

SUBCHAPTER S: RISK REDUCTION STANDARDS
§§335.551 - 335.569
Effective September 1, 2003

§335.551. Purpose, Scope and Applicability.

(a) Purpose. This subchapter specifies the information and procedures necessary to demonstrate compliance with the three risk reduction standards of §335.8 of this title (relating to Closure and Remediation).

(b) Scope. The requirements of this subchapter will, when adequately carried out, assure adequate protection of human health and the environment from potential exposure to contaminants associated with releases from solid waste management facilities or other areas. Cleanup levels are specified for different types of contaminated media such as air, surface water, groundwater, and soil, and for cross-media contamination pathways such as soil to groundwater and soil to air. General procedures based on scientific principles are provided or referenced by these regulations so that specific numeric cleanup levels can be generated. The commission will periodically review the general procedures and revise these regulations as necessary.

(c) Applicability. The requirements of this subchapter apply to persons who undertake a closure or remediation in accordance with §335.8 of this title (relating to Closure and Remediation) during the period from June 28, 1993, until May 1, 2000, unless the person qualifies for an extended period of time as specified in §335.8(a) of this title (relating to Applicability) for submission of a final report to be reviewed according to this subchapter. If the executive director denies approval of the final report for reasons of technical inadequacy, the executive director may require the person to comply with the requirements of Chapter 350 of this title (relating to Texas Risk Reduction Program). For closures and remediations initially reported to the executive director on or after May 1, 2000, the person shall use the procedures of Chapter 350 of this title in place of this subchapter.

Adopted September 2, 1999

Effective September 23, 1999

§335.552. Definitions.

The following words and terms when used in this subchapter shall have the following meanings, unless the context clearly indicates otherwise:

(1) **Carcinogen** - Substances which have been classified for human carcinogenic risk based on the United States Environmental Protection Agency's Weight of Evidence System of Carcinogenicity as Group A - Human Carcinogen; Group B - Probable Human Carcinogen; or Group C - Possible Human Carcinogen.

(2) **Carcinogen classification** - The basis by which substances are classified for human carcinogenic risk based on the United States Environmental Protection Agency's Weight of Evidence System for Carcinogenicity: Group A - Human Carcinogen; Group B - Probable Human Carcinogen; Group C - Possible Human Carcinogen; Group D - Not Classifiable as to Human Carcinogenicity; and Group E - Evidence of Non-Carcinogenicity for Humans.

(3) **Long-term effectiveness** - The ability of a remediation or corrective action to maintain over time the required level of protection of human health and the environment.

(4) **Non-residential property** - Any real property or portion of a property not currently being used for human habitation or for other purposes with a similar potential for human exposure, at which activities have been or are being conducted, having the primary Standard Industrial Classification (SIC) major group numbers 01 - 48 inclusive, 49 except 4941, 50 - 67 inclusive, 72 - 79 inclusive, 80 except 8051, 8059, 8062, 8063, 8069, 81 and 82 except 8211, 8221, 8222, 83 except 8351, 8361, 84 - 86 except 8661, 87 - 91 inclusive, 92 except 9223, and 93 - 97 inclusive. Non-residential property includes all of the block(s) and lot(s) controlled by the same owner or operator that are vacant land, or that are used in conjunction with such business. For leased properties, non-residential property includes the leasehold and any external tank, surface impoundment, septic system, or any other structure, vessel, contrivance, or unit that provides, or are utilized, for the management of contaminants to or from the leasehold.

(5) **Permanence/permanent/permanently** - The property of achieving the maximum degree of long-term effectiveness and of enduring indefinitely without posing the threat of any future release that would increase the risk above levels established for the facility or area.

(6) **Point of exposure** - A location where human or environmental receptors can come into contact with contaminants; also, a location which can be arbitrarily determined for purposes of estimating or measuring the concentration of contaminants available for exposure.

(7) **Practical quantitation limit/PQL** - The lowest concentration of an analyte which can be reliably quantified within specified limits of precision and accuracy during routine laboratory operating conditions. The PQL minimizes to the extent possible the effects of instrument and operator variability and the influences of the sample matrix and other contaminants or substances upon the quantitation of the analyte. "Specified limits of precision and accuracy" are the criteria which have been included in applicable regulations or which are listed in the quality control sections of the analytical method. The PQL may be directly obtained or derived from the following sources with preference given to the most recent, scientifically valid method: federal regulations; EPA guidance documents; calculation from interlaboratory studies; and experimentally determined analytical methods not available from other existing sources.

(8) **Residential property** - Any property that does not exclusively meet the definition of non-residential property. Also, a portion of non-residential property that is used in part for residential activities, such as a day care center, is defined as residential.

(9) **Systemic toxicant** - Substances shown either through epidemiological studies or through laboratory studies to cause adverse health effects other than cancer.

§335.553. Required Information.

(a) For Risk Reduction Standard Number 1 or 2, the person shall provide a final report that documents attainment of the risk reduction standard in accordance with §335.554 or §335.555 of this title (relating to Attainment of Risk Reduction Standard Number 1 and Attainment of Risk Reduction Standard Number 2). The report shall include, but is not limited to, descriptions of procedures and conclusions of the investigation to characterize the nature, extent, direction, rate of movement, volume, composition and concentration of contaminants in environmental media; basis for selecting environmental media of concern; documentation supporting selection of exposure factors; descriptions of removal or decontamination procedures performed in closure or remediation; summaries of sampling methodology and analytical results which demonstrate that contaminants have been removed or decontaminated to applicable levels; and a document that the person proposes to use to fulfill the requirements of §335.560(b) of this title (relating to Post-Closure Care and Deed Certification for Risk Reduction Standard Number 2), as applicable.

