

**APPENDIX D – DESCRIPTION OF COMPARISON VALUES AND OTHER
HEALTH-BASED GUIDELINES**

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DESCRIPTION OF COMPARISON VALUES AND OTHER HEALTH-BASED GUIDELINES

As noted in the text of this public health assessment, ATSDR's comparison values are media-specific concentrations that are considered to be "safe" under default conditions of exposure. They are used as screening values in the preliminary identification of "contaminants of concern" at a site. The latter is, perhaps, an unfortunate term since the word "concern" might be misinterpreted as an implication of "hazard." As ATSDR uses the phrase, however, a "contaminant of concern" is merely a site-specific chemical substance that has been selected for further evaluation of potential health effects.

Generally, a chemical is selected as a contaminant of concern because its maximum concentration in air, water, or soil at the site exceeds one of ATSDR's comparison values. However, it cannot be emphasized strongly enough that comparison values are not thresholds of toxicity. While concentrations at or below the relevant comparison value might reasonably be considered safe, it does not automatically follow that any environmental concentration that exceeds a comparison value would be expected to produce adverse health effects. Indeed, the whole purpose behind highly conservative, health-based standards and guidelines is to enable health professionals to recognize and resolve potential public health problems before they become actual health hazards. The probability that adverse health outcomes will actually occur as a result of exposure to environmental contaminants depends on site-specific conditions and individual lifestyle and genetic factors that affect the route, magnitude, and duration of actual exposure, and not on environmental concentrations alone.

Screening values based on non-cancer effects are obtained by dividing the lowest concentrations associated with health effects found in animal or (less often) human studies by cumulative safety margins (variously called safety factors, uncertainty factors, and modifying factors) that typically range from 10 to 1,000 or more. By contrast, cancer-based screening values are usually derived by linear extrapolation from animal data obtained at high doses, because human cancer incidence data for very low levels of exposure simply do not exist, and probably never will. In neither case can the resulting screening values (i.e., EMEGs or CREGs) be used to make realistic predictions of health risk associated with low-level exposures in humans.

A description or definition of the various comparison values and terms that ATSDR used in this public health assessment are provided below.

Area Sampling is the collection of airborne chemicals at a fixed position in the work area.

Cancer Risk Evaluation Guides (CREGs) are estimated concentrations of contaminants that are expected to cause no more than one excess cancer case for every million (1×10^{-6}) persons who are continuously exposed to the concentration for an entire lifetime. These concentrations are calculated from EPA's cancer slope factors, which indicate the relative potency of carcinogenic chemicals. Only chemicals that are known or suspected of being carcinogenic have CREG comparison values. It should be noted that exposures equivalent to CREGs are not

actually expected to cause one excess cancer in a million persons exposed over a lifetime. Nor does it mean that every person in an exposed population of one million has a 1-in-a-million chance of developing cancer from the specified exposure. Although commonly interpreted in precisely these ways, the CREGs reflect only a rough estimate of population risks, which should not be applied directly to any individual.

Immediately Dangerous to Life and Health (IDLH) is the maximum concentration from which one could escape within 30 minutes without any escape-impairing symptoms or irreversible health effects. Commonly used to determine selection of a respirator.

Environmental Media Evaluation Guide (EMEGs) are estimates of chemical concentrations that are not likely to cause an appreciable risk of deleterious, noncancerous health effects for fixed durations of exposure. These concentrations factor in estimates of receptor body weights and rates of ingestion. EMEGs might reflect several different types of exposure: acute (<14 days), intermediate (15–364 days), and chronic (>365 days). These concentrations are ultimately based on data published in ATSDR Toxicological Profiles for specific chemicals.

Grab Sampling is the direct collection of an air contaminant mixture into a device such as a sampling bag, syringe, or evacuated flask over a few second or minutes.

Lowest-Observed-Adverse-Effect-Level (LOAEL) is defined as the lowest dose of chemical in a study, or group of studies, that produces statistically or biologically significant increases in the frequency or severity of adverse effects between the exposed population and its appropriate control.

Minimal Risk Level (MRL) is defined as an estimate of daily human exposure to a substance that is likely to be without an appreciable risk of adverse effects (non-carcinogenic) over a specified duration of exposure. 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 specified duration within a given route of exposure. MRLs are based only on noncancerous health effects, and do not consider carcinogenic effects. MRLs can be derived for acute, intermediate, and chronic durations of exposure for the inhalation route.

National Ambient Air Quality Standards (NAAQS) are developed by EPA to protect people and the environment from unhealthy and undesirable levels of air pollution. As of the writing of this report, EPA has promulgated NAAQS for seven pollutants (known as “criteria pollutants”). These standards have been developed specifically to protect the health and welfare of humans. To be conservative, these standards were designed to be protective of exposed persons, including most “sensitive” populations (e.g., persons with asthma).

No-Observed-Adverse-Effect-Level (NOAEL) is defined as the dose of chemical at which there were no statistically or biologically significant increases in the frequency or severity of adverse effects seen between the exposed population and its appropriate control. Effects may be produced at this dose, but they are not considered to be adverse.

Permissible Exposure Limit (PEL) is a value established by OSHA, generally expressed as a time weighted average (TWA) limit or as a ceiling exposure limit, that legally must never be exceeded instantaneously even if the TWA exposure limit is not violated. OSHA PELs have the force of law. Note that ACGIH TLVs and NIOSH RELs are recommended exposure limits that may or may not be enacted into law by OSHA.

Personal Sampling is the collection of airborne chemicals in the worker's breathing zone done by having the worker wear the sampling equipment throughout the workday.

