APPENDIX A
ATSDR MINIMAL RISK LEVELS AND WORKSHEETS

The Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) [42 U.S.C. 9601 et seq.], as amended by the Superfund Amendments and Reauthorization Act (SARA) [Pub. L. 99–499], requires that the Agency for Toxic Substances and Disease Registry (ATSDR) develop jointly with the U.S. Environmental Protection Agency (EPA), in order of priority, a list of hazardous substances most commonly found at facilities on the CERCLA National Priorities List (NPL); prepare toxicological profiles for each substance included on the priority list of hazardous substances; and assure the initiation of a research program to fill identified data needs associated with the substances.

The toxicological profiles include an examination, summary, and interpretation of available toxicological information and epidemiologic evaluations of a hazardous substance. During the development of toxicological profiles, Minimal Risk Levels (MRLs) are derived when reliable and sufficient data exist to identify the target organ(s) of effect or the most sensitive health effect(s) for a specific duration for a given route of exposure. An MRL is an estimate of the daily human exposure to a hazardous substance that is likely to be without appreciable risk of adverse noncancer health effects over a specified duration of exposure. MRLs are based on noncancer health effects only and are not based on a consideration of cancer effects. These substance-specific estimates, which are intended to serve as screening levels, are used by ATSDR health assessors to identify contaminants and potential health effects that may be of concern at hazardous waste sites. It is important to note that MRLs are not intended to define clean-up or action levels.

MRLs are derived for hazardous substances using the no-observed-adverse-effect level/uncertainty factor approach. They are below levels that might cause adverse health effects in the people most sensitive to such chemical-induced effects. MRLs are derived for acute (1–14 days), intermediate (15–364 days), and chronic (365 days and longer) durations and for the oral and inhalation routes of exposure. Currently, MRLs for the dermal route of exposure are not derived because ATSDR has not yet identified a method suitable for this route of exposure. MRLs are generally based on the most sensitive chemical-induced end point considered to be of relevance to humans. Serious health effects (such as irreparable damage to the liver or kidneys, or birth defects) are not used as a basis for establishing MRLs. Exposure to a level above the MRL does not mean that adverse health effects will occur.

MRLs are intended only to serve as a screening tool to help public health professionals decide where to look more closely. They may also be viewed as a mechanism to identify those hazardous waste sites that
are not expected to cause adverse health effects. Most MRLs contain a degree of uncertainty because of
the lack of precise toxicological information on the people who might be most sensitive (e.g., infants,
elderly, nutritionally or immunologically compromised) to the effects of hazardous substances. ATSDR
uses a conservative (i.e., protective) approach to address this uncertainty consistent with the public health
principle of prevention. Although human data are preferred, MRLs often must be based on animal studies
because relevant human studies are lacking. In the absence of evidence to the contrary, ATSDR assumes
that humans are more sensitive to the effects of hazardous substance than animals and that certain persons
may be particularly sensitive. Thus, the resulting MRL may be as much as a hundredfold below levels
that have been shown to be nontoxic in laboratory animals.

Proposed MRLs undergo a rigorous review process: Health Effects/MRL Workgroup reviews within the
Division of Toxicology, expert panel peer reviews, and agency wide MRL Workgroup reviews, with
participation from other federal agencies and comments from the public. They are subject to change as
new information becomes available concomitant with updating the toxicological profiles. Thus, MRLs in
the most recent toxicological profiles supersede previously published levels. For additional information
regarding MRLs, please contact the Division of Toxicology, Agency for Toxic Substances and Disease
Registry, 1600 Clifton Road, Mailstop E-29, Atlanta, Georgia 30333.
APPENDIX B
USER'S GUIDE

Chapter 1

Public Health Statement

This chapter of the profile is a health effects summary written in non-technical language. Its intended audience is the general public especially people living in the vicinity of a hazardous waste site or chemical release. If the Public Health Statement were removed from the rest of the document, it would still communicate to the lay public essential information about the chemical.

