

**APPENDIX**

**I**

**GLOSSARY**

Many of the terms included in this glossary have specific regulatory definitions within existing state or federal laws or rules, or may be used as common terms in the environmental field. Handbook users should review the definitions presented below prior to reviewing the remainder of the guidance. (**Note:** Not all terms in this glossary are specifically mentioned in the Handbook.)

**access by general public restricted:** site is not accessible to the general public due to some form of full-time permanent barrier (e.g., a locking gate and fence).

**absorption adjustment factor (AAF):** factor which adjusts the dose estimate in consideration of the absorption efficiencies of the study which is the basis of the toxicity information and the absorption efficiency of the route of exposure of concern. It is not itself an absorption efficiency.

**accessible contamination:** soil contamination generally located less than four (4) feet below the surface where the surface is not completely covered by an impervious (e.g., pavement) or permanent structure. For buildings having earthen floors, the floor shall be considered accessible. Note: Site specific conditions may influence contamination accessibility determinations.

**active remedy/active remediation:** engineered remedy that requires energy to be spent; for example, pump and treat, soil vapor extraction, air sparging, excavation.

**acute exposure:** one dose or multiple doses occurring within a short period of time (typically 24 hours or less).

**ADC:** average daily concentration ( $\text{mg}/\text{m}^3$  or  $\text{mg}/\text{m}^3$ ) during the exposure period.

**ADD:** average daily dose ( $\text{mg}/\text{kg}\text{-day}$ ) during the exposure period.

**ADE:** average daily exposure ( $\text{mg}/\text{kg}\text{-day}$ ) during the exposure period.

**additivity:** see *mixture evaluation*.

**adherence factor (AF):** fraction of soil adhered to the skin.

**adsorption:** intrinsic potential of a molecule to bind to either the organic or mineral fraction of soil. One of the dominant factors in predicting the rate of contaminant migration through the subsurface.

**advective transport:** contaminant migration that occurs due to the motion of flowing groundwater.

**affidavit:** see *real property notification/affidavit, restrictive covenant*.

**agricultural property use:** use of property for farming. Specific uses could include: cultivation of soil; growing and harvesting of any agricultural, horticultural, or floricultural commodity; dairying; raising of livestock, bees, fish, fur-bearing animals, or poultry; and turf and tree farming. Agricultural land use does not include property used for commercial storage, processing, distribution, marketing, or shipping operations.

**air diffusivity:** constant used to describe diffusion of a chemical in air.

**air stripping:** treatment system that removes volatile organic compounds (VOCs) from contaminated groundwater or surface water by forcing an air stream through the water and causing the compounds to volatilize.

**air-filled porosity:** fraction of soil porosity filled by air.

**air-filled soil porosity ( $\rho_a$ ):** a ration describing the volume of soil pore space filled with air to that of the total soil volume ( $L_{air}/L_{soil}$ ).

**area-weighted average:** result of applying data collected at specific point locations to an area under investigation. The value at a given data point is assumed to be representative of an area. The area of influence of a data point extends from that point to halfway between that point and adjacent points.

**aquifer:** water-bearing rock or sediment that will yield water in a usable quantity to a well or spring.

**ASTM RBCA:** American Society for Testing and Materials Risk-Based Corrective Action. A standard guidance document used in underground storage tank and other petroleum release investigations that utilizes a tiered evaluation process to assess risk. ASTM E1739-95 (Reapproved 2015) , Guide to Risk-Based Corrective Action at Petroleum Sites.

**background:** environmental contaminant conditions representative of an area, which has not been impacted by contamination from the site, and which represent natural, ambient conditions.

**balancing criteria:** once threshold criteria are met, a remedial option is chosen through consideration of balancing criteria: long-term effectiveness, ability to implement, short term risk; cost-effectiveness, and community acceptance. The threshold criteria of the National Contingency Plan (NCP) in addition to the above items, specifically included reduction in toxicity, mobility, or volume through treatment, which are now covered under long-term effectiveness.

**bioavailability:** degree to which a material in environmental media is metabolized by an organism.

**bioconcentration:** process by which there is a net accumulation of a chemical directly from an exposure medium into an organism.

**biodegradation:** biological degradation, or transformation of a chemical through biological processes. Depending upon the contaminant and the environment, biological degradation may reduce the contaminant completely to carbon dioxide, water, and salts (mineralization), or may result in the formation of numerous metabolites or “daughter products”, some of which are themselves contaminants.

**biodegradation rate:** rate at which a compound is biologically transformed into metabolites, usually expressed in terms of a biodegradation rate constant. Thus, a biodegradation rate constant of 0.1-1 years indicates that one-tenth of the initial mass of the contaminant originally present will have biologically degraded over a one-year period.

**BTEX:** abbreviation for the monoaromatic compounds benzene, toluene, ethylbenzene, & xylene.

**bulk density:** ratio of the dried mass of the soil/sediment sample to its field volume.

**capacity:** measure of an aquifer’s ability to transmit groundwater to a well.

**carcinogen:** agent capable of inducing a cancer response.

**cation exchange:** process through which the adsorbed cation constituents on colloidal sized particles are interchanged with other cations from the aqueous phase.

**CERCLA:** Comprehensive Environmental Response, Compensation and Liability Act; 42 U.S.C. §§ 9601 *et seq.*, the federal Superfund law.

**chlorinated aliphatic hydrocarbons:** non-aromatic chlorinated compounds including tetrachloroethene, trichloroethene, dichloroethene, trichloroethane, and vinyl chloride.

**chronic exposure:** multiple exposures occurring over an extended period of time or a significant fraction of an individual’s lifetime.

**cis-DCE:** cis isomer of dichloroethene that may be produced through the enzymatic biological degradation of trichloroethene.