Recommended Exposure Limit (REL) is the highest allowable airborne concentration that is not expected to injure a worker established by NIOSH. It may be expressed as a ceiling limit or as a time-weighted-average, usually for 10-hour work shifts.

Reference Concentration (RfC) is an estimate (with uncertainty spanning perhaps an order of magnitude) of a continuous inhalation exposure to the human population (including sensitive subgroups) that is likely to be without an appreciable risk of deleterious noncancer health effects during a lifetime. The inhalation reference concentration is for continuous inhalation exposures and is appropriately expressed in units of mg/m³ or ppm.

Risk-Based Concentrations (RBCs) are derived by Region 3 of the U.S. Environmental Protection Agency (EPA) and represent concentrations of contaminants in tap water, ambient air, fish or soil (industrial or residential) that are considered unlikely to cause adverse health effects. They are derived using conservative exposure assumptions and EPA's Reference Doses, Reference Concentrations, or slope factors. RBCs are based either on cancer or non-cancer effects.

Short Term Exposure Limit (STEL) is the short-term exposure limit or maximum concentration for a continuous exposure period of 15 minutes (with a maximum of four such periods per day, with at least 60 minutes between exposure periods, and provided that the daily TLV-TWA is not exceeded).

Time-weighted-average is the (1) average exposure for an individual over a given working period, as determined by sampling at given times during the period. (2) Also, defined as the most frequently used exposure guideline term; the average concentration over a workday (8 hours for OSHA PELs and ACGIH TLVs, up to 10 hours in a 40-hour workweek for NIOSH RELs).

Threshold Limit Value (TLV) is a term used by the ACGIH to express the airborne concentration of a material to which nearly all workers can be exposed day after day without adverse effects. "Workers" means healthy individuals. The young, old, ill or naturally susceptible will have lower tolerances and need to take additional precautions.

**APPENDIX E – REVIEW OF PERTINENT HUMAN AND ANIMAL STUDIES
FOLLOWING BRIEF EXPOSURES TO SULFUR DIOXIDE**

APPENDIX E

REVIEW OF PERTINENT HUMAN AND ANIMAL STUDIES FOLLOWING BRIEF EXPOSURES TO SULFUR DIOXIDE

This is a brief review of the most important human studies about the effects of sulfur dioxide from acute exposures. In conducting this review, ATSDR used not only its Toxicological Profile for Sulfur Dioxide but also conducted extensive searches of a national toxicological database (TOXLINE).

The most sensitive people to sulfur dioxide exposure are persons with asthma. Children with asthma might be particularly sensitive because of an inherent sensitivity or because children exercise more frequently than do adults, which increases the breathing rate resulting in more exposure to sulfur dioxide in air (ATSDR 1998). It should be noted also that exercise alone can trigger asthma attacks. If sulfur dioxide levels are high enough, children and adults who do not have asthma could also experience harmful effects. The effects of sulfur dioxide on the lungs of persons with asthma are summarized in Table 40 in Appendix B.

Sheppard et al. reported that persons with mild asthma who were exposed to 100 ppb sulfur dioxide for 10 minutes experienced an increase in airway resistance and bronchoconstriction in the lungs during moderate exercise (ATSDR 1998; Sheppard et al. 1981). An increase in airway resistance means that air traveling through the airway passages in the lungs is meeting more resistance; bronchoconstriction is the narrowing of the air passages in the lung. The increases in airway resistance and bronchoconstriction do not produce noticeable symptoms at this level of sulfur dioxide exposure and can only be measured in a clinical setting. Increases in airway resistance and bronchoconstriction are more pronounced in persons exposed to 250 and 500 ppb, and at 500 ppb, the increased airway resistance and bronchoconstriction are associated with wheezing and shortness of breath in some persons with asthma.

Similarly, Balmes et al. reported an increase in airway resistance in persons with asthma exposed to 500 ppb sulfur dioxide for 3 minutes (ATSDR 1998; Balmes et al. 1987). The resulting bronchoconstriction also resulted in wheezing, chest tightness, and shortness of breath. It is important to know that some persons with asthma had to take a bronchodilator after exposure to 500 ppb, whereas others were not able to complete the experiment because of breathing problems. Some authors report that these persons experienced pronounced wheezing and tightness of the chest, with some requesting bronchodilators to relieve the symptoms of bronchoconstriction (ATSDR 1998; Bethel et al. 1984; Koenig et al. 1985, 1993; Balmes et al. 1987; Horstman et al. 1986, 1988; Linn et al. 1984a, 1984b, 1984c; Roger et al. 1985). Numerous other human studies support the findings of these studies in causing an increase in airway resistance and bronchoconstriction in persons with asthma who are exposed to several hundred parts per billion sulfur dioxide (ATSDR 1998). In addition to persons with asthma, another sensitive group is elderly adults with preexisting respiratory or cardiovascular disease or chronic lung disease, such as bronchitis or emphysema (WHO 1979).

Persons without asthma can also experience pulmonary effects when exposed to sulfur dioxide; however, a higher level of exposure is required. Islam et al. report that persons without asthma

who were exposed to 600 to 800 ppb sulfur dioxide for 5 minutes, *using a mouthpiece apparatus*, can experience an increase in airway resistance (Islam et al. 1992). It should be noted that the 600-ppb exposure group in the Islam study is an effect level; the authors did not identify a no-effect level in their study. Uncertainty exists in applying this study to the members of the public who do not have asthma because the authors used a mouthpiece to measure the delivered dose of sulfur dioxide. Using a mouthpiece might increase the amount of sulfur dioxide that enters the lungs because trapping of sulfur dioxide in the nasal passages is avoided. The levels used in this study might be more applicable to exercising persons who do not have asthma, because exercise increases breathing through the mouth rather than the nose. That levels of 600 to 800 ppb sulfur dioxide can cause an effect in persons without asthma, however, is supported by other research. Lawther et al. showed that a similar response occurred at 1,000 ppb sulfur dioxide (Lawther et al. 1975). Also at 1,000 ppb, people can experience an increase in heart rate and breathing rate (Amdur et al. 1953; ATSDR 1998). Therefore, somewhere between 600 and 1,000 ppb sulfur dioxide, persons without asthma might begin to experience lung effects.

