# Remediation and Redevelopment Division

*Michigan Department of Environmental Quality*

**December 10, 2004**

**RRD OPERATIONAL MEMORANDUM NO. 1**

**SUBJECT: <u>TECHNICAL SUPPORT DOCUMENT - ATTACHMENT 3</u>**
**PART 201 DRINKING WATER CRITERIA**
**PART 213 TIER I DRINKING WATER RISK-BASED SCREENING LEVELS**

**Developed under R 299.5710**

**Key definitions for terms used in this document:**

| | |
|---|---|
| **NREPA:** | **The Natural Resources and Environmental Protection Act, 1994 PA 451, as amended** |
| **Part 201:** | **Part 201, Environmental Remediation, of NREPA** |
| **Part 213:** | **Part 213, Leaking Underground Storage Tanks, of NREPA** |
| **MDEQ:** | **Michigan Department of Environmental Quality** |
| **RRD:** | **Remediation and Redevelopment Division** |
| **Criteria or criterion:** | **Includes the cleanup criteria for Part 201 of NREPA and the Risk-Based Screening Levels as defined in Part 213 of NREPA and R 299.5706a(4)** |
| **DWC:** | **Drinking Water Criteria or Criterion** |
| **Facility:** | **Includes "facility" as defined by Part 201 of NREPA and "site" as defined by Part 213 of NREPA** |
| **TSD:** | **Technical Support Document** |

This TSD presents the methodology for development of the generic drinking water criteria. The DWC were developed pursuant to Sections 20120a(1)(a), (b), and (d); 20120(a)(3) and (5); and 21304a(1) (2) of NREPA. This methodology is presented in R 299.5710(3). This TSD supercedes previous MDEQ documents regarding the DWC.

In addition to the Part 201 Administrative Rules, the DWC are presented in Attachment 1 of the RRD Operational Memorandum No. 1: Part 201 Cleanup Criteria/Part 213 Risk-Based Screening Levels. Residential and commercial I DWC are presented in column 1 of the groundwater criteria table. Industrial and commercial DWC are presented in column 2 of the groundwater criteria table. The DWC represent water concentrations of contaminants in units of micrograms per liter (µg/L) or parts per billion (ppb), unless otherwise noted.

## IMPLEMENTATION

The DWC represent concentrations of hazardous substances in drinking water that are safe for long-term consumption. Where the health-based DWC is less than the target detection limit (TDL), the TDL is used in place of the DWC. Criteria that are based on

TDLs are presented in the criteria tables in RRD Operational Memorandum No. 1, Attachment 1 and are identified by the (M) footnote (R 299.5707 and R 299. 5750(M)). All TDLs are presented in the RRD Operational Memorandum No. 2. Where a state drinking water standard (SDWS) has been established pursuant to Act No. 399 of the Public Acts of 1976, the SDWS becomes the health-based DWC as specified by Section 20120a(5) and Section 21304a(4) of NREPA. The DWC based on a SDWS are designated in the criteria table by footnote (A) (R 299.5710(3) and R 299.5750(A)). The DWC for some inorganic hazardous substances default to background when the criteria are less than background (R 299.5707 and R 299.5750(B)). If proposed to be substituted for a cleanup criterion, background concentrations for groundwater must be determined on a regional or facility-specific basis. The RRD Operational Memorandum No. 4 provides guidance on establishing groundwater background values.

Section 20120a(5) and Section 21304a(4) of NREPA and R 299.5709 require that remediation of an aquifer address adverse aesthetic impacts (e.g., odor, taste, color, precipitate) resulting from one or a combination of hazardous substances. However, aesthetic criteria are available for only a limited number of individual hazardous substances. Aesthetic criteria are based on federal secondary maximum contaminant levels or the results of an acceptable taste or odor test. An existing aesthetic value becomes the DWC when it is less than the health-based DWC or the SDWS. Footnote (E) designates those DWC that are based on adverse aesthetic characteristics (R 299.5750(1)(E)). If adverse aesthetic impacts remain after the DWC have been achieved, further remedial measures may be required. Consult the RRD District Supervisor or the RRD Toxicology Unit if you encounter such a situation.