**clean zone:** informal term for the interval between the lower boundary of a zone of contamination and the water table or the first saturated zone. Also referred to as “Zone 2” in the soil leaching guidance.

**cleanup goal:** level of control or conditions of contamination or environmental impact at a site such that the impact does not/will not, pose an unacceptable risk to human health, public welfare, or the environment, during any foreseeable period of time. A cleanup goal is developed from decisions made to ensure *cleanup levels* are met for specific media or to eliminate completed exposure pathways. *Cleanup goals, cleanup level* and *risk target levels* are related terms.

**cleanup level:** media concentration of a contaminant derived, when possible, from a risk-based *criteria* indicated by a tier evaluation or required by statute. This level is used as a partial measure of successful implementation of the *cleanup goal* provided in a response action plan or record of decision. The terms *cleanup level, criteria,* and *standard* are related but not synonymous. See also: *cleanup goal, target risk level.*

**CLP:** EPA Contract Laboratory Program. Laboratories that are under contract with EPA to perform specific analyses, using specific methods, with specific QA/QC procedures.

**commercial property use:** property use which is characterized by extremely varied and broad commercial use, encompassing everything from day care centers and schools to gas stations and warehouses. The physical setting of commercial properties and the activities which workers and the general public engage in at these sites are also extremely variable. This land use designation has been divided into unrestricted and restricted subcategories based on exposure potential.

**complexation:** process of metal species reacting with other dissolved chemical to form new chemicals.

**compliance point:** specific monitoring points (usually monitoring wells) at which the remedial standards are to be applied.

**confinement:** physical containment of the contamination that prevents, minimizes or controls the release and the associated potential for exposure. Considered an acceptable action when implemented as part of a remedy.

**conservative tracer:** chemical employed in the study of groundwater movement that is recalcitrant to biological degradation and chemical transformation.

**containment:** 1) remedy that reduces exposure by controlling groundwater flow. Typically selected when other options not feasible and is usually regarded as a long-term activity. 2) confinement.

**contaminant of potential concern (COPC):** material detected at a hazardous waste site which has the potential to adversely affect receptors due to its concentration, distribution, and/or mode of toxicity. Alternatively, referred to as chemical of potential concern.

**contaminant redistribution factor (CRF):** a dimensionless factor that may be used to estimate contaminant attenuation due to storage and/or loss of chemicals from a contaminated soil layer (Zone 1 of thickness  $d_1$ ) to an underlying, presently non-impacted layer (Zone 2 with thickness  $d_2$ ) in the Tier 2 SLV equation. It is calculated by use of the following equation:

$$CRF = \frac{d_1 + d_2}{d_1}$$

**criteria:** a numerical value on which a judgement or decision can be based. In certain instances the term criteria is defined more narrowly to distinguish a value from promulgated standards (e.g., surface water criteria vs. surface water standards).

**cross media transfer:** transfer of contaminant mass from one medium to another (e.g., surface water or air) as a result of remedial activity.

**cumulative receptor cancer risk:** sum of the estimated excess lifetime cancer risks resulting from exposure to all contaminants at or from a site, at all exposure points, for a given receptor.

**cumulative receptor non-cancer risk:** calculation of the possibility of non-cancer health effects associated with exposure to all contaminants at or from a site at all exposure points identified for a given receptor. The hazard index is a measure of the Cumulative Receptor Non-cancer Risk.

**data quality objectives (DQO):** a set of qualitative, and sometimes quantitative, statements which specify the quality of data required for supporting decisions at a site. DQO's are determined an iterative process that takes many factors into account.

**daughter product:** compounds such as pesticides or chlorinated aliphatic compounds frequently are biologically degraded incompletely, yielding other compounds that may be more or less toxic than the initial ("parent") chemical, metabolite. For example, the biodegradation of trichloroethylene (the parent compound) yields the daughter compound cis-dichloroethylene. See *biodegradation*.

**depth of mixing (dm):** vertical extent of the aquifer from which in-situ groundwater is assumed to be well mixed with leachate from the unsaturated zone under typical hydrologic conditions.

**depth-weighted average concentration (DWC):** A vertical average of soil contamination that may given certain conditions be applied as an average concentration that may be compared to Tier 2 or Tier 3 SLVs.

**diffusion:** net flux of solutes from a zone of higher concentration to a zone of lower concentration.

**dilution attenuation factor (DAF):** term that is used to predict the degree of mixing of the contaminant that is present in the soil leachate over a given distance in the groundwater. It is defined as

$$DAF = \frac{1+(Kid_m)}{IL}$$

where  $K$  is the hydraulic conductivity of the aquifer,  $i$  is the hydraulic gradient,  $d_m$  is the depth of mixing of contaminant in groundwater,  $I$  is the rate of infiltration of water through the soil to groundwater, and  $L$  is the length of the area over which mixing is being calculated.

**direct-push equipment:** generic term for drilling equipment used to advance a sampling device, such as a split-spoon, with little or no rotary movement. This equipment facilitates the collection of both soil and groundwater samples during the same event. A retractable well screen or temporary well casing and screen can be used to collect water samples. Also called "push-probe".

**dispersion, hydrodynamic:** extent to which a substance introduced into a ground-water flow system spreads as it moves, due to mechanical mixing and molecular diffusion. Results in reduced contaminant concentrations down-gradient.

**dispersion:** spreading of solutes due to aquifer heterogeneities at pore-grain scale (mechanical dispersion) or at field scale (macroscopic dispersion).

**dispersivity** term that describes the mechanical mixing of a contaminant in groundwater.

**distribution coefficient ( $K_d$ ):** see *soil-water partition coefficient*.

**DNAPL** see *NAPL*.

**dose-response relationship:** relationship between the amount of an agent (either administered or absorbed) and changes in certain aspects of the biological system (usually toxic effects), apparently in response to that agent.