(b) Risk Reduction Standard Number 3, the person shall conduct the activities set forth in paragraphs (1) - (4) of this subsection. The results of activities required by paragraphs (1) - (3) of this subsection may be combined to address a portion of a facility or one or more facilities of a similar nature or close proximity. The submittal shall be subject to review and approval by the executive director prior to carrying out the closure or remediation. Upon completion of the approved activity, the person shall submit the final report required by paragraph (4) of this subsection.

(1) The person shall prepare a remedial investigation report which contains sufficient documentation such as, but not limited to, descriptions of procedures and conclusions of the investigation to characterize the nature, extent, direction, rate of movement, volume, composition, and concentration of contaminants in environmental media of concern, including summaries of sampling methodology and analytical results. Information obtained from attempts to attain Risk Reduction Standard Number 1 or 2 may be submitted for this purpose.

(2) The person shall prepare a baseline risk assessment report which describes the potential adverse effects under both current and future conditions caused by the release of contaminants in the absence of any actions to control or mitigate the release. The report shall also discuss the degree of uncertainty associated with the baseline risk assessment. Residential land use with on-site exposure shall be assumed to evaluate the future use condition unless the person demonstrates to the satisfaction of the executive director that a different land use assumption such as industrial use is more appropriate. The standard exposure factors set forth in Table 1 (located following paragraph (4) of this subsection) shall be used unless the person documents to the executive director's satisfaction that site-specific exposure data should be used instead.

(3) The person shall evaluate the relative abilities and effectiveness of potential remedies to achieve the requirements for remedies described in §335.561 of this title (relating to Attainment of Risk Reduction Standard Number 3: Closure/Remediation with Controls) when considering the evaluation factors described in §335.562 of this title (relating to Remedy Evaluation Factors for Risk Reduction Standard Number 3). Using this information, the person shall prepare a corrective measure study which recommends the remedy which best achieves the requirements for remedies described in §335.561 of this title. Persons may seek to satisfy the requirements of §335.564 of this title (relating to Post-Closure Care

Not Required for Risk Reduction Standard Number 3) by demonstrating in the corrective measure study using the procedures of §335.563 of this title (relating to Media Cleanup Requirements for Risk Reduction Standard Number 3) that no remedy needs to be performed since the existing conditions of the facility or area conform to the media cleanup requirements without the use of removal, decontamination or control measures. Persons may also seek to satisfy the requirements of §335.564 of this title by demonstrating in the corrective measure study that following completion of their recommended removal and/or decontamination activities the conditions of the facility or area will conform to the media cleanup requirements of §335.563 of this title without the use of control measures. Upon review of the corrective measure study, the executive director may require the person to further evaluate the proposed remedy or to evaluate one or more additional remedies.

(4) The person shall submit to the executive director, for review and acceptance, a final report containing sufficient documentation which demonstrates that the remedy has been completed in accordance with the approved plan and also a document that the person proposes to use to fulfill the requirements of §335.566 of this title (relating to Deed Recordation for Risk Reduction Standard Number 3).

Table 1

Standard Exposure Factors (for use with §335.553(b)(2) and §335.563(e)).

Land Use	Exposure Pathway	Daily Intake Rate	Exposure Frequency	Exposure Duration	Body Weight
Residential	Ingestion of Potable Water	2 liters	350 days/yr	30 years	70 kg
	Ingestion of Soil and Dust+	200 mg-child, age 1-6	350 days/yr	6 years*	15.1 kg*
		100 mg-adult, age 7-31		24 years**	70 kg**
+ These factors yield the age-adjusted soil ingestion factor of 114 mg-yr/kg-day					
	Inhalation of Contaminants	20 cu.m.-total 15 cu.m.-indoor	350 days/yr	30 years	70 kg
Commercial/ Industrial	Ingestion of Potable Water	1 liter	250 days/yr	25 years	70 kg
	Ingestion of Soil and Dust	50 mg	250 days/yr	25 years	70 kg
	Inhalation of Volatiles	20 cu.m./workday	250 days/yr	25 years	70 kg
Agricultural	Consumption of Homegrown Produce	42 g-fruit	350 days/yr	30 years	70 kg
		80 g-vegetables			
Factors for ingestion of potable water, soil and dust, and inhalation of volatiles: Use the Residential Land Use factors.					
Recreational	Consumption of Locally Caught Fish	10 g-freshwater 15 g-saltwater	350 days/yr	30 years	70 kg

(c) For risk reduction standards Numbers 1, 2, and 3, in order for a treatment process to achieve decontamination in contrast to being a control measure, the person must demonstrate to the satisfaction of the executive director that the treatment process permanently alters all contaminants to levels that will not pose a substantial present or future threat to human health and the environment, and must further demonstrate that any residue remaining in place from the treatment will not pose the threat of any future release that would increase the concentrations of contaminants in environmental media above the cleanup levels determined for that particular risk reduction standard.

(d) For Risk Reduction Standards Numbers 1, 2, and 3, attainment of cleanup levels shall be demonstrated by collection and analysis of samples from the media of concern. Persons shall utilize techniques described in SW 846, Test Methods for Evaluating Solid Waste, EPA, or other available guidance in developing a sampling and analysis plan appropriate for the distribution, composition, and heterogeneity of contaminants and environmental media. A sufficient number of samples shall be collected and analyzed for individual compounds to both accurately assess the risk to human health and the environment posed by the facility or area and to demonstrate the attainment of cleanup levels. Noncompound-specific analytical techniques (e.g., total petroleum hydrocarbons, total organic carbon, etc.) may, where appropriate for the nature of the wastes or contaminants, be used to aid in the determination of the lateral and vertical extent and volume of contaminated media; however, such noncompound-specific analyses will serve only as indicator measures and must be appropriately supported by compound-specific analyses. Comparisons may be based on the following methods:

(1) direct comparison of the results of analysis of discrete samples of the medium of concern with the cleanup level;

(2) for a data set of ten or more samples, statistical comparison of the results of analysis utilizing the 95% confidence limit of the mean concentration of the contaminant as determined by the following expression:

Cleanup Level $\geq \bar{x} + ts/\sqrt{n}$, where \bar{x} is the mean concentration, s is the standard deviation and t is a value from Table 2 (located following paragraph (3) of this subsection) based on the number of samples, and \sqrt{n} is the square root of the sample size; or

(3) other statistical methods appropriate for the distribution of the data, subject to prior approval by the executive director.