The major headings in the Public Health Statement are useful to find specific topics of concern. The topics are written in a question and answer format. The answer to each question includes a sentence that will direct the reader to chapters in the profile that will provide more information on the given topic.

Chapter 2

Relevance to Public Health

This chapter provides a health effects summary based on evaluations of existing toxicologic, epidemiologic, and toxicokinetic information. This summary is designed to present interpretive, weight-of-evidence discussions for human health end points by addressing the following questions.

1. What effects are known to occur in humans?
2. What effects observed in animals are likely to be of concern to humans?
3. What exposure conditions are likely to be of concern to humans, especially around hazardous waste sites?

The chapter covers end points in the same order they appear within the Discussion of Health Effects by Route of Exposure section, by route (inhalation, oral, dermal) and within route by effect. Human data are presented first, then animal data. Both are organized by duration (acute, intermediate, chronic). In vitro data and data from parenteral routes (intramuscular, intravenous, subcutaneous, etc.) are also considered in this chapter. If data are located in the scientific literature, a table of genotoxicity information is included.

The carcinogenic potential of the profiled substance is qualitatively evaluated, when appropriate, using existing toxicokinetic, genotoxic, and carcinogenic data. ATSDR does not currently assess cancer potency or perform cancer risk assessments. Minimal risk levels (MRLs) for noncancer end points (if derived) and the end points from which they were derived are indicated and discussed.

Limitations to existing scientific literature that prevent a satisfactory evaluation of the relevance to public health are identified in the Chapter 3 Data Needs section.
Interpretation of Minimal Risk Levels

Where sufficient toxicologic information is available, we have derived minimal risk levels (MRLs) for inhalation and oral routes of entry at each duration of exposure (acute, intermediate, and chronic). These MRLs are not meant to support regulatory action; but to acquaint health professionals with exposure levels at which adverse health effects are not expected to occur in humans. They should help physicians and public health officials determine the safety of a community living near a chemical emission, given the concentration of a contaminant in air or the estimated daily dose in water. MRLs are based largely on toxicological studies in animals and on reports of human occupational exposure.

MRL users should be familiar with the toxicologic information on which the number is based. Chapter 2, "Relevance to Public Health," contains basic information known about the substance. Other sections such as Chapter 3 Section 3.9, "Interactions with Other Substances," and Section 3.10, "Populations that are Unusually Susceptible" provide important supplemental information.

MRL users should also understand the MRL derivation methodology. MRLs are derived using a modified version of the risk assessment methodology the Environmental Protection Agency (EPA) provides (Barnes and Dourson 1988) to determine reference doses for lifetime exposure (RfDs).

To derive an MRL, ATSDR generally selects the most sensitive end point which, in its best judgement, represents the most sensitive human health effect for a given exposure route and duration. ATSDR cannot make this judgement or derive an MRL unless information (quantitative or qualitative) is available for all potential systemic, neurological, and developmental effects. If this information and reliable quantitative data on the chosen end point are available, ATSDR derives an MRL using the most sensitive species (when information from multiple species is available) with the highest NOAEL that does not exceed any adverse effect levels. When a NOAEL is not available, a lowest-observed-adverse-effect level (LOAEL) can be used to derive an MRL, and an uncertainty factor (UF) of 10 must be employed. Additional uncertainty factors of 10 must be used both for human variability to protect sensitive subpopulations (people who are most susceptible to the health effects caused by the substance) and for interspecies variability (extrapolation from animals to humans). In deriving an MRL, these individual uncertainty factors are multiplied together. The product is then divided into the inhalation concentration or oral dosage selected from the study. Uncertainty factors used in developing a substance-specific MRL are provided in the footnotes of the LSE Tables.