**easement:** an agreement giving the right to enter and/or use a property or a portion of a property owned by another, which is binding on current and future owners. An easement may include the right to locate, maintain, and operate remedial equipment or structures on the property. An easement is generally obtained by agreement of the property owner and may require consent of other parties with an interest in the property.

**effective porosity:** volume of the void spaces through which water and other fluids can travel divided by the total volume.

**Eh:** measurement of oxidation/reduction status of a system. See *oxidation /reduction potential*. Eh measurements are obtained through the use of platinum electrodes designed for this purpose.

**electron acceptor:** relative to natural attenuation, the compound that is used by a microorganism essential for growth and metabolic activity. Aerobic microbes, for example, use oxygen as an electron acceptor, producing water as a result of their metabolism. Other microbes use sulfate, iron <sup>3+</sup>, manganese, or carbon dioxide as electron acceptors. PCE or TCE can serve as an electron acceptor for some microbes.

**engineering controls:** physical actions, structures, or improvements (e.g., caps, vaults, fences, groundwater gradient, methane gas capture/venting systems) that reduce, control, or interrupt exposure and/or migration of contamination..

**equilibrium partitioning equation:** an equation that describes the predicted concentrations of chemicals between different phases (i.e. water, pure liquid, and gas). The Tier 1 and Tier 2 SLCs are based upon a linear partitioning equation between the absorbed contaminant concentration ( $C_s$ ) and the dissolved concentration in water ( $C_w$ ),  $C_s/C_w = K_d$ , where  $K_d$  is the soil-water partitioning coefficient.

**evapotranspiration:** process by which water passes from the liquid to the vapor state under given climatic and soil-moisture conditions.

**excess lifetime cancer risk (ECR):** product of exposure and carcinogenic potency. The resulting risk estimate is an upper-bound probability that an individual's exposure during a lifetime to a contaminant could result in cancer.

**exposure pathway:** course a contaminant takes from source to receptor. If the exposure point differs from the source, transport/exposure media (i.e., air, water) are also included.

**exposure point:** location of potential contact between a human or environmental receptor and a release of contaminants. An exposure point may describe an area or zone of potential exposure, as well as a single discrete point.

**exposure point concentration:** concentration of contaminants in a specific medium which a human or environmental receptor may contact at an exposure point.

**exposure route:** mechanism by which a contaminant comes in to contact with a receptor, including, but not limited to, ingestion, inhalation, dermal absorption, and transpiration.

**false negative:** conclusion that an event is false when in fact it is true.

**false positive:** conclusion that an event is true when in fact it is false.

**feasibility study (FS):** analysis of the practicability of a proposal; e.g., a description and analysis of potential cleanup alternatives for a site such as one on the National Priorities List. The feasibility study usually recommends selection of a cost-effective alternative. It usually starts as soon as the remedial investigation is underway; together, they are commonly referred to as the “RI/FS”.

**first order decay:** the natural log of the reduction in contaminant concentration plotted against time, which yields a straight line. This behavior is typically dominant over zero- or second-order decay rates.

**focused feasibility study (FFS):** small-scale investigation of a problem to ascertain whether a proposed research approach is likely to provide useful data.

**fraction of organic carbon ( $f_{oc}$ ):** fraction of organic carbon to the total weight of the soil sample, expressed as a decimal. See *soil-organic carbon partition coefficient ( $K_{oc}$ )*, *total organic carbon*.

**Freundlich relationship:** empirical equation that describes the amount of chemical adsorbed onto a soil surface.

**Global Positioning System (GPS):** system of multiple satellites that may be used to locate position of a GPS transmitter.

**groundwater:** groundwater consists of all waters below the surface of the earth, including, but not limited to, aquifers.

**half-life:** time required for the concentration of a given chemical to become half its initial concentration through either biotic or abiotic processes.

**hazard index (HI):** calculation of the possibility of non-cancer health effects as the result of exposure to contaminants. The calculation consists of summing the hazard quotients (HQs) for multiple substances with the same or similar toxic endpoints. See also: *target risk level*. The  $HI = HQ_1 + HQ_2 + \dots + HQ_n$

**hazard quotient (HQ):** ratio of a single substance exposure level (actual dose) to a reference dose for that substance derived from a similar exposure period (e.g.,  $D_1/RfD_1$ , where D is the daily intake/dose (or air concentration) for a particular contaminant, and the RfD is the reference dose (or air reference concentration, RfC)). See also: *target risk level*.

**health advisories (HAs):** describe concentrations of drinking water contaminants at which adverse non-carcinogenic health effects would not be expected to occur over a specific exposure duration. HAs are developed for 1-day, 10-day, longer term (generally up to 2 years), and lifetime exposures based only on data describing non-carcinogenic endpoints of toxicity. For those substances which are known or probable human carcinogens, HAs for lifetime exposure are not derived. The documentation for each HA should be consulted before proceeding with any calculations.

**Health Based Values (HBV's):** are developed by the MDH for substances or chemicals that have been detected in groundwater and have adequate toxicological data but were not included in the HRL rule. HBVs are developed by the same methodology and have the same meaning as HRLs; however, HBVs are not promulgated under rule and have not undergone external peer review. A HBV is a concentration of a contaminant, or mixture of contaminants, that can be safely consumed daily in drinking water for a lifetime. A HBV is expressed as a concentration (ug/L) or calculated as a “hazard index” when multiple contaminants are present. HBVs are developed by the MDH upon request on a site-specific basis.

**HEAST U.S. EPA's Health Effects Assessment Summary Tables.**

**Henry's law constant (H):** coefficient that represents the equilibrium partitioning factor between water and vapor phase. Typical units for H are  $\text{m}^3\text{-atm/mol}$ ; the dimensionless equivalent value,  $H'$ , is approximately equal to  $H \times 41$ .