If a generic DWC is greater than the solubility limit for that specific hazardous substance, then the solubility limit is the generic DWC (R 299.5708(2)).

All pathways must be evaluated to determine if they are relevant for a particular facility. The drinking water pathway is relevant to all groundwater in an aquifer. An "aquifer" is defined in R 299.5101(d) as "a geological formation, group of formations, or part of a formation capable of yielding a significant amount of groundwater to wells or springs." The drinking water pathway is also relevant to groundwater not in an aquifer if the groundwater can reasonably be expected to transport a hazardous substance into an aquifer in a concentration that exceeds the generic residential criterion. If the drinking water pathway is not relevant, the cleanup criteria are not applicable. Cleanup criteria for groundwater not in an aquifer and not reasonably expected to transport a hazardous substance into an aquifer must be determined by consideration of other exposure pathways and their associated criteria.

The DWC are applicable to all groundwater in an aquifer unless drinking water use is prohibited by enforceable land use restrictions in a restrictive covenant, notice of approved environmental remediation (NAER), notice of corrective action (NoCA), or an approved institutional control (Section 21310a, Section 20120b(4), and Section 20120b(5).

The generic industrial and commercial DWC are applicable to property that is zoned or being used for industrial or commercial II, III, or IV purposes, provided that a NAER, NoCA, or restrictive covenant will limit the property use to those commercial or industrial uses, as appropriate. These criteria are applicable unless drinking water use is prohibited by enforceable land use restrictions in a restrictive covenant or an approved institutional control. Generic residential DWC are applicable at the property boundary unless off-property use of the aquifer is controlled by a restrictive covenant, NAER, NoCA, or approved institutional control.

**GENERIC HEALTH-BASED DRINKING WATER ALGORITHMS**

The DWC are derived from the algorithms presented below except as provided in R 299.5734. Further details regarding the DWC are presented after the algorithms.

EQUATION FOR CARCINOGENIC EFFECTS:

$$DWC = \frac{TR \times BW \times AT \times CF}{SF \times EF \times ED \times IR_{dw}}$$

where,

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|---|---|
| DWC (Drinking water criterion) | = chemical-specific (µg/L or ppb) |
| TR (Target risk level) | = $10^{-5}$ |
| BW (Body weight) | = 70 kg |
| AT (Averaging time in days) | = 25,550 days (70 years x 365 days/year) |
| CF (Conversion factor) | = 1,000 µg/mg |
| SF (Oral cancer slope factor) | = chemical-specific $(mg/kg\text{-}day)^{-1}$ |
| EF (Exposure frequency) | = 350 days/year (residential)<br>= 245 days/year (industrial and commercial) |
| ED (Exposure duration) | = 30 years (residential)<br>= 21 years (industrial and commercial) |
| $IR_{dw}$ (Drinking water ingestion rate) | = 2 liters/day (residential)<br>= 1 liter/day (industrial and commercial) |

EQUATION FOR NONCARCINOGENS:

$$DWC = \frac{THQ \times RfD \times BW \times AT \times RSC \times CF}{EF \times ED \times IR_{dw}}$$

where,

| | |
|---|---|
| DWC (Drinking water criterion) | = chemical-specific (µg/L or ppb) |
| THQ (Target hazard quotient) | = 1 |
| RfD (Oral reference dose) | = chemical-specific (mg/kg-day) |
| BW (Body weight) | = 70 kg |

| | |
|---|---|
| AT (Averaging time) | = 10,950 days (30 years x 365 days/year - residential)<br>= 7,665 days (21 years x 365 days/year - industrial and commercial) |
| RSC (Relative source contribution) | = chemical-specific or 0.2 if chemical-specific data are not available |
| CF (Conversion factor) | = 1,000 µg/mg |
| EF (Exposure frequency) | = 350 days/year (residential)<br>= 245 days/year (industrial and commercial) |
| ED (Exposure duration) | = 30 years (residential)<br>= 21 years (industrial and commercial) |
| $IR_{dw}$ (Drinking water ingestion rate) | = 2 liters/day (residential)<br>= 1 liter/day (industrial and commercial) |