Chapter 3

Health Effects

Tables and Figures for Levels of Significant Exposure (LSE)

Tables (3-1, 3-2, and 3-3) and figures (3-1 and 3-2) are used to summarize health effects and illustrate graphically levels of exposure associated with those effects. These levels cover health effects observed at increasing dose concentrations and durations, differences in response by species, minimal risk levels (MRLs) to humans for noncancer end points, and EPA's estimated range associated with an upper-bound individual lifetime cancer risk of 1 in 10,000 to 1 in 10,000,000. Use the LSE tables and figures for a quick review of the health effects and to locate data for a specific exposure scenario. The LSE tables and figures should always be used in conjunction with the text. All entries in these tables and figures represent studies that provide reliable, quantitative estimates of No-Observed-Adverse-Effect Levels (NOAELs), Lowest-Observed-Adverse-Effect Levels (LOAELs), or Cancer Effect Levels (CELS).
The legends presented below demonstrate the application of these tables and figures. Representative examples of LSE Table 3-1 and Figure 3-1 are shown. The numbers in the left column of the legends correspond to the numbers in the example table and figure.

LEGEND

See LSE Table 3-1

(1) **Route of Exposure** One of the first considerations when reviewing the toxicity of a substance using these tables and figures should be the relevant and appropriate route of exposure. When sufficient data exists, three LSE tables and two LSE figures are presented in the document. The three LSE tables present data on the three principal routes of exposure, i.e., inhalation, oral, and dermal (LSE Table 3-1, 3-2, and 3-3, respectively). LSE figures are limited to the inhalation (LSE Figure 3-1) and oral (LSE Figure 3-2) routes. Not all substances will have data on each route of exposure and will not therefore have all five of the tables and figures.

(2) **Exposure Period** Three exposure periods - acute (less than 15 days), intermediate (15–364 days), and chronic (365 days or more) are presented within each relevant route of exposure. In this example, an inhalation study of intermediate exposure duration is reported. For quick reference to health effects occurring from a known length of exposure, locate the applicable exposure period within the LSE table and figure.

(3) **Health Effect** The major categories of health effects included in LSE tables and figures are death, systemic, immunological, neurological, developmental, reproductive, and cancer. NOAELs and LOAELs can be reported in the tables and figures for all effects but cancer. Systemic effects are further defined in the "System" column of the LSE table (see key number 18).

(4) **Key to Figure** Each key number in the LSE table links study information to one or more data points using the same key number in the corresponding LSE figure. In this example, the study represented by key number 18 has been used to derive a NOAEL and a Less Serious LOAEL (also see the 2 "18r" data points in Figure 3-1).

(5) **Species** The test species, whether animal or human, are identified in this column. Chapter 2, "Relevance to Public Health," covers the relevance of animal data to human toxicity and Section 3.4, "Toxicokinetics," contains any available information on comparative toxicokinetics. Although NOAELs and LOAELs are species specific, the levels are extrapolated to equivalent human doses to derive an MRL.

(6) **Exposure Frequency/Duration** The duration of the study and the weekly and daily exposure regimen are provided in this column. This permits comparison of NOAELs and LOAELs from different studies. In this case (key number 18), rats were exposed to 1,1,2,2-tetrachloroethane via inhalation for 6 hours per day, 5 days per week, for 3 weeks. For a more complete review of the dosing regimen refer to the appropriate sections of the text or the original reference paper, i.e., Nitschke et al. 1981.

(7) **System** This column further defines the systemic effects. These systems include: respiratory, cardiovascular, gastrointestinal, hematological, musculoskeletal, hepatic, renal, and dermal/ocular. "Other" refers to any systemic effect (e.g., a decrease in body weight) not covered in these systems. In the example of key number 18, 1 systemic effect (respiratory) was investigated.
(8) **NOAEL** A No-Observed-Adverse-Effect Level (NOAEL) is the highest exposure level at which no harmful effects were seen in the organ system studied. Key number 18 reports a NOAEL of 3 ppm for the respiratory system which was used to derive an intermediate exposure, inhalation MRL of 0.005 ppm (see footnote "b").