**hot spot :** discrete area of a hazardous waste site characterized by contaminant levels substantially higher than those of the surrounding area of the site.

**hydraulic conductivity(K):** coefficient that describes the capacity of a permeable medium to transmit fluid.

**hydraulic gradient (i):** the change in head per unit distance along the direction of steepest change.

**hydrolysis:** abiotic or biotic breakdown of chemicals under the influence of  $\text{H}^+$  and  $\text{OH}^-$  ions in water.

**in-situ remedies:** remedies that are implemented at the site without removal of the contaminated media. For example, bioremediation technologies which inject oxygen and/or bacteria into the contaminated media.

**infiltration rate:** term that describes the flow rate by which water migrates downward from the soil surface into and through the unsaturated zone.

**interim response action (IRA):** early remedial actions taken to control immediate hazard during completion of the remedial investigation, alternatives analysis, detailed analysis, and remedial design.

**intrinsic biodegradation:** natural biological degradation of a chemical in situ.

**ionizable organic compounds:** organic chemicals with functional groups that can dissociate under subsurface pH conditions. For example,  $\text{R-COOH}$  compounds yielding  $\text{R-COO}^- + \text{H}^+$

**IRIS** US EPA's Integrated Risk Information System. One of the primary risk characterization databases.

**irreducible water content:** water content at which capillary pressure increases rapidly with negligible decrease in water content of porous medium.

**J:** analytical laboratory report qualifier indicating the identity of a chemical is certain, but the concentration is only an estimate. This data is to be used in the same way as positive data, but the uncertainty should be noted so that appropriate precautionary notes accompany the chemical evaluation.

**K:** hydraulic conductivity.

**$K_d$ :** soil-water partition coefficient. Also: distribution coefficient, partition coefficient.

**$K_{oc}$ :** soil-organic carbon partition coefficient.

**$K_{ow}$ :** octanol-water partition coefficient.

**LADC:** lifetime average daily concentration ( $\text{mg}/\text{m}^3$  or  $\text{mg}/\text{m}^3$ ).

**LADD:** average daily dose ( $\text{mg}/\text{kg}\text{-day}$ ).

**leachate:** liquid containing dissolved chemicals that is created by water passing through a contaminated soil or waste.

**LNAPL:** see *NAPL*.

**lowest observed adverse effect level (LOAEL):** lowest exposure level at which there are statistically or biologically significant increases in frequency or severity of adverse effects between the exposed population and its appropriate control group.

**lowest observed effect concentration (LOEC):** lowest concentration of a chemical in a toxicity test that causes an effect that is statistically significantly different from the controls.

**matrix spike (MS):** 1) spiked samples are samples that have specific concentrations of analytes of interest added. They are used to measure the performance of the complete analytical system including chemical matrix interference from a sample matrix. 2) an aliquot of sample spiked with a known concentration of target analyte(s). The spike occurs prior to sample preparation and analysis. A matrix spike is used to document the bias of a method in a given sample matrix. (EPA SW 846, Rev.1, July 1992)

**matrix spike duplicate (MSD):** intralaboratory split samples spiked with identical concentrations of target analyte(s). The spiking occurs prior to sample preparation and analysis. They are used to document the precision and bias of a method in a given sample matrix. (EPA SW 846, Rev.1, July 1992)

**maximum contaminant level (MCL):** EPA administered maximum permissible level of a contaminant in water which is delivered to any user of a public water system. MCLs are enforceable standards that are set as close to MCLGs as feasible. MCLs consider factors such as treatment technology and cost and, therefore, are not strictly health based. Thus, the basis for an MCL must be carefully examined before an MCL is used in a risk-based decision, or, for example, to derive a reference dose. Generally, an MCL is not used to derive a reference dose.

**maximum contaminant level goal (MCLG):** non-enforceable concentration of a drinking water contaminant that is protective against adverse human health effects and allows an extra margin of safety. MCLGs for substances considered to be carcinogenic are set at zero because EPA assumes that any level of exposure is associated with some level of risk. MCLGs for substances not treated as known or probable human carcinogens are based upon chronic toxicity or other health data and applied uncertainty data.

**media:** natural materials that may be contaminated by a release: soil, sediment, groundwater, surface water, or air.

**method detection limit (MDL):** minimum concentration of a substance that can be measured and reported with 99% confidence that the analyte concentration is greater than zero and is determined from the analysis of a sample in a given matrix type containing the analyte. (40 CFR Part 136 App. B)

**microcosm study:** laboratory studies designed to determine the rate of biodegradation or the fate of particular contaminants. Microcosm studies are carried out in laboratory flasks where variables such as pH, temperature, or oxygen can be carefully controlled. Normally, field samples of soil or groundwater are used to set up replicate microcosm studies. Replicates may vary in contaminant concentration or incubating conditions in order to assess the effect of changing single parameters on the fate of a contaminant.

**MINTEQ2:** computer program for calculating geochemical equilibria. It was originally developed by Battelle Pacific Northwest Laboratory for the EPA. Its modeling capabilities include ion speciation, redox equilibrium, ion exchange, adsorption, and mass transfer. This model was used by USEPA to develop  $K_d$  values for metals as a function of soil pH.

**mixture evaluation:** when two or more contaminants have the same toxic endpoint, the cumulative risk must be determined. For non-carcinogens with the same toxic endpoint, a hazard index, i.e., a cumulative receptor non-cancer risk, must be determined. For carcinogens, a cumulative receptor cancer risk must be determined.

