Inhalation:**

Choose the contaminant of interest from the list of previously-entered contaminants or enter a new contaminant name. Then enter the concentration and units for the contaminant. The 'Manage Contaminants' button can be used to add and delete contaminants and to enter additional physical-chemical data for contaminants (e.g., molecular weight).

The units for other parameters in the dose algorithms must be expressed in units that are consistent with those used for contaminant concentration (e.g., units used for intake rates must be consistent with units for concentration data). In some cases, conversions may be needed to ensure that units are consistent. For example:

The contaminant concentration (central tendency or upper percentile) entered here should be consistent with the 'Exposure Descriptor' selected on the Scenario Description tab.

For inhalation scenarios, the concentration of contaminant that needs to be entered is the concentration of contaminant in the air when the person is engaging in the activity specified. ExpoFIRST does not calculate an air concentration based on the concentration of contaminant being emitted into the air from a product.

**Dermal:**

Choose the contaminant of interest from the list of previously-entered contaminants or enter a new contaminant name. Then enter the concentration and units for the contaminant. The 'Manage Contaminants' button can be used to add and delete contaminants and to enter additional physical-chemical data for contaminants (e.g., molecular weight).

The units for other parameters in the dose algorithms must be expressed in units that are consistent with those used for contaminant concentration (e.g., units used for intake rates must be consistent with units for concentration data). In some cases, conversions may be needed to ensure that units are consistent. For example:

The contaminant concentration (central tendency or upper percentile) entered here should be consistent with the 'Exposure Descriptor' selected on the Scenario Description tab.

For dermal–solids, enter a contaminant-specific absorption fraction (ABS). For dermal–water, enter values for permeability factor (Kp) and other parameters used to calculate DA (event). These contaminant-specific values are not available in the EFH. Guidance for these values is provided in EPA'S RAGS, Part E

(<https://www.epa.gov/risk/risk-assessment-guidance-superfund-rags-part-e>).



## Exposure Factors Tab

Exposure factors include parameters such as drinking water, food, and soil intake rates; inhalation rates; skin surface area; body weight; and exposure duration. Behavioral information (e.g., activity pattern data) is used for estimating temporal parameters in the dose equation (e.g., exposure time, exposure duration). A key purpose of the EFH is to provide exposure assessors with recommended values for exposure factors related to human behavior and characteristics that help determine an individual's exposure to a contaminant. Each chapter in the EFH presents recommended values for the exposure factors covered in that chapter. To the extent possible, the EFH recommended values are used as a starting point to estimate an exposure dose; however, you can modify any of these assumed values to be more site-specific. Exposure factors must be expressed in consistent units; in some cases, unit conversion factors may be necessary. A unit conversion tool is provided above, if needed.

This tab provides a summary of exposure factor values based on the user-defined scenario. Click on the receptor group type of interest to view exposure factors, exposure factor values, and factor-specific notes. On this screen, you can modify exposure factor values (except for AT, which is calculated by the tool based on ED) to be more site-specific and provide any pertinent notes for the modified factor values in the 'Description' field.

Quick Reference Tables: ExpoFIRST provides access to several EFH tables that may be useful for estimating certain exposure factors. Data from these tables are not programmed into ExpoFIRST because their selection requires professional judgment. Quick Reference tables are only available for particular scenarios. View the FAQs from the 'User's Guide and Other Resources' button on the ExpoFIRST home page for a full listing of all quick reference tables included in ExpoFIRST.

**Note:** Exposure frequency (EF) is 365 days/year for all food and water ingestion scenarios because the data used in estimating ingestion rates for these media are assumed to represent average daily intake over a year. This applies for age groups of less than one year (e.g., 6 months to 1 year) also, because EF will be weighted by the Exposure Duration (ED) in these scenarios (e.g., 365 days/year multiplied by 0.5 years for individuals aged 6 months to 1 year = 182.5 days).



**Results tab**

This tab provides ADRs, ADDs, LADDs or adjusted air concentrations (inhalation only) by contaminant and 'Group Type' for the user-defined scenario. Results can be sorted as needed by the user. Click the 'Export to Excel' button to create detailed reports that can be tailored by the user.

**Dermal Solids Scenarios:** Note for dermal solids scenarios the product of Surface Area (SA) and Adherence Factor (AF) for each body part are summed together and added to the equation.

**Dermal Water Scenarios:** Note the equation used for DAevent for each exposure group is shown on the *Results* tab. The equation may be inorganic, organic eq. 1, or organic eq. 2. See the *Contaminant* tab for the full equations and additional details.

