# Health Consultation

OATLAND ISLAND EDUCATION CENTER

SAVANNAH, CHATHAM COUNTY, GEORGIA

EPA FACILITY ID: GAN000407185

FEBRUARY 23, 2005

U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES
Public Health Service
Agency for Toxic Substances and Disease Registry
Division of Health Assessment and Consultation
Atlanta, Georgia 30333

## Health Consultation: A Note of Explanation

An ATSDR health consultation is a verbal or written response from ATSDR to a specific request for information about health risks related to a specific site, a chemical release, or the presence of hazardous material. In order to prevent or mitigate exposures, a consultation may lead to specific actions, such as restricting use of or replacing water supplies; intensifying environmental sampling; restricting site access; or removing the contaminated material.

In addition, consultations may recommend additional public health actions, such as conducting health surveillance activities to evaluate exposure or trends in adverse health outcomes; conducting biological indicators of exposure studies to assess exposure; and providing health education for health care providers and community members. This concludes the health consultation process for this site, unless additional information is obtained by ATSDR which, in the Agency's opinion, indicates a need to revise or append the conclusions previously issued.

You May Contact ATSDR TOLL FREE at
1-888-42ATSDR
or
Visit our Home Page at: http://www.atsdr.cdc.gov

# HEALTH CONSULTATION

## OATLAND ISLAND EDUCATION CENTER

## SAVANNAH, CHATHAM COUNTY, GEORGIA

EPA FACILITY ID: GAN000407185

Prepared by:

U.S. Department of Health and Human Services
Agency for Toxic Substances and Disease Registry
Division of Health Assessment and Consultation
Atlanta, Georgia 30333

## Background and Statement of Issues

The Agency for Toxic Substances and Disease Registry (ATSDR) was requested by the Office of Health and Safety (OHS), Centers for Disease Control and Prevention (CDC) to evaluate the potential human health hazard of future residential use of on-site groundwater at the Oatland Island Education Center. The primary customers of this health consultation are the environmental health engineers and environmental health scientists of CDC OHS. Secondary customers include environmental regulatory staff of the Georgia Environmental Protection Division and representatives of Savannah-Chatham County Public Schools. The purpose of this Health Consultation is to address whether groundwater contaminants left on the site could pose a health hazard to future residents if the property is sold and developed for residential use.

Oatland Island Education Center is located immediately east of Savannah, Georgia. The Center is owned and operated by the Savannah-Chatham County Public Schools as an environmental education facility. The facility is open to the general public daily except on Sundays and holidays.

Bottled water is provided because no on-site groundwater is currently used for drinking purposes. In the recent past, an on-site well supplied potable water for the facility. Use of that well for human drinking-water purposes has been suspended, but the well is still used for all other purposes including bathing, toilets, irrigation, and animal water supply. The well draws water from the Floridan Aquifer at approximately 600 feet below surface [1].

The 173 acre facility (approximately 89 acres of "highland" and approximately 84 acres of "marshland") contains several buildings, wildlife enclosures, and trails [1]. The indoor exhibits and classrooms are in a two-story brick building. Outdoor exhibits include numerous fenced enclosures and cages that contain wildlife such as wolves, deer, and bison. The facility has a single on-site residence that houses the facility manager and the manager's family.

The "highlands" of the facility are surrounded on three sides (north, west, and south) by marshlands and streams. The facility is bordered on the east and south by Richardson creek and to the north by Oatland Island Creek. Sandtown Road on the eastern facility boundary separates the property from the Sandtown residential area.

In 1999, two public water supply wells and approximately 12 private drinking water wells were reported to be within a 2-mile radius of the facility[1]. The public water supply wells are 1500 and 2500 feet northeast of the facility and draw water from the Floridan Aquifer at approximately 700 feet below surface. The nearest off-site private drinking water wells are reported to be 1500 feet northeast of the facility, with the shallowest depth reported at 260 feet. All of these off-site wells are believed to be upgradient from the facility [1].