**modifying factor (MF):** uncertainty factor which is greater than zero and less than or equal to ten; the magnitude of the MF depends upon the professional assessment of scientific uncertainties of the study and database not explicitly treated with the standard uncertainty factors (e.g., the completeness of the overall database and the number of species tested); the default value for the MF is 1.

**NAPL:** non-aqueous phase liquid. The free product, or non-dissolved, portion of the contaminants. A dense non-aqueous phase liquid (DNAPL) is denser than water and tends to sink through saturated porous media. A light, non-aqueous phase liquid (LNAPL) is less dense than water and tends to float at the water table.

**natural attenuation:** intrinsic capacity of soil and groundwater to reduce concentrations of original contaminants, resulting in daughter products that may or may not be toxic. Natural attenuation processes are biodegradation, dilution, adsorption, and abiotic degradation.

**natural resource damage assessment:** study and compilation of damages to natural resources caused by site contamination. (43 CFR, Part 11)

**net infiltration:** the amount of infiltration from precipitation which reaches water table and is equivalent to groundwater recharge. This is a required term in the dilution attenuation factor. The term infiltration rate and net infiltration and groundwater recharge are equivalent as used in the soil leaching guidance.

**no observed adverse effect level (NOAEL):** the exposure level at which there are not statistically or biologically significant increases in frequency or severity of adverse effects between the exposed population and its appropriate control group.

**no observed effect concentration (NOEC):** highest concentration of a chemical in a toxicity test that causes effects that are not statistically significantly different from the controls.

**octanol-water partition coefficient ( $K_{ow}$ ):** represents the degree to which an organic substance will preferentially dissolve in water vs. an organic solvent.

**organic carbon content:** see *fraction of organic carbon ( $F_{oc}$ )*

**oxidation/reduction potential:** oxidation/reduction reaction is a chemical reaction where electrons are transferred from one chemical species (which is oxidized) to another (which is reduced). Formally defined, the oxidation/reduction potential is a measurement of the electromotive force generated in the coupling of two chemical half-reactions, normally expressed in volts. For purposes of this document, the oxidation/reduction potential is basically the measurement of how “electron rich” is the groundwater or soil environment. Normally this is expressed numerically as pE or Eh. The fate of contaminants is closely linked to the redox status of the soil or groundwater. For example, the large redox potential between an oxidized chlorinated solvent such as PCE and a methanogenic groundwater environment favors the dechlorination of PCE to TCE, DCE and vinyl chloride.

**P & T vial:** purge and trap vial. Type of sample container used for the collection, storage and delivery of a water sample for VOC analysis. Most common example is 40 ml glass container with single Teflon septum inside the screw cap.

**passive remedy/passive remediation:** remedy requiring no energy expenditure, other than monitoring. Synonymous with natural attenuation.

**permanence:** implemented remedy is considered permanent when it allows for the unrestricted use of all land and natural resources impacted by contaminants and, except for the purpose of treatment, does not involve removal of the contaminants to another site, and minimizes exchanges of the contaminant with other media.

**permanent solution:** measure or combination of measures which will, when completed, attain a level of each identified substance of concern at a disposal site or in the surrounding environment such that no substance of concern will present a significant risk to public health, safety, public welfare, or the environment.

**permanent structure:** a structure that is fixed in place and intended to last indefinitely. A multi-level concrete parking ramp is considered a permanent structure, as opposed to a slab-on-grade bituminous parking lot.

**physical alteration:** dredging, filling, draining, or permanent inundation of a wetlands. Restoring a degraded wetland by reestablishing its hydrology is not a physical alteration.

**planned use of property:** current use of the property, if that use (or reuse) will be continued for a foreseeable period of time, or a new use involving activities that will continue for the foreseeable future. In most cases the term “planned use of the property” implies a long-term commitment or expectation about how the property will be used as determined by current or future owners or actions of local units of government, government agencies, or other organizations representing the community where the property is located, such as property use or economic development plans or zoning ordinances. A foreseeable period of time means the period of time during which requirements to maintain the necessary institutional controls, engineering controls as part of the remedy and/or other requirements such as compliance monitoring are necessary to protect public health and the environment. In some cases, the term planned future use may also encompass short-term development or redevelopment activities such as demolition, excavation, and construction. The concept of planned use generally refers to human use of the property, except where the use is specifically for ecological or environmental purposes, such as a nature preserve or a wildlife management area. Where habitat exists, exposures to ecological receptors are likely to be similar regardless of use (i.e., there is no residential or industrial exposure scenario for ecological receptors). Property use will influence ecological exposure primarily by affecting the presence or amount of habitat on a site. Therefore, ecological risk or protectiveness of remedies for the environment must be evaluated on a site-specific basis, independent of human property use scenarios.

**plume boundary** fringe of contaminated water in plan or cross-sectional view. Determined by mapping contaminant concentrations.

**point-of-use treatment:** treatment of contaminated drinking water just upstream of human exposure. For example, point of use treatment of a residential drinking water well might consist of carbon treatment at the wellhead.

**porosity:** ratio of the volume of void spaces in a soil to the total volume of the sample.

**potential drinking water aquifer:** (relative to a groundwater risk evaluation review area) an aquifer that is not currently pumped to supply drinking water within the review area. This aquifer, outside the review area, could be used for drinking water.

**practical quantitation limit (PQL):** smallest concentration of an analyte for which quantitative results may be obtained with a specified degree of confidence. Considered the lowest level achievable among labs within specified limits during routine laboratory operations. Also called reporting limit (RL).

**presumptive remedy:** a remedy proven effective at previous sites with similar conditions. Used to streamline site characterization and accelerate the selection process.

**property:** real property, land, buildings and fixtures, and improvements attached to land and buildings and associated legal rights.