Table 2

Values for “t” (for use with §335.553(d)).

n	t	n	t	n	t
10	1.812	20	1.725	50	1.676
11	1.796	21	1.721	60	1.671
12	1.782	22	1.717	70	1.667
13	1.771	23	1.714	80	1.664
14	1.761	24	1.711	90	1.662
15	1.753	25	1.708	100	1.661
16	1.746	30	1.697	120	1.658
17	1.740	35	1.690	145	1.656
18	1.734	40	1.684		
19	1.729	45	1.680		

(e) For Risk Reduction Standards Numbers 2 and 3, in determining toxicity information for contaminants (e.g., EPA carcinogen classification, type of toxicant, reference doses, carcinogenic slope factors, etc.), persons shall utilize values from the following sources in the order indicated. For Risk Reduction Standard Number 2, persons may utilize data from these sources that are more current than those used to derive the unadjusted medium-specific concentrations listed in §335.568 of this title (relating to Appendix II), provided that substantiating information is furnished to the executive director in the report required by §335.555(f) of this title (relating to Attainment of Risk Reduction Standard Number 2: Closure/Remediation to Health-Based Standards and Criteria).

- (1) Integrated Risk Information System (IRIS);
- (2) Health Effects Assessment Summary Table (HEAST);
- (3) EPA Criteria Documents;
- (4) Agency for Toxic Substances and Disease Registry (ATSDR) Toxicological Profiles; and
- (5) other scientifically valid published sources.

(f) For Risk Reduction Standards Numbers 2 and 3, persons determining cleanup levels for contaminated media characterized by noncompound-specific analytical techniques (e.g., total petroleum hydrocarbons, total organic carbon, etc.) and for which individual compounds such as hazardous constituents are not present as contaminants, must at a minimum consider other scientifically valid published numeric criteria to address: adverse impacts on environmental quality; adverse impacts on the public welfare and safety; conditions that present objectionable characteristics (e.g., taste, odor, etc.); or conditions that make a natural resource unfit for use.

(g) All engineering and geoscientific information submitted to the agency shall be prepared by, or under the supervision of, a licensed professional engineer or licensed professional geoscientist, and shall be signed, sealed, and dated by qualified professionals as required by the Texas Engineering Practice Act and the Texas Geoscience Practice Act and the licensing and registration boards under these acts.

Adopted August 6, 2003

Effective September 1, 2003

§335.554. Attainment of Risk Reduction Standard Number 1: Closure/Remediation to Background.

(a) Compliance with this standard is attained when the criteria set forth in subsections (b) - (g) of this section are met.

(b) For closure of hazardous waste management units and response to unauthorized discharges of hazardous waste, all hazardous waste and hazardous waste residues and contaminated design and operating system components such as liners, leachate collection systems and dikes must be removed from the unit or area of the unauthorized discharge. For remediation of media that have become contaminated by releases from a hazardous waste management unit or by other unauthorized discharge of hazardous waste, the contaminated media must be removed or decontaminated to cleanup levels specified in this section.

(c) For closure of non-hazardous industrial solid waste management units, response to unauthorized discharges of non-hazardous industrial solid waste, and the remediation of media that have become contaminated by discharges of non-hazardous industrial solid waste or other contaminants, all waste and waste residues, contaminated design and operating system components such as liners, leachate collection systems and dikes, and contaminated media must be removed or decontaminated to cleanup levels specified in this section.

(d) Background as represented by results of analyses of samples taken from media that are unaffected by waste management or industrial activities shall be used to determine compliance with the requirements of this section. If the Practical Quantitation Limit (PQL) is greater than background, then the PQL rather than background shall be used as the cleanup level provided that the person satisfactorily demonstrates to the executive director that lower levels of quantitation of a contaminant are not possible.

(e) Attainment of cleanup levels shall be demonstrated by collection and analysis of samples from the media of concern using the procedures of §335.553(d) of this title (relating to Required Information).

(f) The person must submit a report to the executive director in accordance with §335.553(a) of this title (relating to Required Information) that documents compliance with the requirements of this section.

(g) Provided that attainment of this risk reduction standard for the facility or area can be demonstrated to the executive director pursuant to this section, the person is released from deed recordation requirements of §335.5 of this title (relating to Deed Recordation of Waste Disposal) and post-closure care responsibilities.

Effective June 28, 1993

§335.555. Attainment of Risk Reduction Standard Number 2: Closure/Remediation to Health-Based Standards and Criteria.

(a) Compliance with this standard is attained when the criteria set forth in subsections (b) - (f) of this section are met.

(b) For closure of hazardous waste management units and response to unauthorized discharges of hazardous waste, all hazardous waste and hazardous waste residues must be removed from the unit or area of the unauthorized discharge. Contaminated design and operating system components such as liners, leachate collection systems and dikes must be removed from the unit or area of the unauthorized discharge. For remediation of media that have become contaminated by releases from a hazardous waste management unit or by other unauthorized discharge of hazardous waste, the contaminated media must be removed or decontaminated to cleanup levels specified in this section or such other lower levels necessary to be in conformance with current hazardous waste regulations.

(c) For closure of non-hazardous industrial solid waste management units, response to unauthorized discharges of non-hazardous industrial solid waste, and the remediation of media that have become contaminated by discharges of non-hazardous industrial solid waste or other contaminants, all waste and waste residues, contaminated design and operating system components such as liners, leachate collection systems and dikes, and contaminated media must be removed or decontaminated to cleanup levels specified in this section.