Several human studies show additional harmful effects occurring for exposures above 1,000 ppb. The adverse effects observed included increased heart rate and breathing rate, increased number of macrophages in lung fluid, cough, irritation, redness of the airways, and increased inflammatory cells in lung fluid (Sandstrom et al. 1989; Lawther et al. 1975; Amdur et al. 1953).

Activity level and weather conditions are also a factor in whether or not sulfur dioxide can cause harmful effects. When people are at rest and breathing normally, sulfur dioxide is absorbed in the moist environment of the nasal passages and less sulfur dioxide reaches the air passages in the lung. Therefore, people at rest can be exposed to higher levels of sulfur dioxide before experiencing effects on the lung than people who are exercising. During exercise or increased activity, however, people breathe faster and are more likely to breathe through their mouth; therefore, more sulfur dioxide is likely to reach the lower air passages in the lung. These factors result in more sulfur dioxide reaching the lungs, thus causing an increase in airway resistance and bronchoconstriction. Weather also becomes a factor, because more sulfur dioxide will reach the air passages in cold, dry (low humidity) atmospheres, thus increasing the likelihood of increased airway resistance and bronchoconstriction (ATSDR 1998; Bethel et al. 1984; Linn et al. 1985; Sheppard et al. 1984).

From the information presented in Table 40 (Appendix B), 100 ppb sulfur dioxide might cause mild effects in the lungs of exercising persons with asthma from exposures as short as 3 minutes. About 10% (or 10 of every 100) children have asthma. At 100 ppb sulfur dioxide, the responses do not produce any signs or symptoms but can be measured in a clinical setting. The effects on airway resistance become more pronounced with increasing sulfur dioxide concentration to point that wheezing and shortness of breath can occur when sulfur dioxide levels reach about 500 ppb. When sulfur dioxide levels reach about 5,000 ppb, throat irritation and cough can occur along with effects that can only be detected in a clinical setting.

APPENDIX F – DEFINITIONS FOR TSP, PM₁₀, AND PM_{2.5}

APPENDIX F

DEFINITIONS FOR TSP, PM₁₀, AND PM_{2.5}

Introduction

For nearly 20 years, EPA has closely monitored the levels of solid particles and liquid droplets or aerosols, or “particulate matter,” in the air that people breathe. Many health studies have shown that the size of airborne particles is closely related to potential health effects among exposed populations (see Public Health Implications section for more details). As a result, EPA and public health agencies focus on the size of airborne particles when evaluating levels of air pollution. Over the years, particulate matter has been generally classified into three categories: TSP, PM₁₀, and PM_{2.5}; therefore, it is first important to understand the definition for these terms before describing the ability of particulates to cause harmful effects.

Total suspended particulates (TSP)

TSP refers to a wide range of solid particles and liquid droplets found in ambient air, and typically is measured as particles having aerodynamic diameters of 25 to 40 microns or less (EPA 1996). EPA’s health-based National Ambient Air Quality Standards (NAAQS) regulated ambient air concentrations of TSP until 1987; these standards required annual average concentrations of TSP to be less than 75 µg/m³ and 24-hour average concentrations to be less than 260 µg/m³ (EPA 1996). Many industrial, commercial, mobile, and natural sources emit TSP to the air.

Particulate matter smaller than 10 microns (PM₁₀)

PM₁₀ refers to the subset of TSP composed of particles smaller than 10 microns in diameter. With research showing that PM₁₀ can penetrate into sensitive regions of the respiratory tract, EPA stopped regulating airborne levels of TSP in 1987, and began regulating ambient air concentrations of PM₁₀. EPA continues to regulate levels of PM₁₀ today, and requires annual average concentrations to be less than 50 µg/m³ and 24-hour average concentrations to be less than 150 µg/m³ (EPA 1996). Typical sources of PM₁₀ include, but are not limited to, wind-blown dust, grinding operations, and dusts generated by motor vehicles driving on roadways.

Particulate matter smaller than 2.5 microns (PM_{2.5})

PM_{2.5} or “fine particulates” refers to the subset of TSP composed of particles with aerodynamic diameters of 2.5 microns or less. By definition, PM_{2.5} is also a subset of PM₁₀. With recent studies linking inhalation of fine particles to adverse health effects in children and other sensitive populations, EPA proposed regulating ambient air concentrations of PM_{2.5} in 1997. These health-based regulations require annual average concentrations of PM_{2.5} to be less than 15 µg/m³ and 24-hour average concentrations to be less than 65 µg/m³ (EPA 1997). Although many sources emit PM_{2.5}, the pollutant is primarily emitted by combustion sources (e.g., motor vehicles, power generation, boilers and industrial furnaces, residential heating). Fine particles are also formed in the air from other pollutants. Although EPA’s promulgation of the PM_{2.5} standard is still under

legal review, ATSDR uses the proposed standard and other scientific evidence to evaluate inhalation exposures to PM_{2.5}.