**QA/QC:** quality assurance/quality control.

**quality assurance (QA):** system of activities whose purpose is to provide to the producer or user of a product or a service so that it meets defined standards of quality with a stated level of confidence.

**quality control (QC):** overall system of activities whose purpose is to control the quality of a product or service so that it meets the needs of users. The aim is to provide quality that is satisfactory, adequate, dependable, and economic.

**reasonable maximum exposure (RME):** maximum exposure that is reasonably expected to occur. An element of the risk characterization procedure.

**receptor:** 1) human or non-human organism (or population, community, or ecosystem) that has or has the potential to experience adverse effects from direct or indirect exposure to contaminated media. 2) location of media point of exposure for a given receptor, as in “drinking water well” or “groundwater receptor”.

**recreational property use:** use of property for recreational purposes which is characterized by unrestricted access by the public. In site risk characterizations, an exposure frequency lower than the residential setting and potential recreational exposure assumptions are used in the calculation of cleanup levels. Recreational property uses generally include, but are not limited to, the following: parks, playing fields, beaches, green spaces, open areas, wildlife management areas, and nature preserves.

**reduced iron:**  $\text{Fe}^{2+}$ . Certain microorganisms generate  $\text{Fe}^{2+}$  by using  $\text{Fe}^{3+}$  as a terminal electron acceptor.

**reduced manganese:**  $\text{Mn}^{2+}$ . Reduced manganese is produced by microorganisms that use  $\text{Mn}^{4+}$  as an electron acceptor.

**reducing conditions:** groundwater or sediments characterized by a low Eh reading or high hydrogen concentrations. In an environment that is strongly reducing (sulfate reducing or methanogenic conditions), microorganisms are able to donate electrons to the relatively oxidized chlorinated aliphatic compounds such as PCE, resulting in their dehalogenation.

**reference concentration (RfC):** estimate (with uncertainty of perhaps an order of magnitude or greater) of a continuous inhalation exposure to a human population that is likely to be without an appreciable risk of deleterious noncancer effects.

**reference dose (RfD):** estimate (with uncertainty of perhaps an order of magnitude or greater) of a daily inhalation exposure level for the human population, that is likely not to result in appreciable risk of deleterious effects during a lifetime. Chronic RfDs are specifically developed to be protective for long-term exposure to a compound.

**relative permeability** in isotropic porous media, the ratio of effective permeability to the corresponding permeability at saturation.

**remedial standard, level, requirement, or goal:** risk or technology-based standard against which contaminant levels are compared to make a determination that 1) risk to public health and welfare and environment are reduced to an acceptable level, or 2) cleanup goals have been met. Similar or synonymous terms include cleanup levels, cleanup goals, thresholds, and threshold criteria.

**remotely accessible contamination:** 1) soil contamination located at a depth greater than twelve (12) feet below the ground surface; or 2) soil contamination completely covered by an existing building or other permanent structure which does not have earthen floors, regardless of depth. Whenever and wherever reasonable doubt exists over the characterization of accessibility, the more accessible category shall be selected. Note: Site specific conditions may influence soil accessibility determinations.

**residential property use:** use of property as homes or residences. As used relative to risk characterization, this property use scenario generally assumes potential residential exposure in the

calculation of cleanup levels. Residential property use can be characterized by single-family and/or multiple-family dwellings.

**residual contamination:** contamination remaining on-site after implementation of a remedial action has been completed.

**restricted commercial property use:** use of property for commercial purposes where access or occupancy by non-employees is less frequent or is restricted. This property use can range from no public access for both outdoor and indoor activities (e.g., large-scale warehouse operations), to limited public access and indoor office worker activities (e.g., banks, dentist office). In general, restricted commercial property use excludes the kinds of facilities specifically listed under unrestricted commercial use.

**retardation/retardation coefficient:** term that refers to the effect that soil and sediments have on the movement of chemicals. For some chemicals, the solute front will travel more slowly than the rate of the advecting groundwater, while others are more mobile. The mathematical expression for estimating the retardation of contaminants in groundwater is:

$$R = 1 + [(K_{oc})(f_{oc})(\rho_b)]/n$$

where  $K_{oc}$  is the organic carbon partitioning coefficient,  $f_{oc}$  is the organic carbon fraction in the sediment,  $\rho_b$  is the soil bulk density.

**review area:** relative to groundwater pathways risk evaluation, the area surrounding the site within which aquifer type, present aquifer use, and future use are evaluated and classified as a measure of actual or potential human exposure.

**risk assessment procedure:** a process to identify potential adverse effects to humans or ecosystems resulting from exposure to environmental hazards. May include qualitative and quantitative analyses. Elements of a risk assessment procedure include hazard identification (including chemicals of potential concern); toxicity (dose-response) assessment (the toxicity potential of the contaminant); exposure assessment (exposure routes, exposed populations, frequency, duration and extent of exposure); risk characterization (type and magnitude of risks to exposed populations using information from previous three elements); and the uncertainty analysis (nature and magnitude of uncertainty and variability inherent in, or assumptions and limitations of, the characterization of risks).

**risk based corrective action (RBCA):** tiered approach to remedial action supported by the American Society for Testing of Materials (ASTM). Remedial goals for sites with minimal data are conservatively low; as the amount of site specific investigative data increases, remedial goals can be tailored specifically for the site conditions, which in some cases requires less costly or involved cleanup actions.

**risk characterization:** an element of conventional risk assessment procedure. A systematic, scientific assessment of potential adverse health effects resulting from exposure to hazardous agents or situations which uses information from the site characterization.

**risk-based approach:** approach to decision-making in investigation and remedial action. Based primarily on evaluations of risks posed to human health and the environment. Other aspects considered in this approach include planned property use, a preference for detoxification and treatment, and minimization of cross-media transfer of contaminants.