(d) The concentration of a contaminant in contaminated media of concern such as ground water, surface water, air or soil shall not exceed cleanup levels as defined in §335.556 of this title (relating to Determination of Cleanup Levels for Risk Reduction Standard Number 2).

(1) If the Practical Quantitation Limit (PQL) and/or the background concentration, determined in a manner consistent with §335.554 of this title (relating to Attainment of Risk Reduction Standard Number 1) for a contaminant is greater than the cleanup level, the greater of the PQL or background shall be used for determining compliance with the requirements of this section.

(2) Attainment of cleanup levels shall be demonstrated by collection and analysis of samples from the contaminated media of concern using the procedures of §335.553(d) of this title (relating to Required Information).

(e) The person must prepare a document that he intends to use to fulfill the deed certification requirements of §335.560 of this title (relating to Post Closure Care and Deed Certification for Risk Reduction Standard Number 2) and include this document as part of the report of subsection (f) of this section.

(f) The person must submit a report to the executive director in accordance with §335.553(a) of this title (relating to Required Information) that documents compliance with the requirements of this section. The executive director may require additional information or analysis, such as but not limited to consideration of cumulative health effects and cross-media contamination, prior to accepting a certification of closure or remediation under this performance standard. Upon approval of the report by the executive director, the person shall comply with the requirements of §335.560 of this title (relating to Post Closure Care and Deed Certification for Risk Reduction Standard Number 2).

Effective June 28, 1993

§335.556. Determination of Cleanup Levels for Risk Reduction Standard Number 2.

(a) For purposes of this risk reduction standard, cleanup levels for individual contaminants are represented by Texas or federal promulgated health-based standards, or, when these are not available or do not provide appropriate protection for human health or the environment, persons must develop cleanup levels based on procedures specified or referenced in this section for determining other numeric criteria, referred to as Medium Specific Concentrations (MSCs), and are required to perform any necessary adjustments to these numeric criteria. The MSCs address a single contaminant in a medium and consider one or more exposure pathways, specifically, water ingestion (Water MSC) and soil ingestion with inhalation of volatiles and particulates (Soil MSC). Where a contaminant in one medium has the potential to contaminate another medium, defined as cross-media contamination, additional numeric criteria are developed as cleanup levels (e.g., the soil-to-ground water contaminant pathway). To determine cleanup levels for contaminated media of concern, persons must perform the evaluations of subsections (b) - (e) of this section.

(b) In addition to the exposure pathways defined or referenced in this section, the person must evaluate other exposure pathways at or near the facility (e.g., dermal absorption, ingestion of contaminated fish, etc.) by which human populations (including sensitive subgroups) or environmental receptors (e.g., aquatic organisms, food-chain crops, etc.) are likely to be exposed to contaminants. If such evaluation indicates the need for additional remediation at the facility to adequately protect human health or environmental receptors, then the person shall develop numeric criteria by utilizing available guidance or scientific literature to serve in place of, or in addition to, cleanup levels determined pursuant to this section.

(c) The person must determine the appropriate exposure factors from §335.557 of this title (relating to Criteria for Selection of Non-Residential Soil Requirements for Risk Reduction Standard Number 2); and

(d) The person must calculate MSCs in accordance with §335.558 of this title (relating to Medium Specific Concentrations for Risk Reduction Standard Number 2); and

(e) The person must determine any cross-media requirements and modifications to cleanup levels in accordance with §335.559 of this title (relating to Medium Specific Requirements and Adjustments for Risk Reduction Standard Number 2).

Effective June 28, 1993

§335.557. Criteria for Selection of Non-Residential Soil Requirements for Risk Reduction Standard Number 2.

All facilities or areas shall be subject to the residential soil requirements unless one of the conditions of paragraphs (1) - (3) of this section is satisfied for use of the non-residential soil requirements.

(1) For property located within the jurisdictional area of a zoning authority, persons may provide documentation that the property is zoned for commercial or industrial use.

(2) For property not located within the jurisdictional area of a zoning authority, persons may provide documentation that the activities being conducted on the property satisfy the definition for non-residential property (§335.553 of this title (relating to Definitions)).

(3) For government-owned (local, state or federal) property which does not satisfy either of the conditions of subsections (a) or (b) of this section but does have non-residential activities occurring on all or portions of the property, the person may provide documentation that access will be restricted such that the exposure assumptions remain valid for the duration of government control.

Effective June 28, 1993

§335.558. Medium Specific Concentrations for Risk Reduction Standard Number 2.

(a) Medium specific concentrations (MSCs) for ingestion of surface water and ground water, and soil ingestion along with inhalation of volatiles and particulates are calculated according to the procedures specified in subsections (b) -(d) of this section based on residential exposure factors. MSCs are subject to additional numeric criteria and adjustments of §335.559 of this title (relating to Medium Specific Requirements and Adjustments for Risk Reduction Standard Number 2). The derivation of all equations is presented in §335.567 of this title (relating to Appendix I).

(b) For a contaminant which is a carcinogen, the MSC is the concentration which represents an excess upper bound lifetime cancer Target Risk (TR) of 0.000001 (also expressed as one (1) in one

million (1,000,000)) for Class A and B carcinogens, or 0.00001 (also expressed as one (1) in one hundred thousand (100,000)) for Class C carcinogens due to continuous lifetime exposure as calculated using the equations and factors listed in paragraphs (1) and (2) of this subsection.

(1) Water MSC for Ingestion, in units of milligrams per liter (mg/L):

$$MSC = \frac{85.16 (TR)}{Sf_o} \quad \text{Equation 1}$$

where

Sf_o is the chemical-specific oral cancer slope factor.