**Site History and CDC Involvement;**

The Communicable Disease Center (now known as the Center for Disease Control and Prevention) and its predecessor agency, the Office of Malaria Control in War Areas, operated the Technical Development Laboratories (TDL) on the site from approximately 1943 to 1973. In 1974, the United States Government deeded the property to the Savannah-Chatham Board of Public Education with the stipulation that the property be used for educational purposes for a period of thirty years [1].

In 1998, a map was discovered by school officials that indicated the location of two on-site disposal areas labeled Insecticide Burial Area and Radioactive Burial Area [1]. Follow up interviews with former TDL employees revealed a practice of burying insecticides in 1-gallon, 5-gallon, and 55-gallon metal containers, cardboard boxes, and plastic bags. Apparently, some research materials included radionuclide tracers. The radionuclides were buried in a separate trench from insecticides.

CDC initiated environmental investigations by contracted consultants in 1998. Soil samples in burial areas confirmed the presence of dichlorodiphenyltricholoroethane (DDT) and degradation products, dichlorodiphenyldichloroethane (DDD) and dichlorodiphenyldichloroethylene (DDE) [2]. Results from monitor wells indicated detectable concentrations of the same pesticides in the shallow groundwater in burial areas A (Insecticide Burial area) and B (Radioactive Burial area).

Water samples were also collected from the deep-water supply well on-site and an off-site community well. Both wells were reported to be screened in the Floridan Aquifer. The water in both wells was analyzed for metals, pesticides, volatiles, and semi-volatile chemicals listed as priority pollutants under the EPA contract laboratory program (CLP). None of the chemicals exceeded established detection limits, including the detection limit of 0.10 micrograms per liter (ug/L) for DDT, DDD or DDE [1]. The most recent (August 2004) testing of the on-site water supply well did not reveal any Area A contaminants.

Following additional environmental investigations in 1998 and 1999, CDC voluntarily began environmental clean up actions. Soil removal activities began in January 2000. Pesticide contaminated soils were removed from Area A (Insecticide Burial area) and shipped off-site for treatment and disposal. By October 2000, excavations in Area A were backfilled with non-contaminated soil [2]. Similar soil excavation and removal activities occurred in Area B (Radioactive Materials Burial area), including backfilling with non-contaminated soil.

In December 2000, 18 additional monitoring wells were installed in Areas A and B to better define the extent of the pesticide contamination of the local groundwater. Evaluation of groundwater sampling results from Area B did not indicate any presence of chlorinated pesticides above detection limits.

Results from sampling shallow groundwater of Area A indicated the presence of the pesticides dieldrin and benzene hexachloride (BHC), also known as hexachlorocyclohexane (HCH). The initial contaminants of concern, DDD, DDE, and DDT, were not found above detection limits in the post-removal monitoring results until March 2003. Additional groundwater monitoring was performed to better define the extent of pesticide contamination [2].

As part of the voluntary remediation, CDC decided to test an in-situ groundwater remediation technique recommended by consultants. Pilot scale in-situ treatment studies were conducted on site during 2003. A reagent was injected into the contaminated groundwater zone through small-diameter, shallow injection wells. The reagent, composed of hydrogen peroxide and chelated iron catalyst, was injected into the contaminated zone to degrade the pesticides by oxidation. The consultants believed that contaminant concentrations were lowered following two pilot-scale injections, [2] and they then recommended full-scale treatment. In December 2003, full-scale treatment began with an initial injection followed by additional injections in January and March 2004 [3].

CDC has periodically tested the deep on-site water supply well for Area A contaminants. The most recent results from August 2004 confirm the well water to be free of any site-related contaminants [4].

## Discussion

### Environmental data

All environmental data used in this report are derived from reports prepared by two environmental consultant companies, Soil and Material Engineers (S& ME) and Montgomery Watson Harza Americas, under contract with CDC for Oatland Island environmental investigations and remediation. The specific reports are listed in the references at the end of this report.