**risk-based site evaluation:** RBSE, a process of applying a tiered evaluation scheme based on site specific characteristics and property or surface water use. It extends beyond risk characterization to include statutory, engineering, economic, social and political factors in making site decisions.

**risk management:** a decision-making process whereby policies or regulations related to political, social, historical, and economic factors are integrated with risk assessment.

**saturation concentration:** maximum amount of non-aqueous liquid phase that porous medium can hold under given conditions.

**Secondary Maximum Contaminant Level (SMCL's):** non-enforceable guidelines regarding cosmetic effects (such as skin or tooth discoloration) and aesthetic effects (such as taste, odor, or color) of drinking water.

**SESOIL:** acronym for “A Seasonal Soil Compartment Mode”, developed for the EPA. It was designed for long-term environmental hydrologic, sediment, and pollutant fate simulations. In the hydrologic cycle rainfall, infiltration, surface runoff, evapotranspiration, and ground-water recharge are considered. In the pollutant fate cycle advection, diffusion, volatilization, adsorption and desorption, chemical degradation or decay, and other processes are considered. It can also model to a limited degree effects of biological degradation on the leaching process.

**short-term hazard:** hazard which would pose a significant risk of harm to health or safety if it were present for even a short period of time.

**site:** 1) physical property where a release has occurred or the source is located, as well as where remediation may be needed, 2) property or portion of property evaluated for potential environmental impact relative to technical assistance or liability assurance. See *facility* and *release*.

**site characterization:** a systematic process involving documentation of a qualitative and quantitative site investigation, including data collection results, identification of exposure pathways, and forming conclusions and recommendations. The results of a site characterization and a tier evaluation inform each other as part of an iterative process which leads to remedial action decisions.

**slope factor:** slope of the cancer dose-response curve in the low-dose region. The units of the slope factor are usually expressed as  $1/(\text{mg}/\text{kg}\cdot\text{day})$ . The slope factor represents a plausible upper-bound estimate of the probability of an adverse health-related response per unit intake of a chemical over a lifetime.

**soil bulk density:** the ratio of the dried mass of the soil/sediment sample to its field volume.

**soil-organic carbon partition coefficient ( $K_{oc}$ ):**  $K_{oc}$  predicts the degree to which a chemical will bind to the organic carbon fraction in the soil (L/kg). The  $K_{oc}$  may be thought of as soil-water partition coefficient normalized for organic carbon. For organic compounds, the  $K_d$  may be estimated by  $K_d = K_{oc} * f_{oc}$ . Also *distribution coefficient, partition coefficient*.

**soil leachate concentration (SLC):** concentration of a contaminant in the soil leachate that represents the dissolved form of that contaminant in the aqueous phase. It is calculated based on the total contaminant concentration in the soil, the capacity of the contaminant to bind to the soil matrix, and the physical-chemical characteristics of the contaminant.

**soil leaching value (SLV):** estimated concentration of a contaminant in soil that will not likely, through typical leaching processes, contaminate underlying groundwater given certain physical conditions predominating at the site. Calculation of the SLV considers the capacity of the contaminant to bind to the soil matrix, as reflected in the soil leachate concentration (SLC), the dilution attenuation factor (DAF) in the groundwater, and/or the potential for the contaminant to biologically degrade.

**soil-water partition coefficient ( $K_d$ ):**  $K_d$  is an experimentally derived physical constant that expresses the ratio of the amount of chemical adsorbed to the soil solids to the amount dissolved in the water (L/kg).  $K_d$  is a valid predictor of the partitioning between liquid and solids only if the reactions that cause the partitioning are assumed to be fast and reversible. The reversibility of partitioning equilibria is thought to decrease significantly with older spills.

**soil saturation concentration ( $C_{sat}$ ):** concentration of a contaminant in soil at which the absorptive limits of the soil particles, the solubility limits of the soil pore water, and the saturation of soil pore air have been reached.

**soil venting:** treatment system that removes volatile organic compounds (VOCs) from contaminated soil by forcing air through the soil matrix, volatilizing compounds which are then vented and/or treated.

**soil-to-groundwater leaching pathway:** route for migration of contaminants from the soil matrix to the underlying groundwater.

**solubility:** physical property of a compound, normally expressed in milligrams per liter, that determines how much of a solute (the contaminant) that the solvent (water) can carry in dissolved form per unit volume.

**source area boundary:** lateral and vertical extent of source area.

**source length (L):** length of a contaminated source area along the direction of groundwater flow.

**source area:** area of soil or groundwater from which contamination originates. May include waste material or contaminated soil or groundwater, including a secondary contaminant plume.

**specific capacity:** expression of well productivity, the yield of a well per unit of drawdown.

**SRV:** average daily exposure (mg/kg-day) during the exposure period.

**stable plume:** stable ground-water contaminant plume occurs when there is no net advance of the plume front, and no significant change over time in contaminant concentrations measured in network and compliance wells or other compliance points. The rate of contamination advance is equal to that of natural attenuation, creating a stationary plume front.

**storativity (S):** volume of water released from or taken into aquifer storage per unit surface area of aquifer per unit change in head. Storativity is equal to the product of the specific storage and the aquifer thickness. Also known as storage coefficient.

**subchronic exposure:** multiple exposures occurring over a small fraction of an individual's lifetime (e.g., a period of several months to several years).

**target risk level:** values, such as hazard quotient and hazard index, that represent levels of acceptable risk protective of human health, public welfare and the environment. For example, the ratio 0.2, the hazard quotient for an individual compound associated with a non-cancer chronic endpoint, is a target risk level. The cleanup goal and cleanup level are derived, in part, from the target risk level.

**Tier evaluation:** quantitative, phased approach to site risk assessment requiring increasing amounts of site specific data collection and analysis to evaluate risk and to determine the need for additional site investigation or remedial action.