(9) **LOAEL** A Lowest-Observed-Adverse-Effect Level (LOAEL) is the lowest dose used in the study that caused a harmful health effect. LOAELs have been classified into "Less Serious" and "Serious" effects. These distinctions help readers identify the levels of exposure at which adverse health effects first appear and the gradation of effects with increasing dose. A brief description of the specific end point used to quantify the adverse effect accompanies the LOAEL. The respiratory effect reported in key number 18 (hyperplasia) is a Less serious LOAEL of 10 ppm. MRLs are not derived from Serious LOAELs.

(10) **Reference** The complete reference citation is given in Chapter 9 of the profile.

(11) **CEL** A Cancer Effect Level (CEL) is the lowest exposure level associated with the onset of carcinogenesis in experimental or epidemiologic studies. CELs are always considered serious effects. The LSE tables and figures do not contain NOAELs for cancer, but the text may report doses not causing measurable cancer increases.

(12) **Footnotes** Explanations of abbreviations or reference notes for data in the LSE tables are found in the footnotes. Footnote "b" indicates the NOAEL of 3 ppm in key number 18 was used to derive an MRL of 0.005 ppm.

**LEGEND**

See Figure 3-1

LSE figures graphically illustrate the data presented in the corresponding LSE tables. Figures help the reader quickly compare health effects according to exposure concentrations for particular exposure periods.

(13) **Exposure Period** The same exposure periods appear as in the LSE table. In this example, health effects observed within the intermediate and chronic exposure periods are illustrated.

(14) **Health Effect** These are the categories of health effects for which reliable quantitative data exists. The same health effects appear in the LSE table.

(15) **Levels of Exposure** concentrations or doses for each health effect in the LSE tables are graphically displayed in the LSE figures. Exposure concentration or dose is measured on the log scale "y" axis. Inhalation exposure is reported in mg/m³ or ppm and oral exposure is reported in mg/kg/day.

(16) **NOAEL** In this example, 18r NOAEL is the critical end point for which an intermediate inhalation exposure MRL is based. As you can see from the LSE figure key, the open-circle symbol indicates to a NOAEL for the test species-rat. The key number 18 corresponds to the entry in the LSE table. The dashed descending arrow indicates the extrapolation from the exposure level of 3 ppm (see entry 18 in the Table) to the MRL of 0.005 ppm (see footnote "b" in the LSE table).

(17) **CEL** Key number 38r is 1 of 3 studies for which Cancer Effect Levels were derived. The diamond symbol refers to a Cancer Effect Level for the test species-mouse. The number 38 corresponds to the entry in the LSE table.
(18) **Estimated Upper-Bound Human Cancer Risk Levels** This is the range associated with the upper-bound for lifetime cancer risk of 1 in 10,000 to 1 in 10,000,000. These risk levels are derived from the EPA's Human Health Assessment Group's upper-bound estimates of the slope of the cancer dose response curve at low dose levels ($q_1^*$).

(19) **Key to LSE Figure** The Key explains the abbreviations and symbols used in the figure.
Table 3-1. Levels of Significant Exposure to [Chemical x] – Inhalation