### Groundwater Contamination

On the basis of the results from frequent groundwater monitoring since 1998, the groundwater contamination appears to be limited to an oblong area approximately 150 feet wide and 360 feet long within the water table aquifer (contaminants are less than 30 feet below ground surface) in Burial Area A. Table 1 contains maximum concentrations reported for April 2004. The highest concentrations were found in 3 of the 20 monitoring wells, MW-12, MW-17 and MW-18. In 2003, DDT, DDD, and DDE were measured above detection limits but at levels less than ATSDR comparison values at only one monitoring well (8A). However, monitoring in 2000, 2001, 2002, or in January and April 2004 did not indicate levels above detection limits.

Two other pesticides were reported in monitoring wells from the July 2002 sampling. Aldrin was measured in monitoring wells MW-12 and MW-18 at concentrations of .032 and .027 micrograms per liter (ug/L) respectively. Alpha endosulfan was measured in well MW-18 at a concentration of .022 ug/L. Aldrin and alpha endosulfan are not considered contaminants of concern in this health consultation for two reasons: the contaminants are not considered to persist in groundwater since they have not been reported above detection limits in any monitoring well since July 2002, and the reported concentrations are below health concern levels.

The most frequently detected groundwater contaminants are the isomers of benzene hexachloride (BHC): alpha, beta, delta, and gamma. As indicated by Table 1, most of the monitoring wells do not contain contaminated groundwater.

Groundwater flow appears to be moving southeasterly from Area A toward the marsh area bordering Richardson Creek. During monitoring well construction, the drilling logs indicated that the downward movement of contaminants from the water table zone is retarded by the presence of clay at approximately 24 feet below ground surface.

Table 1. Pesticides measured above detection limits in monitoring wells in April 2004.

| **Contaminant** | **Maximum Groundwater Monitoring Concentration (ug/L) *** | **Frequency Of Detection+** | **Comparison Value (ppb)**** | **Source of Comparison Values** |
|---|---|---|---|---|
| Alpha-BHC | 0.53 | 5/20 | 0.006 | CREG |
| Beta-BHC | 0.23 | 5/20 | 0.02 | CREG |
| Delta-BHC | 1.6 | 5/20 | None | None |
| Gamma-BHC | 0.057 | 2/20 | 0.2 | MCL |
| Dieldrin | 0.05 | 3/20 | 0.002 | CREG |

* maximum values reported for April 2004 monitoring. Source of environmental concentrations, In-Situ Chemical Status Report No.3, Oatland Island Education Center, Savannah, Georgia, Montgomery Watson Harza, May 2004.
+ Frequency of Detection is number of wells indicating measurements above the detection limits (total number of monitoring wells is 20).
****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. Please see Appendix B for further explanation of comparison values.

Wells for monitoring and wells for residential water supply differ significantly in the frequency of use and in the volume of water used. Monitoring wells on Oatland Island are used approximately one day every 3 months. During sampling, the wells probably remove fewer than 100 gallons of water from the aquifer. Residential water supply wells are used daily, and depending on the daily routines of residents, these wells may remove as much as 1000 gallons of water from the aquifer in a single day. As a result of the frequent use and higher rate of pumping, a residential water supply well installed in the water table on Oatland Island would affect a much greater portion of the water table aquifer than would the current monitoring wells. A residential well, which would be expected to draw water from uncontaminated portions of the water table aquifer would dilute the contaminant concentrations to less than the maximum values reported in Table

1. Therefore, anyone using such residential wells (an unlikely event) would be exposed to much lower doses than those estimated in Table 2.

In addition to the dilution effect of frequent and higher rates of pumping, contaminant concentrations in the water table are expected to continue to disperse and dilute with continuing rainfall recharge. The removal of contaminated soils has eliminated a continuing source of groundwater contamination. Eventually the majority of the mobile contaminants, such as lindane (gamma-BHC), will flow into Richardson Creek.