**APPENDIX G – ESTIMATION OF PM_{10} AND $PM_{2.5}$ CONCENTRATIONS FROM
MEASURED TSP CONCENTRATIONS**

APPENDIX G

ESTIMATION OF PM_{10} AND $PM_{2.5}$ CONCENTRATIONS FROM MEASURED TSP CONCENTRATIONS

The only ambient air monitoring data available for the years Stauffer was operating is for TSP, and no sampling data characterized the size distribution of these particles. ATSDR prefers to base conclusions regarding exposures to particulate matter on measurements of PM_{10} or $PM_{2.5}$ concentrations, which are more predictive of adverse health effects. Because no sampling studies measured air concentrations of these particle size fractions, ATSDR investigated options for estimating the PM_{10} and $PM_{2.5}$ exposure levels.

This appendix describes how we *estimated* PM_{10} and $PM_{2.5}$ exposure levels from the TSP monitoring data, based on our knowledge of particle size distributions in the vicinity of elemental phosphorus production facilities. Important information on the uncertainty and limitations associated with this estimation is also presented.

Estimating Long-Term PM_{10} Levels from TSP Levels

PM_{10} is a subset of TSP. The relative amount of PM_{10} within TSP depends on many factors, such as the local sources of air pollution. ATSDR investigated multiple options to *estimate* the amount of PM_{10} within the TSP that was measured at the Anclote Road monitoring station. One option was to use PM_{10} :TSP ratios, based on sampling data collected in northern Pinellas County and southern Pasco County in the 1990s. Comments from peer reviewers suggested that such an approach involves considerable uncertainty, because we would be using ratios derived from a time period when Stauffer was not operating.

As an improved approach, ATSDR estimates PM_{10} levels during the time Stauffer operated using a PM_{10} :TSP ratio derived from extensive ambient air monitoring data collected near the fence-line of an active elemental phosphorus production facility in southeastern Idaho—a sampling arrangement similar to the Anclote Road monitoring station being adjacent to the Stauffer facility. At the Idaho facility, the average PM_{10} :TSP ratio, based on nearly 2 whole years of concurrent sampling, was 0.50, with a standard deviation of 0.14. ATSDR applied this average ratio to estimate annual average PM_{10} concentrations in the years for which only TSP data are available. Table 48 in Appendix B documents these results. The end of this section describes the uncertainties inherent in this approach.

Estimating Long-Term $PM_{2.5}$ Levels from PM_{10} Levels

To *estimate* the exposure concentrations for $PM_{2.5}$, ATSDR similarly applied $PM_{2.5}$: PM_{10} ratios to the estimated PM_{10} levels. We had considered using $PM_{2.5}$: PM_{10} ratios measured in St. Petersburg and other parts of the southeastern United States for this analysis, but comments from peer reviewers questioned whether such data would be representative of ambient conditions in the vicinity of an elemental phosphorus plant. Based on these comments, we decided that particle size ratios observed near the elemental phosphorus production facility a more representative of the airborne particle size distribution that occurred near Stauffer. Thus, we used the same data

set identified in the previous section, which indicates that the average $PM_{2.5}:PM_{10}$ ratio near the elemental phosphorus plant was 0.6. Table 49 shows we used this factor to *estimate* $PM_{2.5}$ concentrations in the vicinity of Stauffer based on this particle size ratio.

Uncertainty and Limitations

Since ambient air concentrations of PM_{10} and $PM_{2.5}$ were never measured near Stauffer while the facility operated, ATSDR could only *estimate* the airborne levels of these pollutants, and our estimates—no matter what approach we took—would involve some uncertainty. The extent of uncertainty in our $PM_{2.5}$ and PM_{10} estimates depends on the validity of the assumptions made in applying the ratios. The key question for this calculation is to what extent particle size ratios observed at the fence-line of one elemental phosphorus production facility are representative of ratios at the fence-line of another. While we expect the magnitude of particulate matter levels to differ considerably between the Idaho and Florida facilities (due to the differences in production levels), there is less reason to believe that the composition of various particle sizes would differ dramatically, especially considering the similarity in the production processes.

Nonetheless, ATSDR emphasizes that the PM_{10} and $PM_{2.5}$ exposure concentrations are *estimates* of actual air pollution levels, and they might understate or overstate actual exposures. The fact that our estimated $PM_{2.5}$ concentrations are consistent with those predicted by our dispersion modeling analysis (see Section 5.3.2) reassures us that the concentrations estimated using the ratio approach are reasonable, though some uncertainties undoubtedly remain.

APPENDIX H – ATSDR GLOSSARY OF ENVIRONMENTAL HEALTH TERMS

APPENDIX H

ATSDR GLOSSARY OF ENVIRONMENTAL HEALTH TERMS

The Agency for Toxic Substances and Disease Registry (ATSDR) is a federal public health agency with headquarters in Atlanta, Georgia, and 10 regional offices in the United States. ATSDR's mission is to serve the public by using the best science, taking responsive public health actions, and providing trusted health information to prevent harmful exposures and diseases related to toxic substances. ATSDR is not a regulatory agency, unlike the U.S. Environmental Protection Agency (EPA), which is the federal agency that develops and enforces environmental laws to protect the environment and human health.

This glossary defines words used by ATSDR in communications with the public. It is not a complete dictionary of environmental health terms. If you have questions or comments, call ATSDR's toll-free telephone number, 1-888-42-ATSDR (1-888-422-8737).

Absorption

The process of taking in. For a person or animal, absorption is the process of a substance getting into the body through the eyes, skin, stomach, intestines, or lungs.

Acute

Occurring over a short time [compare with **chronic**].