**GENERAL INFORMATION ABOUT THE DWC ALGORITHMS**

The AT represents the number of days over which the exposure is averaged. The AT value depends upon the type of toxic effect being evaluated. When evaluating long-term exposure to noncarcinogenic compounds, exposure is calculated by averaging over the period of exposure (i.e., subchronic or chronic exposures). For carcinogenic compounds, exposures are calculated by prorating the total cumulative dose over a lifetime (also called lifetime average daily dose). The approach for carcinogens is based on the assumption that a high dose of a carcinogen received over a short period of time is equivalent to a corresponding low dose received over a lifetime.

The acceptable level of risk for carcinogens is one in one hundred thousand ($10^{-5}$) pursuant to Section 20120a(4) and Section 21304a(3) of NREPA. Exposure to noncarcinogens is evaluated through the use of a hazard quotient (HQ). The HQ is the ratio of the assumed exposure level and a reference or safe dose, both for a similar exposure period. An acceptable THQ is equal to or less than one (R 299.5710(3)). A THQ of greater than one (i.e., the exposure level is greater than the reference dose) is considered unacceptable.

The RSC factor of 20 percent (0.2) is included in the algorithm for noncarcinogens to maintain consistency with the United States Environmental Protection Agency (EPA) and State of Michigan development of drinking water standards. The 20 percent RSC represents a default value that may be replaced with a chemical-specific value when data are available. The RSC accounts for the fact that there are many chemicals to which people are exposed through a variety of media and activities. The default RSC of 0.2 assumes that a receptor gets 20 percent of his/her exposure to a contaminant from drinking water while 80 percent of their exposure comes from other sources. For example, solvents are common industrial contaminants that are found in products routinely used by the general consumer. Ignoring exposures from other sources when generating cleanup criteria for solvents could underestimate the risk posed by these types of chemicals. In light of the fact that chemical-specific data regarding RSCs are extremely limited and significant exposures to certain chemicals do occur from a variety of sources, it is necessary to identify a conservative default value for this generic approach.

The ED of 30 years represents the national upper-bound for time of occupancy (90th percentile) at one residence (EPA, 1989). The EF of 350 represents the number of days per year that a resident is exposed to drinking water at their home; it assumes that people spend approximately 15 days per year away from their homes for vacations or other reasons.

An ED of 21 years for a commercial/industrial worker is extrapolated from 1991 statistics from the United States Department of Labor (EPA, 1991b) as the 90th percentile. The EF of 245 days for the worker drinking water scenario is derived from the assumption that there are 260 work days per year minus 3 work weeks (15 days) of vacation and sick time. The assumed amount of water ingested at work (1 liter/day) is based on EPA's recommendation (EPA, 1991a). Adjustments to these algorithms can be made only as allowed for under R 299.5706a(9).

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## REFERENCES

EPA (U.S. Environmental Protection Agency). 1989. Risk Assessment Guidance for Superfund. Volume I. Human Health Evaluation Manual (Part A). Interim Final. EPA/540/1-89/002. December 1989.

EPA (U.S. Environmental Protection Agency). 1991a. Risk Assessment Guidance for Superfund: Volume I. Human Health Evaluation Manual (Part B, Development of Risk-Based Preliminary Remediation Goals). Interim. Publication 9285.7-01B. December 1991.

EPA (U.S. Environmental Protection Agency). 1991b. Risk Assessment Guidance for Superfund. Volume I: Human Health Evaluation Manual Supplemental Guidance. “Standard Default Exposure Factors.” Interim Final. OSWER Directive: 9285.6-03. March 25, 1991.