**Pathway Analysis**

An exposure pathway is the process by which an individual is exposed to contaminants originating from a contamination source. An exposure pathway consists of the following five elements: 1) a *source* of contamination; 2) a *media* such as air or soil through which the contaminant is transported; 3) a *point of exposure* where people can contact the contaminant; 4) a *route of exposure* by which the contaminant enters or contacts the body; and 5) a *receptor population*. A pathway is considered complete if all five elements are present and connected. If one of these elements is missing, the pathway is considered incomplete, and human exposure is not possible.

The Oatland Island site does not contain a completed exposure pathway for groundwater contaminants. The water table aquifer has not been used as a drinking water source. Contaminants are unlikely to migrate either vertically or laterally into any current drinking water well. It is highly unlikely that future water supplies will be threatened by on-site groundwater contamination because local water development practices are to drill into the deeper Floridan Aquifer for drinking water supply rather than to use the water table aquifer.

The most recent (August 2004) testing of the water supply well for Oatland Island Educational Center did not indicate any contaminants from Area A. Contaminants from Area A are not expected to ever reach the existing deep water supply well serving the Oatland Island Education Center because of the vertical barriers (layers or lenses of clay) to contaminant migration in the approximately 600 feet between the water table aquifer and the well intake..

**Public Health Implications**

In the highly unlikely event that anyone would ingest the maximum contaminant concentrations reported from the April monitoring, such theoretical exposure would not be expected to cause short-term or long-term adverse non-cancerous health effects. Table 2 lists the estimated doses using the April monitoring results. These estimated doses do not exceed published Minimal Risk Levels (MRLs).

As noted in Table 2, an MRL has not been established for delta-BHC. However, the estimated dose is at least an order of magnitude below the MRLs established for the other isomers of BHC. Therefore, ingestion of the concentration reported for delta-BHC would not be expected to cause human adverse health effects.

Table 2. Estimated doses for adults using drinking water from monitoring wells

| **Contaminant** | **Maximum Groundwater Concentration (ug/L)** | **Estimated Dose (mg/kg/day)** | **Chronic MRL* (mg/kg/day)** | **Intermediate MRL* (mg/kg/day)** |
|---|---|---|---|---|
| Alpha-BHC | 0.53 | 0.000015 | 0.008 | |
| Beta-BHC | 0.23 | 0.0000066 | | 0.0006 |
| Delta-BHC | 1.6 | 0.000046 | None | |
| Gamma-BHC | 0.057 | 0.0000063 | | 0.00001 |
| Dieldrin | 0.05 | 0.0000014 | 0.00005 | |

*MRL–minimal risk levels

**Implications for cancer;**

Regulatory clean-up levels for groundwater are often based on theoretical cancer risk calculations for hypothetical situations. Using a hypothetical situation for the Oatland Island Education Center site in which people drank water for 70 years from a well that tapped the contaminated water table aquifer, the following theoretical cancer risks can be calculated.

Please note that all cancer risks for the BHC isomers in Table 2 are based on laboratory studies of animals, usually mice. No health studies have been located that link ingestion of BHC isomers to the development of cancer in humans.

The maximum dose ($1.5 \times 10^{-5}$ mg/kg/day) for alpha-BHC estimated in Table 2 falls within the range of doses corresponding to a lifetime risk of 1 in 10,000 of developing cancer for an adult drinking the water for 70 years. The maximum dose for beta-BHC estimated in Table 2 falls within the range of doses corresponding to a theoretical lifetime risk of 1 in 100,000 for developing cancer.

Delta-BHC is structurally related to carcinogenic HCH isomers, but it is currently listed by EPA as “not classifiable” for human carcinogenicity. The EPA has additionally classified lindane (gamma-BHC) as “having suggestive evidence of carcinogenicity, but not sufficient to assess human carcinogenic potential” [5].

The estimated maximum dose of dieldrin falls within the range of doses corresponding to a theoretical lifetime risk of 1 in 100,000 for developing cancer.

Assuming that the theoretical exposures to these chemicals result in an additive cancer risk, the overall theoretical lifetime cancer risk is estimated to be 1 in 10,000 based on most conservative risk assumptions. These predicted theoretical cancer risks are considered conservative upper estimates. The actual risk of cancer is unlikely to be higher and may be substantially lower or even zero.