Acute exposure

Contact with a substance that occurs once or for only a short time (up to 14 days) [compare with **intermediate duration exposure** and **chronic exposure**].

Additive effect

A biologic response to exposure to multiple substances that equals the sum of responses of all the individual substances added together [compare with **antagonistic effect** and **synergistic effect**].

Adverse health effect

A change in body function or cell structure that might lead to disease or health problems.

Aerobic

Requiring oxygen [compare with **anaerobic**].

Ambient

Surrounding (for example, *ambient* air).

Anaerobic

Requiring the absence of oxygen [compare with **aerobic**].

Analyte

A substance measured in the laboratory. A chemical for which a sample (such as water, air, or blood) is tested in a laboratory. For example, if the analyte is mercury, the laboratory test will determine the amount of mercury in the sample.

Analytic epidemiologic study

A study that evaluates the association between exposure to hazardous substances and disease by testing scientific hypotheses.

Antagonistic effect

A biologic response to exposure to multiple substances that is **less** than would be expected if the known effects of the individual substances were added together [compare with **additive effect** and **synergistic effect**].

Background level

An average or expected amount of a substance or radioactive material in a specific environment, or typical amounts of substances that occur naturally in an environment.

Biodegradation

Decomposition or breakdown of a substance through the action of microorganisms (such as bacteria or fungi) or other natural physical processes (such as sunlight).

Biologic indicators of exposure study

A study that uses (a) **biomedical testing** or (b) the measurement of a substance [an **analyte**], its **metabolite**, or another marker of exposure in human body fluids or tissues to confirm human exposure to a hazardous substance [also see **exposure investigation**].

Biologic monitoring

Measuring hazardous substances in biologic materials (such as blood, hair, urine, or breath) to determine whether exposure has occurred. A blood test for lead is an example of biologic monitoring.

Biologic uptake

The transfer of substances from the environment to plants, animals, and humans.

Biomedical testing

Testing of persons to find out whether a change in a body function might have occurred because of exposure to a hazardous substance.

Biota

Plants and animals in an environment. Some of these plants and animals might be sources of food, clothing, or medicines for people.

Body burden

The total amount of a substance in the body. Some substances build up in the body because they are stored in fat or bone or because they leave the body very slowly.

CAP

See **Community Assistance Panel**.

Cancer

Any one of a group of diseases that occurs when cells in the body become abnormal and grow or multiply out of control.

Cancer risk

A theoretical risk of for getting cancer if exposed to a substance every day for 70 years (a lifetime exposure). The true risk might be lower.

Carcinogen

A substance that causes cancer.

Case study

A medical or epidemiologic evaluation of one person or a small group of people to gather information about specific health conditions and past exposures.

Case-control study

A study that compares exposures of people who have a disease or condition (cases) with people who do not have the disease or condition (controls). Exposures that are more common among the cases may be considered as possible risk factors for the disease.

CAS registry number

A unique number assigned to a substance or mixture by the American Chemical Society Abstracts Service.

Central nervous system

The part of the nervous system that consists of the brain and the spinal cord.

CERCLA [see **Comprehensive Environmental Response, Compensation, and Liability Act of 1980**]

Chronic

Occurring over a long time (more than 1 year) [compare with **acute**].

Chronic exposure

Contact with a substance that occurs over a long time (more than 1 year) [compare with **acute exposure** and **intermediate duration exposure**].

Cluster investigation

A review of an unusual number, real or perceived, of health events (for example, reports of cancer) grouped together in time and location. Cluster investigations are designed to confirm case reports; determine whether they represent an unusual disease occurrence; and, if possible, explore possible causes and contributing environmental factors.

Community Assistance Panel (CAP)

A group of people, from a community and from health and environmental agencies, who work with ATSDR to resolve issues and problems related to hazardous substances in the community. CAP members work with ATSDR to gather and review community health concerns, provide information on how people might have been or might now be exposed to hazardous substances, and inform ATSDR on ways to involve the community in its activities.

Comparison value (CV)

Calculated concentration of a substance in air, water, food, or soil that is unlikely to cause harmful (adverse) health effects in exposed people. The CV is used as a screening level during the public health assessment process. Substances found in amounts greater than their CVs might be selected for further evaluation in the public health assessment process.

Completed exposure pathway [see **exposure pathway**].

Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA)

CERCLA, also known as **Superfund**, is the federal law that concerns the removal or cleanup of hazardous substances in the environment and at hazardous waste sites. ATSDR, which was created by CERCLA, is responsible for assessing health issues and supporting public health activities related to hazardous waste sites or other environmental releases of hazardous substances.

Concentration

The amount of a substance present in a certain amount of soil, water, air, food, blood, hair, urine, breath, or any other media.

Contaminant

A substance that is either present in an environment where it does not belong or is present at levels that might cause harmful (adverse) health effects.

Delayed health effect

A disease or injury that happens as a result of exposures that might have occurred in the past.

Dermal

Referring to the skin. For example, dermal absorption means passing through the skin.

Dermal contact

Contact with (touching) the skin [see **route of exposure**].

Descriptive epidemiology

The study of the amount and distribution of a disease in a specified population by person, place, and time.

Detection limit

The lowest concentration of a chemical that can reliably be distinguished from a zero concentration.

Disease prevention

Measures used to prevent a disease or reduce its severity.

Disease registry

A system of ongoing registration of all cases of a particular disease or health condition in a defined population.

DOD

United States Department of Defense.

DOE

United States Department of Energy.