**Tier 1 evaluation:** early site evaluation, sometimes considered a screening level evaluation. Tier 1 includes the initial quantitative risk evaluation and will determine if site conditions warrant further investigation. This evaluation requires the least amount of site-specific information and consists of comparing site contaminant data to non-site specific Tier 1 criteria to determine if individual contaminants or mixtures of contaminants pose a potential risk exceeding target risk levels. Sites presenting conditions that are not addressed by the generic Tier 1 assumptions about exposure pathways must undergo a more site-specific evaluation.

**Tier 2 evaluation:** site evaluation which typically relies on a limited amount of site-specific information including land or surface water use determinations. The site contaminant concentrations are compared against Tier 2 criteria which are generated using more site-specific information to determine if individual contaminants or mixtures of contaminants pose a potential risk exceeding the target risk levels.

**Tier 3 evaluation:** site-specific evaluation based on more complex modeling using site-specific data. Tier 3 evaluation is necessary in cases where remediation to Tier 2 target risk levels is not feasible or when site conditions require a unique approach to site investigation and setting remediation goals.

**TCLP:** Toxicity Characteristic Leaching Procedure. A laboratory procedure for soil, sediment, or waste samples, that simulates conditions in a landfill by leaching the sample with an acidic solution. The leachate is then analyzed for specific inorganic and/or organic species. There are separate regulatory standards for TCLP analytes, which define whether or not a sample is hazardous.

**total organic carbon (TOC):** carbon fraction of the total organic matter of sediments or groundwater. It is the portion of the sample that comes from biologically derived compounds composed primarily of nitrogen, carbon, oxygen, and phosphorous. It may be estimated by multiplying the organic matter concentration by 0.6. See *fraction of organic carbon, (F<sub>oc</sub>)*.

**total porosity:** ratio of the volume of void spaces in a soil or sediment to the total volume of the sample.

**toxic endpoint:** endpoint of cancer for carcinogens or the organ or physiological system(s) affected by exposure to non-carcinogens.

**toxicity threshold:** dose or exposure below which a significant adverse effect is not expected. Carcinogens are thought to be non-threshold chemicals, to which no exposure can be presumed to be without some risk of adverse effect.

**transmissivity (T):** rate at which water is transmitted through a unit width of aquifer under a unit hydraulic gradient. Transmissivity is a function of the properties of the liquid and porous medium, and the thickness of the porous medium.

**uncertainty factor (UF):** one of several, generally 10-fold factors, used in operationally deriving the Reference Dose (RfD) from experimental data. UFs are intended to account for: (1) variation in sensitivity among the members of the human population; (2) the uncertainty in extrapolating animal data to humans; (3) the uncertainty in extrapolating from data obtained in a study that is of less-than-lifetime exposure; and (4) the uncertainty in using LOAEL data rather than NOAEL data.

**unit risk** upper-bound excess lifetime cancer risk estimated to result from continuous exposure to an agent at a concentration of 1 ppm in water or 1 mg/m<sup>3</sup> in air.

**unrestricted commercial property use:** use of property for any commercial use including to house, educate, or provide care for children, the elderly, the infirm, or other sensitive sub-populations. Relative to risk evaluation, an unrestricted commercial use exposure scenario allows for a higher exposure potential which approximates a residential setting. This subcategory of commercial property use is usually, but not always, located in or near residential areas and, therefore, may be used by other populations for purposes other than the intended commercial use (e.g., recreational). Specific uses could include but are not limited to: day care centers; any form of educational facility; churches; social centers; hospitals; elder care facilities; and nursing homes.

**vadose (unsaturated) zone:** as used in this document, the vadose zone is defined as the zone between the land surface and the water table. It includes the root zone, intermediate zone, and capillary fringe. The pore spaces contain water at less than atmospheric pressure, as well as air and other gases.

**volatile organic compound (VOC):** generally, an organic compound with a Henry's Law constant greater than  $10^{-5}$  (atm-m<sup>3</sup>/mol), a boiling point less than 180°C, and a molecular weight less than 200 g/mol.

**volatility** physical property of any compound that indicates its tendency to change to a gas state. It is expressed as vapor pressure (mm Hg) for pure compounds. Henry's Law is used to determine volatility of dissolved compounds.

**volatilization:** conversion of all or part of a liquid or solid to a vapor or gas.

**volumetric moisture content:** volume of water divided by the total volume in a sample of aquifer.

**volumetric water content:** ratio of the volume of water contained in a given sample of soil/sediment to the bulk volume of the entire field soil/sediment sample.

**water diffusivity:** constant used to describe diffusion of a chemical in water.

**wellhead protection area:** capture zone of a municipal well corresponding to a given travel time to the well (typically 5, 10, or 20 years). A rule administered by MDH requires a land use plan promoting best management practices within a wellhead protection area.

**wetlands:** areas that are inundated or saturated by surface water or groundwater at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands generally include swamps, marshes, bogs, and similar areas. Constructed wetlands designed for wastewater treatment are not waters of the state. Wetlands must have the following attributes: 1) a predominance of hydric soils; 2) inundate or saturated by surface water or groundwater at a frequency and duration sufficient to support a prevalence of hydrophytic vegetation typically adapted for life in a saturated soil condition; and 3) under normal circumstances support a prevalence of such vegetation.

**X-ray fluorescence (XRF):** 1) the property of a sample, usually soil or sediment, that permits the analysis of inorganic (usually metal) species. 2) an XRF spectrophotometer is a portable instrument that can be used for running these types of analyses in the field. The instrument uses a radioactive source to bombard the sample with x-rays, and the resultant emissions (fluorescence) are analyzed to yield a concentration of the target analyte(s) in the sample.