<table>
<thead>
<tr>
<th>Key to figure&lt;sup&gt;a&lt;/sup&gt;</th>
<th>Species</th>
<th>Exposure frequency/duration</th>
<th>System</th>
<th>NOAEL (ppm)</th>
<th>LOAEL (effect)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Less serious (ppm)</td>
<td>Serious (ppm)</td>
</tr>
<tr>
<td>INTERMEDIATE EXPOSURE</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Systemic</td>
<td>9</td>
<td>9</td>
<td>9</td>
<td>9</td>
</tr>
<tr>
<td>6</td>
<td>Rat</td>
<td>13 wk 5 d/wk 6 hr/d</td>
<td>Resp</td>
<td>3&lt;sup&gt;b&lt;/sup&gt;</td>
<td>10 (hyperplasia)</td>
</tr>
<tr>
<td>CHRONIC EXPOSURE</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cancer</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>38</td>
<td>Rat</td>
<td>18 mo 5 d/wk 7 hr/d</td>
<td></td>
<td></td>
<td>20 (CEL, multiple organs)</td>
</tr>
<tr>
<td>39</td>
<td>Rat</td>
<td>89–104 wk 5 d/wk 6 hr/d</td>
<td></td>
<td></td>
<td>10 (CEL, lung tumors, nasal tumors)</td>
</tr>
<tr>
<td>40</td>
<td>Mouse</td>
<td>79–103 wk 5 d/wk 6 hr/d</td>
<td></td>
<td></td>
<td>10 (CEL, lung tumors, hemangiosarcomas)</td>
</tr>
</tbody>
</table>

<sup>a</sup> The number corresponds to entries in Figure 3-1.

<sup>b</sup> Used to derive an intermediate inhalation Minimal Risk Level (MRL) of $5 \times 10^3$ ppm; dose adjusted for intermittent exposure and divided by an uncertainty factor of 100 (10 for extrapolation from animal to humans, 10 for human variability).
Figure 3-1. Levels of Significant Exposure to [Chemical X] - Inhalation

Acute (≤14 days)
- Systemic
  - Death
  - Respiratory
  - Hematological

Intermediate (15-364 days)
- Systemic
  - Death
  - Hematological
  - Reproductive
  - Cancer

* Doses represent the lowest dose tested per study that produced a tumorigenic response and do not imply the existence of a threshold for the cancer end point.

<table>
<thead>
<tr>
<th>Animal</th>
<th>Effect</th>
<th>Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>k-Monkey</td>
<td>Cancer</td>
<td>Effect Level - Animals</td>
</tr>
<tr>
<td>o-Guinea Pig</td>
<td>LOAEL, More Serious-Animals</td>
<td></td>
</tr>
<tr>
<td>r-Rat</td>
<td>LOAEL, Less Serious-Animals</td>
<td></td>
</tr>
<tr>
<td>h-Rabbit</td>
<td>NOAEL - Animals</td>
<td></td>
</tr>
<tr>
<td>m-Mouse</td>
<td>Minimal Risk Level for effects other than Cancer</td>
<td></td>
</tr>
</tbody>
</table>