(2) Soil MSC for Ingestion with Inhalation of volatiles and particulates, in units of milligram per kilogram (mg/kg):

$$MSC = \frac{5110 (TR)}{[(7.98 \times 10^{-3}) \times SF_o] + (SF_i \times [(450/VF) + (9.72 \times 10^{-8})])} \quad \text{Equation 2}$$

where

VF is the chemical-specific soil-to-air volatilization factor.

(c) For a contaminant which is a systemic toxicant, the MSC is the concentration to which human populations (including sensitive subgroups) could be exposed by direct ingestion or inhalation on a daily basis without appreciable risk of deleterious effects during a lifetime. The MSC is calculated using the equations and factors listed in paragraphs (1) and (2) of this subsection.

(1) Water MSC for Ingestion in units of milligram per liter (mg/L):

$$MSC = 36.5 RfD_o \text{ mg/L} \quad \text{Equation 3}$$

where

RfD_o is the chemical-specific oral reference dose.

(2) Soil MSC for Ingestion with Inhalation of volatiles and particulates, in units of milligram per kilogram (mg/kg):

$$MSC = \frac{2190 \text{ mg/kg}}{[(7.98 \times 10^{-3}/RfD_o) + ((1/RfD_i) \times [(450/VF) + (9.72 \times 10^{-8})])]} \quad \text{Equation 4}$$

where

VF is the chemical-specific soil-to-air volatilization factor.

(d) Examples of unadjusted MSCs, standards and criteria are listed in §335.568 of this title (relating to Appendix II: "Examples of Medium Specific Concentrations, Standards and Criteria for Health-Based Closure/Remediation (31 TAC §335.558)". The commission will revise Appendix II on an annual basis to reflect newly promulgated standards and MSCs based on current toxicological data.

Effective June 28, 1993

§335.559. Medium Specific Requirements and Adjustments for Risk Reduction Standard Number 2.

(a) Numeric cleanup levels. The subsections (b) - (h) of this section specify requirements that can define or modify numeric cleanup levels such as MSCs or require non-health based criteria to be addressed.

(b) Surface water. In determining the necessity for remediation at the facility, persons shall utilize Chapter 307 of this title (relating to Texas Surface Water Quality Standards) or, if those values are not available, Maximum Contaminant Levels (MCLs) promulgated under the Safe Drinking Water Act, or if MCLs are not available or appropriate, MSCs based upon human ingestion of the water. Any discharge or release into or adjacent to surface water, including storm water runoff, occurring during or after attainment of Risk Reduction Standard Number 2, shall be compliant with the Texas Surface Water Quality Standards of Chapter 307 of this title and may be subject to the permitting requirements of Chapter 305 of this title (relating to Consolidated Permits) or other authorization from the commission.

(c) Air. In determining the necessity for remediation at the facility, persons shall observe limitations established by the National Ambient Air Quality Standards (NAAQS) and the National Emission Standards for Hazardous Air Pollutants (NESHAPS) as found in the 40 Code of Federal Regulations (CFR) Parts 50 and 61, respectively, and other applicable federal standards and guidelines of the EPA. Also, limitations established by the commission under the Texas Clean Air Act, the state implementation plan or other federal requirements must be observed. Permit requirements, limitations established by standard exemptions, or other requirements of the commission relative to atmospheric emissions and/or air quality may also apply.

(d) Groundwater. The groundwater cleanup levels shall be determined by a consideration of the following.

(1) For residential exposure, the concentration of a contaminant dissolved in groundwater must not exceed the MCL, if promulgated pursuant the Federal Safe Drinking Water Act, §141, otherwise the water MSC for ingestion determined pursuant to §335.556 of this title (relating to Determination of Cleanup Levels for Risk Reduction Standard Number 2). Phase-separated non-aqueous liquids released from the unit that is undergoing closure or remediation must be removed or decontaminated.

(2) For nonresidential exposure, the concentration of a contaminant dissolved in groundwater must not exceed the MCL if promulgated pursuant to the Federal Safe Drinking Water

Act, §141. If no MCL has been promulgated, the groundwater concentration shall not exceed the water MSC for ingestion determined pursuant to §335.556 of this title, which has been multiplied by a factor of 3.36 for carcinogens or 2.8 for systemic toxicants to account for lower ingestion rates associated with nonresidential worker exposure. Persons must be able to demonstrate that the quality of groundwater at the facility property boundary will be protective for residential exposure. Phase-separated non-aqueous liquids released from the unit that is undergoing closure or remediation must be removed or decontaminated to the extent practicable.

(3) For residential and non-residential exposure, if the groundwater at the facility or area has a naturally occurring background total dissolved solids concentration greater than 10,000 milligrams per liter, the cleanup level for a contaminant dissolved in this groundwater determined pursuant to paragraph (1) or (2) of this subsection, as appropriate, may be adjusted by multiplying by 100. The resulting value becomes the maximum concentration for groundwater for residential and non-residential exposure, respectively.

(4) The executive director may require the evaluation of additional exposure pathways or environmental receptors as part of the adjustment of paragraph (3) of this subsection.

(e) Soil. For all situations, concentrations of contaminants in soils must be protective of surface water, air, and groundwater as specified in subsections (b) - (d) of this section. No soil remaining in place shall exhibit the hazardous waste characteristics of ignitability, corrosivity, or reactivity as defined in 40 CFR Part 261, Subpart C. The sum of concentrations of the volatile organic compounds in vapor phase in soil shall not exceed 1,000 parts per million by weight or volume, as measured by EPA Test Method 8015 or calculated by using soil concentrations and Henry's Law constants.