Dose (for chemicals that are not radioactive)

The amount of a substance to which a person is exposed over some time period. Dose is a measurement of exposure. Dose is often expressed as milligram (amount) per kilogram (a measure of body weight) per day (a measure of time) when people eat or drink contaminated water, food, or soil. In general, the greater the dose, the greater the likelihood of an effect. An “exposure dose” is how much of a substance is encountered in the environment. An “absorbed dose” is the amount of a substance that actually got into the body through the eyes, skin, stomach, intestines, or lungs.

Dose (for radioactive chemicals)

The radiation dose is the amount of energy from radiation that is actually absorbed by the body. This is not the same as measurements of the amount of radiation in the environment.

Dose-response relationship

The relationship between the amount of exposure [**dose**] to a substance and the resulting changes in body function or health (response).

Environmental media

Soil, water, air, **biota** (plants and animals), or any other parts of the environment that can contain contaminants.

Environmental media and transport mechanism

Environmental media include water, air, soil, and **biota** (plants and animals). Transport mechanisms move contaminants from the source to points where human exposure can occur. The **environmental media and transport mechanism** is the second part of an **exposure pathway**.

EPA

United States Environmental Protection Agency.

Epidemiologic surveillance

The ongoing, systematic collection, analysis, and interpretation of health data. This activity also involves timely dissemination of the data and use for public health programs.

Epidemiology

The study of the distribution and determinants of disease or health status in a population; the study of the occurrence and causes of health effects in humans.

Exposure

Contact with a substance by swallowing, breathing, or touching the skin or eyes. Exposure may be short-term [**acute exposure**], of intermediate duration, or long-term [**chronic exposure**].

Exposure assessment

The process of finding out how people come into contact with a hazardous substance, how often and for how long they are in contact with the substance, and how much of the substance they are in contact with.

Exposure-dose reconstruction

A method of estimating the amount of people's past exposure to hazardous substances.

Computer and approximation methods are used when past information is limited, not available, or missing.

Exposure investigation

The collection and analysis of site-specific information and biologic tests (when appropriate) to determine whether people have been exposed to hazardous substances.

Exposure pathway

The route a substance takes from its source (where it began) to its end point (where it ends), and how people can come into contact with (or get exposed to) it. An exposure pathway has five parts: a **source of contamination** (such as an abandoned business); an **environmental media and transport mechanism** (such as movement through groundwater); a **point of exposure** (such as a private well); a **route of exposure** (eating, drinking, breathing, or touching), and a **receptor population** (people potentially or actually exposed). When all five parts are present, the exposure pathway is termed a **completed exposure pathway**.

Exposure registry

A system of ongoing followup of people who have had documented environmental exposures.

Feasibility study

A study by EPA to determine the best way to clean up environmental contamination. A number of factors are considered, including health risk, costs, and what methods will work well.

Geographic information system (GIS)

A mapping system that uses computers to collect, store, manipulate, analyze, and display data. For example, GIS can show the concentration of a contaminant within a community in relation to points of reference such as streets and homes.

Grand rounds

Training sessions for physicians and other health care providers about health topics.

Groundwater

Water beneath the earth's surface in the spaces between soil particles and between rock surfaces [compare with **surface water**].

Half-life ($t_{1/2}$)

The time it takes for half the original amount of a substance to disappear. In the environment, the half-life is the time it takes for half the original amount of a substance to disappear when it is changed to another chemical by bacteria, fungi, sunlight, or other chemical processes. In the human body, the half-life is the time it takes for half the original amount of the substance to disappear, either by being changed to another substance or by leaving the body. In the case of radioactive material, the half life is the amount of time necessary for one half the initial number of radioactive atoms to change or transform into another atom (that is normally not radioactive). After two half lives, 25% of the original number of radioactive atoms remain.

Hazard

A source of potential harm from past, current, or future exposures.

Hazardous Substance Release and Health Effects Database (HazDat)

The scientific and administrative database system developed by ATSDR to manage data collection, retrieval, and analysis of site-specific information on hazardous substances, community health concerns, and public health activities.

Hazardous waste

Potentially harmful substances that have been released or discarded into the environment.

Health consultation

A review of available information or collection of new data to respond to a specific health question or request for information about a potential environmental hazard. Health consultations are focused on a specific exposure issue. Health consultations are therefore more limited than a public health assessment, which reviews the exposure potential of each pathway and chemical [compare with **public health assessment**].

Health education

Programs designed with a community to help it know about health risks and how to reduce these risks.

Health investigation

The collection and evaluation of information about the health of community residents. This information is used to describe or count the occurrence of a disease, symptom, or clinical measure and to estimate the possible association between the occurrence and exposure to hazardous substances.

Health promotion

The process of enabling people to increase control over, and to improve, their health.

Health statistics review

The analysis of existing health information (i.e., from death certificates, birth defects registries, and cancer registries) to determine if there is excess disease in a specific population, geographic area, and time period. A health statistics review is a descriptive epidemiologic study.

Indeterminate public health hazard

The category used in ATSDR's public health assessment documents when a professional judgment about the level of health hazard cannot be made because information critical to such a decision is lacking.

Incidence

The number of new cases of disease in a defined population over a specific time period [contrast with **prevalence**].

Ingestion

The act of swallowing something through eating, drinking, or mouthing objects. A hazardous substance can enter the body this way [see **route of exposure**].

Inhalation

The act of breathing. A hazardous substance can enter the body this way [see **route of exposure**].

Intermediate duration exposure

Contact with a substance that occurs for more than 14 days and less than a year [compare with **acute exposure** and **chronic exposure**].

In vitro

In an artificial environment outside a living organism or body. For example, some toxicity testing is done on cell cultures or slices of tissue grown in the laboratory, rather than on a living animal [compare with **in vivo**].