Estimated Upper-Bound Human Cancer Risk Levels
APPENDIX C

ACRONYMS, ABBREVIATIONS, AND SYMBOLS

ACGIH  American Conference of Governmental Industrial Hygienists
ADI    Acceptable Daily Intake
ADME   Absorption, Distribution, Metabolism, and Excretion
AFID   alkali flame ionization detector
AFOSH  Air Force Office of Safety and Health
AML    acute myeloid leukemia
AOAC   Association of Official Analytical Chemists
atm    atmosphere
ATSDR  Agency for Toxic Substances and Disease Registry
AWQC   Ambient Water Quality Criteria
BAT    Best Available Technology
BCF    bioconcentration factor
BEI    Biological Exposure Index
BSC    Board of Scientific Counselors
C      Centigrade
CAA    Clean Air Act
CAG    Cancer Assessment Group of the U.S. Environmental Protection Agency
CAS    Chemical Abstract Services
CDC    Centers for Disease Control and Prevention
CEL    Cancer Effect Level
CE LDS Computer-Environmental Legislative Data System
CERCLA Comprehensive Environmental Response, Compensation, and Liability Act
CFR    Code of Federal Regulations
Ci     curie
CL     ceiling limit value
CLP    Contract Laboratory Program
cm     centimeter
CML    chronic myeloid leukemia
CNS    central nervous system
CPSC   Consumer Products Safety Commission
CWA    Clean Water Act
d     day
Derm   dermal
DHEW   Department of Health, Education, and Welfare
DHHS   Department of Health and Human Services
DNA    deoxyribonucleic acid
DOD    Department of Defense
DOE    Department of Energy
DOL    Department of Labor
DOT    Department of Transportation
DOT/UN/ Department of Transportation/United Nations/
NA/IMCO North America/International Maritime Dangerous Goods Code
DWEL   Drinking Water Exposure Level
ECD    electron capture detection
ECG/EKG electrocardiogram
EEG electroencephalogram
EEGL Emergency Exposure Guidance Level
EPA Environmental Protection Agency
F Fahrenheit
F<sub>1</sub> first-filial generation
FAO Food and Agricultural Organization of the United Nations
FDA Food and Drug Administration
FEMA Federal Emergency Management Agency
FIFRA Federal Insecticide, Fungicide, and Rodenticide Act
FPD flame photometric detection
fpm feet per minute
ft foot
FR *Federal Register*
g gram
Gd gestational day
gen generation
GLC gas liquid chromatography
GPC gel permeation chromatography
HPLC high-performance liquid chromatography
hr hour
HRGC high resolution gas chromatography
HSDB Hazardous Substance Data Bank
IDLH Immediately Dangerous to Life and Health
IARC International Agency for Research on Cancer
ILO International Labor Organization
in inch
IRIS Integrated Risk Information System
Kd adsorption ratio
kg kilogram
kkg metric ton
K<sub>oc</sub> organic carbon partition coefficient
K<sub>ow</sub> octanol-water partition coefficient
L liter
LC liquid chromatography
L<sub>C</sub><sub>10</sub> lethal concentration, low
L<sub>C</sub><sub>50</sub> lethal concentration, 50% kill
L<sub>D</sub><sub>10</sub> lethal dose, low
L<sub>D</sub><sub>50</sub> lethal dose, 50% kill
L<sub>T</sub><sub>50</sub> lethal time, 50% kill
LOAEL lowest-observed-adverse-effect level
LSE Levels of Significant Exposure
m meter
MA *trans,trans*-muconic acid
MAL Maximum Allowable Level
mCi millicurie
MCL Maximum Contaminant Level
MCLG Maximum Contaminant Level Goal
mg milligram
min minute
mL milliliter
<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Full Form</th>
</tr>
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<tbody>
<tr>
<td>mm</td>
<td>millimeter</td>
</tr>
<tr>
<td>mm Hg</td>
<td>millimeters of mercury</td>
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<tr>
<td>mmol</td>
<td>millimole</td>
</tr>
<tr>
<td>mo</td>
<td>month</td>
</tr>
<tr>
<td>mppcf</td>
<td>millions of particles per cubic foot</td>
</tr>
<tr>
<td>MRL</td>
<td>Minimal Risk Level</td>
</tr>
<tr>
<td>MS</td>
<td>mass spectrometry</td>
</tr>
<tr>
<td>NAAQS</td>
<td>National Ambient Air Quality Standard</td>
</tr>
<tr>
<td>NAS</td>
<td>National Academy of Science</td>
</tr>
<tr>
<td>NATICH</td>
<td>National Air Toxics Information Clearinghouse</td>
</tr>
<tr>
<td>NATO</td>
<td>North Atlantic Treaty Organization</td>
</tr>
<tr>
<td>NCE</td>
<td>normochromatic erythrocytes</td>
</tr>
<tr>
<td>NCI</td>
<td>National Cancer Institute</td>
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<tr>
<td>NIEHS</td>
<td>National Institute of Environmental Health Sciences</td>
</tr>
<tr>
<td>NIOSH</td>
<td>National Institute for Occupational Safety and Health</td>