(f) Residential soil requirements. In addition to the requirements of subsection (e) of this section, the concentration of a contaminant throughout the soil column (i.e., surface and subsurface soils) shall not exceed the lower of the soil MSC, based upon residential human ingestion of soil and inhalation of particulates and volatiles (as defined in the preceding section), and the residential soil-to-groundwater cross-media protection concentration, a numeric value which is determined as follows:

(1) a value which is 100 times the residential groundwater cleanup level determined by the procedures of subsection (d)(1) of this section. Examples of such values are listed in Appendix II; or

(2) a concentration in soil that does not produce a leachate in excess of MCLs or MSCs for groundwater when subjected to the Synthetic Precipitation Leaching Procedure, Method 1312 of SW 846, Test Methods for Evaluating Solid Waste, United States Environmental Protection Agency. Other test methods that more accurately simulate conditions at the facility may be used in the demonstration in place of this method, subject to prior approval of the executive director.

(g) Nonresidential soil requirements. Nonresidential soils shall conform to the requirements of subsection (e) of this section. The concentration of a contaminant in near-surface soils (i.e., within two feet of the land surface) shall not exceed the lower of the nonresidential soil MSC defined in paragraph

(1) of this subsection, based upon worker ingestion of soil and inhalation of particulates and volatiles, and the nonresidential soil-to-groundwater cross-media protection concentration defined in paragraph (2) of this subsection. In no event shall compliance be achieved with the surface soil criteria by applying two feet of clean soil onto the surface of a facility or area without prior approval from the executive director. The concentration of a contaminant in subsurface soils (i.e., greater than two feet in depth from the land surface) shall not exceed the nonresidential soil-to-groundwater cross-media protection concentration.

(1) Nonresidential soil MSC. The MSC is calculated using the equations and factors listed in subparagraphs (A) and (B) of this paragraph. The chemical-specific factors SF_o , SF_i , RfD_o , RfD_i , and VF are the same as for the soil MSCs of the preceding section. The derivation of all equations is presented in Appendix I.

(A) Carcinogenic effects equation, in units of milligram per kilogram (mg/kg):

$$MSC = \frac{286.16 (TR)}{[(5 \times 10^{-5}) \times SF_o] + (SF_i \times [(20/VF) + (4.3 \times 10^{-9})])]} \text{ mg/kg} \quad \text{Equation 5}$$

(B) Systemic toxicant effects equation, in units of milligram per kilogram (mg/kg):

$$MSC = \frac{102.2 \text{ mg/kg}}{[(5 \times 10^{-5}/RfD_o) + ((1/RfD_i) \times [(20/VF) + (4.3 \times 10^{-9})])]} \quad \text{Equation 6}$$

(2) Non-residential soil-to-ground water cross-media protection concentration. Persons must demonstrate that a contaminant in soil does not pose the potential for a future release of leachate in excess of the groundwater concentration considered to be protective for nonresidential worker exposure. Persons may make this demonstration by showing that a contaminant occurs in soil at less than the concentration described in either subparagraph (A) or (B) of this paragraph:

(A) a concentration which is 100 times the nonresidential groundwater cleanup level determined by the procedures of subsection(d)(2) or (3), as applicable, of this section.

(B) a concentration in soil that does not produce a leachate in excess of the groundwater concentration of this paragraph when subjected to the Synthetic Precipitation Leaching Procedure, Method 1312 of SW 846, Test Methods for Evaluating Solid Waste, U. S. Environmental Protection Agency. Other test methods that more accurately simulate conditions at the facility may be used in the demonstration in place of this method, subject to prior approval by the executive director.

(h) Other criteria. For contaminants that do not exceed standards or criteria protective of human health and environmental receptors as determined by the procedures of this section but otherwise adversely impact environmental quality, or the public welfare and safety, or present objectionable characteristics (e.g., taste, odor, etc.), or make a natural resource unfit for use, other scientifically valid published criteria may be utilized such as but not limited to threshold limit values for air and secondary maximum contaminant levels for water.

Adopted October 24, 2001

Effective November 15, 2001

§335.560. Post Closure Care and Deed Certification for Risk Reduction Standard Number 2.

(a) Provided that attainment of this risk reduction standard for the facility can be demonstrated to the executive director pursuant to §335.555 of this title (relating to Attainment of Risk Reduction Standard Number 2), the conditions of subsections (b) and (c) of this section apply.

(b) The person is required to place in the county deed records of the county or counties in which such activities take place the information specified in paragraphs (1) - (4) of this subsection. The statements should be worded such that a lay person can easily understand them. An example format is provided in §335.569 of this title (relating to Appendix III). Proof of deed certification of the required information shall be provided to the executive director in writing no later than 90 days after acceptance of the report required by §335.555(f) of this title (relating to Attainment of Risk Reduction Standard Number 2).

(1) A certification signed by the person, showing the person's full name and title, and stating that closure or remediation of the facility or area was carried out in accordance with a plan designed to meet §335.555 of this title (relating to Risk Reduction Standard Number 2), which mandates that the remedy be designed to eliminate substantial present and future risk, such that no post-closure care or engineering or institutional control measures are required to protect human health and the environment.

(2) A metes and bounds description of the portion or portions of the tract of land on which closure or remediation of industrial solid waste, municipal hazardous waste or contaminants was achieved.

(3) For a facility that satisfies the conditions of §335.557 of this title (relating to Criteria for Selection of Non-Residential Soil Requirements for Risk Reduction Standard Number 2) for use of non-residential soil requirements, a statement that current or future owners of the facility must undertake actions as necessary to protect human health and the environment in accordance with the rules of the commission.

(4) A statement that information and documents concerning the closure or remediation of the facility or area are available for inspection upon request at the Texas Water Commission. The statement shall further describe the jurisdiction of the Texas Water Commission to review the establishment of the final cleanup criteria.

(c) The person is released from post-closure care responsibilities upon acceptance by the executive director of the proof of deed certification required by subsection (b) of this section.

Effective June 28, 1993

§335.561. Attainment of Risk Reduction Standard Number 3: Closure/Remediation With Controls.