In vivo

Within a living organism or body. For example, some toxicity testing is done on whole animals, such as rats or mice [compare with **in vitro**].

Lowest-observed-adverse-effect level (LOAEL)

The lowest tested dose of a substance that has been reported to cause harmful (adverse) health effects in people or animals.

Medical monitoring

A set of medical tests and physical exams specifically designed to evaluate whether an individual's exposure could negatively affect that person's health.

Metabolism

The conversion or breakdown of a substance from one form to another by a living organism.

Metabolite

Any product of **metabolism**.

mg/kg

Milligram per kilogram.

mg/cm²

Milligram per square centimeter (of a surface).

mg/m³

Milligram per cubic meter; a measure of the concentration of a chemical in a known volume (a cubic meter) of air, soil, or water.

Migration

Moving from one location to another.

Minimal risk level (MRL)

An ATSDR estimate of daily human exposure to a hazardous substance at or below which that substance is unlikely to pose a measurable risk of harmful (adverse), noncancerous effects. MRLs are calculated for a route of exposure (inhalation or oral) over a specified time period (acute, intermediate, or chronic). MRLs should not be used as predictors of harmful (adverse) health effects [see **reference dose**].

Morbidity

State of being ill or diseased. Morbidity is the occurrence of a disease or condition that alters health and quality of life.

Mortality

Death. Usually the cause (a specific disease, condition, or injury) is stated.

Mutagen

A substance that causes **mutations** (genetic damage).

Mutation

A change (damage) to the DNA, genes, or chromosomes of living organisms.

National Priorities List for Uncontrolled Hazardous Waste Sites (National Priorities List or NPL)

EPA's list of the most serious uncontrolled or abandoned hazardous waste sites in the United States. The NPL is updated on a regular basis.

No apparent public health hazard

A category used in ATSDR's public health assessments for sites where human exposure to contaminated media might be occurring, might have occurred in the past, or might occur in the future, but where the exposure is not expected to cause any harmful health effects.

No-observed-adverse-effect level (NOAEL)

The highest tested dose of a substance that has been reported to have no harmful (adverse) health effects on people or animals.

No public health hazard

A category used in ATSDR's public health assessment documents for sites where people have never and will never come into contact with harmful amounts of site-related substances.

NPL [see National Priorities List for Uncontrolled Hazardous Waste Sites]

Physiologically based pharmacokinetic model (PBPK model)

A computer model that describes what happens to a chemical in the body. This model describes how the chemical gets into the body, where it goes in the body, how it is changed by the body, and how it leaves the body.

Pica

A craving to eat nonfood items, such as dirt, paint chips, and clay. Some children exhibit pica-related behavior.

Plume

A volume of a substance that moves from its source to places farther away from the source. Plumes can be described by the volume of air or water they occupy and the direction they move. For example, a plume can be a column of smoke from a chimney or a substance moving with groundwater.

Point of exposure

The place where someone can come into contact with a substance present in the environment [see **exposure pathway**].

Population

A group or number of people living within a specified area or sharing similar characteristics (such as occupation or age).

Potentially responsible party (PRP)

A company, government, or person legally responsible for cleaning up the pollution at a hazardous waste site under Superfund. There may be more than one PRP for a particular site.

ppb

Parts per billion.

ppm

Parts per million.

Prevalence

The number of existing disease cases in a defined population during a specific time period [contrast with **incidence**].

Prevalence survey

The measure of the current level of disease(s) or symptoms and exposures through a questionnaire that collects self-reported information from a defined population.

Prevention

Actions that reduce exposure or other risks, keep people from getting sick, or keep disease from getting worse.

Public comment period

An opportunity for the public to comment on agency findings or proposed activities contained in draft reports or documents. The public comment period is a limited time period during which comments will be accepted.

Public availability session

An informal, drop-by meeting at which community members can meet one-on-one with ATSDR staff members to discuss health and site-related concerns.

Public health action

A list of steps to protect public health.

Public health advisory

A statement made by ATSDR to EPA or a state regulatory agency that a release of hazardous substances poses an immediate threat to human health. The advisory includes recommended measures to reduce exposure and reduce the threat to human health.

Public health assessment (PHA)

An ATSDR document that examines hazardous substances, health outcomes, and community concerns at a hazardous waste site to determine whether people could be harmed from coming into contact with those substances. The PHA also lists actions that need to be taken to protect public health [compare with **health consultation**].

Public health hazard

A category used in ATSDR's public health assessments for sites that pose a public health hazard because of long-term exposures (greater than 1 year) to sufficiently high levels of hazardous substances or **radionuclides** that could result in harmful health effects.

Public health hazard categories

Public health hazard categories are statements about whether people could be harmed by conditions present at the site in the past, present, or future. One or more hazard categories might be appropriate for each site. The five public health hazard categories are **no public health hazard, no apparent public health hazard, indeterminate public health hazard, public health hazard, and urgent public health hazard**.

Public health statement

The first chapter of an ATSDR **toxicological profile**. The public health statement is a summary written in words that are easy to understand. The public health statement explains how people might be exposed to a specific substance and describes the known health effects of that substance.

Public meeting

A public forum with community members for communication about a site.

Radioisotope

An unstable or radioactive isotope (form) of an element that can change into another element by giving off radiation.

Radionuclide

Any radioactive isotope (form) of any element.

RCRA [See Resource Conservation and Recovery Act (1976, 1984)]

Receptor population

People who could come into contact with hazardous substances [see **exposure pathway**].