</tr>
<tr>
<td>NIOSHTIC</td>
<td>NIOSH's Computerized Information Retrieval System</td>
</tr>
<tr>
<td>NFPA</td>
<td>National Fire Protection Association</td>
</tr>
<tr>
<td>ng</td>
<td>nanogram</td>
</tr>
<tr>
<td>NLM</td>
<td>National Library of Medicine</td>
</tr>
<tr>
<td>nm</td>
<td>nanometer</td>
</tr>
<tr>
<td>NHANES</td>
<td>National Health and Nutrition Examination Survey</td>
</tr>
<tr>
<td>nmol</td>
<td>nanomole</td>
</tr>
<tr>
<td>NOAEL</td>
<td>no-observed-adverse-effect level</td>
</tr>
<tr>
<td>NOES</td>
<td>National Occupational Exposure Survey</td>
</tr>
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<td>NOHS</td>
<td>National Occupational Hazard Survey</td>
</tr>
<tr>
<td>NPD</td>
<td>nitrogen phosphorus detection</td>
</tr>
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<td>NPDES</td>
<td>National Pollutant Discharge Elimination System</td>
</tr>
<tr>
<td>NPL</td>
<td>National Priorities List</td>
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<tr>
<td>NR</td>
<td>not reported</td>
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<tr>
<td>NRC</td>
<td>National Research Council</td>
</tr>
<tr>
<td>NS</td>
<td>not specified</td>
</tr>
<tr>
<td>NSPS</td>
<td>New Source Performance Standards</td>
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<tr>
<td>NTIS</td>
<td>National Technical Information Service</td>
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<td>National Toxicology Program</td>
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<tr>
<td>ODW</td>
<td>Office of Drinking Water, EPA</td>
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<tr>
<td>OERR</td>
<td>Office of Emergency and Remedial Response, EPA</td>
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<tr>
<td>OHM/TADS</td>
<td>Oil and Hazardous Materials/Technical Assistance Data System</td>
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<tr>
<td>OPP</td>
<td>Office of Pesticide Programs, EPA</td>
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<tr>
<td>OPPTS</td>
<td>Office of Prevention, Pesticides and Toxic Substances, EPA</td>
</tr>
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<td>OPPT</td>
<td>Office of Pollution Prevention and Toxics, EPA</td>
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<tr>
<td>OSHA</td>
<td>Occupational Safety and Health Administration</td>
</tr>
<tr>
<td>OSW</td>
<td>Office of Solid Waste, EPA</td>
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<td>OTS</td>
<td>Office of Toxic Substances</td>
</tr>
<tr>
<td>OW</td>
<td>Office of Water</td>
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<tr>
<td>OWRS</td>
<td>Office of Water Regulations and Standards, EPA</td>
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<tr>
<td>PAH</td>
<td>Polycyclic Aromatic Hydrocarbon</td>
</tr>
<tr>
<td>PBPD</td>
<td>Physiologically Based Pharmacodynamic</td>
</tr>
<tr>
<td>PBPK</td>
<td>Physiologically Based Pharmacokinetic</td>
</tr>
<tr>
<td>PCE</td>
<td>polychromatic erythrocytes</td>
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<tr>
<td>PEL</td>
<td>permissible exposure limit</td>
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<tr>
<td>PID</td>
<td>photo ionization detector</td>
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<tr>
<td>Abbreviation</td>
<td>Full Form</td>
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<td>-----------</td>
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<tr>
<td>pg</td>
<td>picogram</td>
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<tr>
<td>pmol</td>
<td>picomole</td>
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<tr>
<td>PHS</td>
<td>Public Health Service</td>
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<tr>
<td>PMR</td>
<td>proportionate mortality ratio</td>
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<tr>
<td>ppb</td>
<td>parts per billion</td>
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<tr>
<td>ppm</td>
<td>parts per million</td>
</tr>
<tr>
<td>ppt</td>
<td>parts per trillion</td>
</tr>
<tr>
<td>PSNS</td>
<td>Pretreatment Standards for New Sources</td>
</tr>
<tr>
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> greater than
\ge greater than or equal to
= equal to
< less than
\le less than or equal to
% percent
α alpha
β beta
γ gamma
δ delta
μm micrometer
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APPENDIX D

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