(a) Compliance with this standard is attained when, in the evaluation of the executive director, the person recommends the remedy which best achieves the requirements of subsections (b) - (d) of this section taking into consideration the evaluation factors of §335.562 of this title (relating to Remedy Evaluation Factors) and then following approval subsequently completes the remedy, submits the final report required by §335.553(b)(4) of this title (relating to Required Information), initiates any post-closure care required by §335.565 of this title (relating to Post closure care required for Risk Reduction Standard Number 3) and completes the deed recordation requirements of §335.566 of this title (relating to Deed Recordation for Risk Reduction Standard Number 3).

(b) A remedy must be permanent or, if that is not practicable, achieve the highest degree of long-term effectiveness possible;

(c) A remedy must be cost-effective in that it achieves the best balance between long-term effectiveness and cost for alternative remedies which meet the cleanup objectives for a facility; and

(d) A remedy must achieve media cleanup requirements as specified pursuant to §335.563 of this title (relating to Media Cleanup Requirements for Risk Reduction Standard Number 3).

Effective June 28, 1993

§335.562. Remedy Evaluation Factors for Risk Reduction Standard Number 3.

(a) General. For closure/remediation in accordance with Risk Reduction Standard Number 3, persons shall consider the evaluation factors set forth in subsections (b) - (g) of this section when evaluating the relative abilities and effectiveness of potential remedies to achieve the requirements for remedies described in §335.561 of this title (relating to Attainment of Risk Reduction Standard Number 3). A description of the evaluation for these factors for the proposed remedy shall be included in the corrective measure study prepared pursuant to §335.553 (b) (3) of this title (relating to Required Information). Persons performing these evaluations shall submit to the executive director upon request such additional information as may reasonably be required to enable the executive director to determine whether such evaluation has been conducted in a manner compliant with this section.

(b) Compliance with other laws and regulations. Remedies shall be evaluated to determine attainment of cleanup requirements for other Texas or federal environmental laws which are either legally applicable to the facility or that address problems or situations that are sufficiently similar to those encountered at the facility that their use is well suited to the facility.

(c) Long-term effectiveness and permanence. Remedies shall be evaluated for long-term effectiveness. Factors that shall be considered in this evaluation include:

(1) Magnitude of risks remaining after completion of the closure or remedial action;

(2) The type, degree and duration of post-closure care required including but not limited to operation and maintenance, monitoring, inspections and reports and their frequencies, or other activities which will be necessary to protect human health and the environment;

(3) Potential for exposure of humans and environmental receptors to contaminants remaining at the facility;

(4) Long-term reliability of any engineering and voluntary institutional controls; and

(5) Potential need for replacement of components of the remedy.

(d) Reduction of toxicity, mobility, or volume. Remedies shall be evaluated to determine the degree to which treatment could be used to significantly and irreversibly reduce the toxicity, mobility or volume of contaminants. Factors to be considered in this evaluation include:

(1) The amount of contaminants that will be treated or destroyed;

(2) The degree of expected reduction in toxicity, mobility, or volume;

(3) The type, quantity, toxicity, and mobility of contaminants remaining after treatment; and

(4) The degree to which the treatment is irreversible.

(e) Short-term effectiveness. The short-term effects of remedies shall be evaluated considering the following:

(1) Short-term risks that might be posed to the community, workers, or the environment during implementation of the remedy and the effectiveness and reliability of protective measures; and

(2) Time until protection is achieved.

(f) Implementability. The ease or difficulty of implementing the remedies shall be evaluated by considering the following types of factors:

(1) Degree of difficulty associated with constructing the remedy;

(2) Expected operational reliability of the remedy;

(3) Availability of necessary equipment and specialists;

(4) Available capacity and location of needed treatment, storage, and disposal services.

(g) Cost. The types of costs that shall be evaluated include the following:

(1) Capital costs;

(2) Operation and maintenance costs; and

- (3) Net present value of capital and operation and maintenance costs.

Effective June 28, 1993

§335.563. Media Cleanup Requirements for Risk Reduction Standard Number 3.

(a) General. For closure/remediation in accordance with Risk Reduction Standard Number 3, persons shall propose media cleanup levels in accordance with the conditions set forth in subsections (b) - (j) of this section.

(b) Carcinogens. For known or suspected carcinogens, media cleanup levels shall be established at concentrations which represent an excess upperbound lifetime risk of between one in 10,000 and one in one million. The executive director will use one in one million as a goal in establishing such concentration limits. The cumulative excess risk to exposed populations (including sensitive subgroups) shall not be greater than one in 10,000.

(c) Systemic toxicants. For systemic toxicants, media cleanup levels shall represent concentrations to which the human population (including sensitive subgroups) could be exposed on a daily basis without appreciable risk of deleterious effect during a lifetime or part of a lifetime and where:

- (1) the hazard quotient, which is the ratio of a single systemic toxicant exposure level for a specified time period to a reference dose for that systemic toxicant derived from the same time period, shall not exceed one; and

- (2) the hazard index shall not exceed one. The hazard index is the sum of the hazard quotients for a single or multiple systemic toxicants which affect the same target organ or act by the same method of toxicity and act through a single or multiple media exposure pathways.

(d) Additional considerations. In establishing media cleanup levels pursuant to subsections (b) and (c) of this section, the executive director may consider and may direct persons who submit plans or reports in accordance with §335.553(b) of this title (relating to Required Information) to address the following:

- (1) multiple contaminants in a medium;
- (2) exposure to multiple contaminated media;
- (3) reasonable expected future exposure conditions at the facility; and

- (4) the technical limitations, effectiveness, practicability, or other relevant features of available remedies.