Reference dose (RfD)

An EPA estimate, with uncertainty or safety factors built in, of the daily lifetime dose of a substance that is unlikely to cause harm in humans.

Registry

A systematic collection of information on persons exposed to a specific substance or having specific diseases [see **exposure registry** and **disease registry**].

Remedial Investigation

The CERCLA process of determining the type and extent of hazardous material contamination at a site.

Resource Conservation and Recovery Act (1976, 1984) (RCRA)

This Act regulates management and disposal of hazardous wastes currently generated, treated, stored, disposed of, or distributed.

RFA

RCRA Facility Assessment. An assessment required by RCRA to identify potential and actual releases of hazardous chemicals.

RfD

See **reference dose**.

Risk

The probability that something will cause injury or harm.

Risk reduction

Actions that can decrease the likelihood that individuals, groups, or communities will experience disease or other health conditions.

Risk communication

The exchange of information to increase understanding of health risks.

Route of exposure

The way people come into contact with a hazardous substance. Three routes of exposure are breathing [**inhalation**], eating or drinking [**ingestion**], or contact with the skin [**dermal contact**].

Safety factor [see **uncertainty factor**]

SARA [see **Superfund Amendments and Reauthorization Act**]

Sample

A portion or piece of a whole. A selected subset of a population or subset of whatever is being studied. For example, in a study of people the sample is a number of people chosen from a larger population [see **population**]. An environmental sample (for example, a small amount of soil or water) might be collected to measure contamination in the environment at a specific location.

Sample size

The number of units chosen from a population or environment.

Solvent

A liquid capable of dissolving or dispersing another substance (for example, acetone or mineral spirits).

Source of contamination

The place where a hazardous substance comes from, such as a landfill, waste pond, incinerator, storage tank, or drum. A source of contamination is the first part of an **exposure pathway**.

Special populations

People who might be more sensitive or susceptible to exposure to hazardous substances because of factors such as age, occupation, sex, or behaviors (for example, cigarette smoking). Children, pregnant women, and older people are often considered special populations.

Stakeholder

A person, group, or community who has an interest in activities at a hazardous waste site.

Statistics

A branch of mathematics that deals with collecting, reviewing, summarizing, and interpreting data or information. Statistics are used to determine whether differences between study groups are meaningful.

Substance

A chemical.

Substance-specific applied research

A program of research designed to fill important data needs for specific hazardous substances identified in ATSDR's **toxicological profiles**. Filling these data needs would allow more accurate assessment of human risks from specific substances contaminating the environment.

This research might include human studies or laboratory experiments to determine health effects resulting from exposure to a given hazardous substance.

Superfund Amendments and Reauthorization Act (SARA)

In 1986, SARA amended CERCLA and expanded the health-related responsibilities of ATSDR. CERCLA and SARA direct ATSDR to look into the health effects from substance exposures at hazardous waste sites and to perform activities including health education, health studies, surveillance, health consultations, and toxicological profiles.

Surface water

Water on the surface of the earth, such as in lakes, rivers, streams, ponds, and springs [compare with **groundwater**].

Surveillance [see **epidemiologic surveillance**]

Survey

A systematic collection of information or data. A survey can be conducted to collect information from a group of people or from the environment. Surveys of a group of people can be conducted by telephone, by mail, or in person. Some surveys are done by interviewing a group of people [see **prevalence survey**].

Synergistic effect

A biologic response to multiple substances where one substance worsens the effect of another substance. The combined effect of the substances acting together is greater than the sum of the effects of the substances acting by themselves [see **additive effect** and **antagonistic effect**].

Teratogen

A substance that causes defects in development between conception and birth. A teratogen is a substance that causes a structural or functional birth defect.

Toxic agent

Chemical or physical (for example, radiation, heat, cold, microwaves) agents which, under certain circumstances of exposure, can cause harmful effects to living organisms.

Toxicological profile

An ATSDR document that examines, summarizes, and interprets information about a hazardous substance to determine harmful levels of exposure and associated health effects. A toxicological profile also identifies significant gaps in knowledge on the substance and describes areas where further research is needed.

Toxicology

The study of the harmful effects of substances on humans or animals.

Tumor

An abnormal mass of tissue that results from excessive cell division that is uncontrolled and progressive. Tumors perform no useful body function. Tumors can be either benign (not cancer) or malignant (cancer).

Uncertainty factor

Mathematical adjustments for reasons of safety when knowledge is incomplete. For example, factors used in the calculation of doses that are not harmful (adverse) to people. These factors are applied to the lowest-observed-adverse-effect-level (LOAEL) or the no-observed-adverse-effect-level (NOAEL) to derive a minimal risk level (MRL). Uncertainty factors are used to account for variations in people's sensitivity, for differences between animals and humans, and for differences between a LOAEL and a NOAEL. Scientists use uncertainty factors when they have some, but not all, the information from animal or human studies to decide whether an exposure will cause harm to people [also sometimes called a **safety factor**].

Urgent public health hazard

A category used in ATSDR's public health assessments for sites where short-term exposures (less than 1 year) to hazardous substances or conditions could result in harmful health effects that require rapid intervention.

Volatile organic compounds (VOCs)

Organic compounds that evaporate readily into the air. VOCs include substances such as benzene, toluene, methylene chloride, and methyl chloroform.

Other glossaries and dictionaries:

Environmental Protection Agency <http://www.epa.gov/OCEPAterms/>

CDC National Center for Environmental Health

<http://www.cdc.gov/nceh/dls/report/glossary.htm>

National Library of Medicine <http://www.nlm.nih.gov/medlineplus/dictionaries.html>