Although the maximum doses calculated for alpha and beta isomers and dieldrin fall within the range for a slight theoretical lifetime risk of cancer (70-year exposure), the possibility is remote that anyone residing on Oatland Island would ever ingest even a single dose close to the estimated maximum. Therefore, the contaminated groundwater at Oatland Island does not pose a realistic potential to cause human cancer.

**Child Health Considerations**
ATSDR evaluated the sampling data to assess the potential health effects on children in the community and found no exposures that children would be especially sensitive to.

## Conclusions

The current level of chemical contamination in the shallow groundwater on Oatland Island does not pose a public health hazard because no one is using the shallow groundwater as a water supply, and the reported levels of contaminants are well below levels of concern for noncancer health effects. Only a slight theoretical risk of cancer exists. Groundwater contaminants in Area A are not expected to reach the water supply well serving the Oatland Island Education Center. One reason for this expectation is that the flow of the water table aquifers is not toward the water supply well but rather is southward toward Richardson Creek. A second reason is that clay deposits below the water table greatly restrict the vertical flow to the intake area of the water supply well, which is approximately 600 feet below surface.

Following confirmation testing for biological and chemical contaminants required by Georgia and Federal drinking water regulations for community wells, it should be safe to re-institute the use of the on-site water supply well for all potable (including drinking water) purposes.

## Recommendations

No public health recommendations.

## Cited References

[1] Soil and Materials Engineers. Compliance Status Report, Oatland Island Education Center, Savannah, Georgia, December 9, 1999.

[2] Montgomery Watson Harza Americas. July 2002 Round of Semi-Annual Groundwater Sampling and Monitored Natural Attenuation Report, Oatland Island Education Center, Savannah, Georgia, October, 2002.

[3] Montgomery Watson Harza Americas. In-Situ Chemical Oxidation Status Report No. 3, Oatland Island Education Center, Savannah, Georgia, May, 2004.

[4] Analytical Services Inc. Laboratory Report, Norcross, Georgia, September 16, 2004.

[5] Agency for Toxic Substances and Disease Registry. Toxicological Profile of Hexachlorocyclohexane, Atlanta, Georgia, 2003.

[6] Agency for Toxic Substances and Disease Registry. Toxicological Profile of Aldrin and Dieldrin, Atlanta, Georgia, 2002.

## *Preparers of the Report*

John H. Mann, P.G.
Senior Hydrogeologist
Superfund and Program Analysis Branch
Division of Health Assessment and Consultation

Technical Review by:

Shan-Ching Tsai, Ph.D.
Toxicologist
Division of Health Assessment and Consultation

John Crellin, Ph.D.
Senior Environmental Epidemiologist
Division of Health Assessment and Consultation

Supervisory and Policy Review by:

Sven Rodenbeck, Sc.D., P.E., DEE
Deputy Branch Chief.
Superfund and Program Analysis Branch
Division of Health Assessment and Consultation

Rick Gillig, MCP
Chief, Superfund and Program Analysis Branch
Division of Health Assessment and Consultation
Agency for Toxic Substances and Disease Registry

**Appendix A**
**Minimal Risk Levels**
**A note of explanation**

## Minimal Risk Levels: a Note of Explanation

An MRL is an estimate of the daily human exposure to a hazardous substance that is likely to be without appreciable risk of adverse noncancer health effects over a specified duration of exposure. These substance-specific estimates, which are intended to serve as screening levels, are used by ATSDR health assessors and other responders to identify contaminants and potential health effects that may be of concern at hazardous waste sites. **It is important to note that MRLs are not intended to define clean-up or action levels for ATSDR or other Agencies.**

The ATSDR toxicological profiles include an examination, summary, and interpretation of available toxicological information and epidemiologic evaluations of a hazardous substance. During the development of toxicological profiles, MRLs are derived when ATSDR determines that reliable and sufficient data exist to identify the target organ(s) of effect or the most sensitive health effect(s) for a specific duration for a given route of exposure to the substance. MRLs are based on noncancer health effects only and are not based on considerations of cancer effects. Inhalation MRLs are exposure concentrations expressed in units of parts per million (ppm) for gases and volatiles or milligrams per cubic meter ($mg/m^3$) for particles. Oral MRLs are expressed as daily human doses in units of milligrams per kilogram per day (mg/kg/day). Radiation MRLs are expressed as external exposures in units of millisieverts.

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

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

# Appendix B
# Comparison Values

## COMPARISON VALUES

ATSDR comparison values are media-specific concentrations that are considered to be "safe" under default conditions of exposure. These comparison values are used as screening values in the preliminary identification of "contaminants of concern" at a site. The term is perhaps unfortunate in that the word "concern" may 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 the health assessor has selected for further evaluation of potential health effects.

Usually, 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, we strongly emphasize that comparison values are ***not*** thresholds of toxicity. Although concentrations at or below the relevant comparison value may reasonably be considered safe, environmental concentration that exceed a comparison value may not necessarily 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 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 noncancer effects are obtained by dividing no-observed-adverse-effect levels (NOAELs) or lowest-observed-adverse-effect levels (LOAELs) determined in animal or less often in 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 risks associated with low-level exposures in humans.

Following is a list of the various comparison values that ATSDR uses to select chemicals for further evaluation and abbreviations for the most common units of measure. A description of the comparison values follows.

CREG = cancer risk evaluation guide

EMEG = environmental media evaluation guide

IEMEG = intermediate environmental media evaluation guide

kg = kilogram (1,000 grams)

LOAEL = lowest-observed-adverse-effect level

MCL = maximum contaminant level

mg = milligram (0.001 grams)

MRL = minimal risk level

NOAEL = no-observed-adverse-effect level

ppb = parts per billion

ppm = parts per million

RMEG = reference dose media evaluation guide

µg = microgram (0.000001 grams)

**Cancer Risk Evaluation Guides (CREGs)** are estimated contaminant concentrations in water, soil, or air that would be expected to cause no more than one excess cancer in a million persons exposed over a lifetime. CREGs are calculated from EPA's cancer slope factors and cannot be used to make predictions about actual cancer incidence rates.

**Environmental Media Evaluation Guides (EMEGs)** are concentrations of a contaminant in water, soil, or air that are unlikely to be associated with any appreciable risk of deleterious noncancer effects over a specified duration of exposure. EMEGs are derived from ATSDR minimal risk levels (MRL) by factoring in default body weights and ingestion rates. Separate EMEGS are computed for acute (≤14 days), intermediate (15-364 days), and chronic (≥365 days) exposures. See the definition of minimal risk levels.

**Intermediate Environmental Media Evaluation Guides (IEMEG)** are media-specific concentrations which correspond to a minimal risk level (MRL), factoring in body weight and ingestion rates for intermediate exposures (i.e., >14 days and <1 year).

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

**Maximum Contaminant Levels (MCLs)** represent contaminant concentrations in drinking water that EPA deems protective of public health (considering the availability and economics of water treatment technology) over a lifetime (70 years) at an exposure rate of 2 liters of water per day.

**Minimal Risk Levels (MRL)** are estimates of daily human exposure to a chemical (i.e., doses expressed in mg/kg/day) that are unlikely to be associated with any appreciable risk of deleterious noncancer effects over a specified duration of exposure. MRLs are derived for acute (≤14 days), intermediate (15-364 days), and chronic (≥365 days) exposures and are published in ATSDR's Toxicological Profiles for specific chemicals.

**No-Observed-Adverse-Effect Level (NOAEL)** is the dose of chemical at which there are no statistically significant or biologically significant increases in frequency or severity of adverse effects when comparing the exposed population and an appropriate control population. Nonadverse effects may still be observed at this dose, but they will have no deleterious impact on the organism.

**Reference Dose Media Evaluation Guide (RMEG)** is the concentration of a contaminant in air, water, or soil that corresponds to EPA's reference dose of RfC for that contaminant when default values for body weight and intake rates are taken into account.