(e) Standard exposure factors. In determining media cleanup levels pursuant to subsections (b) and (c) of this section, persons shall use the standard exposure factors for residential use of the facility

as set forward in Table 1 (located in §335.553 of this title) unless the person documents to the satisfaction of the executive director that:

(1) site-specific data warrant deviation from the standard exposure factors; or

(2) a land use other than residential is more appropriate based on:

(A) historical, current, and probable future land use; and

(B) effectiveness of institutional or legal controls placed on the future use of the land.

(f) Air. Media cleanup levels for air will be established to meet the lowest of the values determined by the requirements of paragraphs (1) - (3) of this subsection.

(1) Concentrations of contaminants in air that emanate from a facility, area of soil contamination, or plume of contaminated groundwater shall not exceed:

(A) National Ambient Air Quality Standards (NAAQS), National Emission Standards for Hazardous Air Pollutants (NESHPAS) (as found in 40 Code of Federal Regulation Parts 50 and 61 respectively) and other applicable federal standards and guidelines of the Environmental Protection Agency; and

(B) concentrations established by the commission under the Texas Clean Air Act, the state implementation plan, or other federal requirements. Permit requirements, limitations established by standard exemptions, or other requirements relative to atmospheric emissions and/or air quality may also apply.

(2) For residential exposure conditions, concentrations of contaminants in air that emanate from a facility, area of soil contamination, or plume of contaminated ground water shall not exceed concentrations that satisfy subsections (b) - (e) of this section at exposure points located both within the contaminated area and at the property boundary.

(3) For nonresidential exposure conditions, concentrations of contaminants in air that emanate from a facility, area of soil contamination, or plume of contaminated groundwater shall not exceed either OSHA permissible exposure limits, threshold limit values or other criteria applicable to an industrial exposure setting within the facility boundaries or concentrations that satisfy subsections (b) - (e) of this section at the property boundary.

(g) Surface water. In determining the necessity for remediation at the facility, persons shall utilize Chapter 307 of this title (relating to Texas Surface Water Quality Standards) or, if those values are not available, maximum contaminant levels (MCLs) promulgated under the Safe Drinking Water Act or, if MCLs are not available or appropriate, values calculated pursuant to subsections (b) - (e) of this section based upon human ingestion of the water or other site-specific exposure pathway. Any discharge or release into or adjacent to surface water, including storm water runoff, occurring during or

after attainment of Risk Reduction Standard Number 3, shall be compliant with Chapter 307 of this title and may be subject to the permitting requirements of Chapter 305 of this title (relating to Consolidated Permits) or other authorization from the commission.

(h) Groundwater. Media cleanup levels for groundwater that is a current or potential source of drinking water as defined in paragraph (1) of this subsection shall not exceed MCLs promulgated under the Safe Drinking Water Act or, if MCLs are not available, values calculated according to subsections (b) - (e) of this section based upon human ingestion of the water. Cleanup levels for groundwater may be subject to the modifications of paragraphs (2) - (4) of this subsection.

(1) Groundwater that has a background total dissolved solids (TDS) content less than or equal to 10,000 milligrams per liter (mg/L) and that occurs within a geologic zone that is sufficiently permeable to transmit water to a pumping well in usable quantities shall be considered a current or potential source of drinking water for the purpose of determining cleanup levels.

(2) The cleanup levels shall be achieved throughout the plume of contaminated groundwater, with the exception of the circumstances described in subparagraphs (A) - (C) of this paragraph:

(A) when alternate concentration limits of §335.160(b) of this title (relating to Alternate Concentration Limits) have been approved in a permit issued by the commission for a hazardous waste management facility;

(B) when the selected remedy calls for waste to be left in place and when appropriate control measures are installed or operated, the executive director may authorize the zone underlying the area encompassing the original source(s) of release to be excluded from this requirement;

(C) when the person documents to the executive director's satisfaction pursuant to subsection (e) of this section that a future land use other than residential is appropriate for the facility or area and further demonstrates that institutional or legal controls will effectively prevent use of the contaminated groundwater, the extent of plume remediation may be determined in a manner consistent with §335.160(b) of this title.

(3) The executive director may determine that remediation of groundwater to the extent required in paragraphs (1) or (2) of this subsection is not necessary if the person demonstrates to the executive director's satisfaction that:

(A) the contaminant is present in groundwater that is not a current or potential source of drinking water and the contaminated groundwater is not hydraulically connected with and is not likely to migrate to either surface water or to groundwater that is a current or potential source of drinking water; or

(B) restoration of the groundwater to these levels is technically impracticable.

(4) If a determination is made pursuant to paragraph (3) of this subsection, the executive director may require any alternative measures or cleanup levels that are necessary to protect human health and the environment. At a minimum, for all cases described in this subsection, phase-separated non-aqueous liquids shall be removed from groundwater zones to the extent practicable.

(i) Soil. Concentrations of contaminants in soil shall not exceed the following values:

(1) the values calculated pursuant to subsections (b) - (d) of this section based upon human ingestion of the soils at all points where direct contact exposure to the soils may occur; and

(2) values which will allow the air, surface water, and groundwater cleanup levels specified in subsections (f) - (h) of this section, respectively, to be maintained over time taking into account the effects of engineering controls.

(A) Such determinations shall be based on sound scientific principles including fate and transport evaluation of contaminant migration. Procedures and conclusions shall be documented to the satisfaction of the executive director.

(B) The executive director may require the evaluation of additional migration pathways beyond those listed in this section if determined necessary. Such additional pathways may include but are not limited to, food chain contamination, impairment of soil for agricultural purposes, phytotoxicity, accumulations of contaminants in sediment of surface water bodies, or other impairments of natural resources, land, or water use.

(j) Other adjustments. Cleanup levels may be adjusted according to paragraphs (1) - (3) of this subsection.

(1) If the practical quantitation limit (PQL) or the background concentration (represented by results of analyses of samples taken from media that are not affected by waste management or industrial activities) for a contaminant is greater than the cleanup level determined by procedures of this section, then the greater of the PQL or background shall become the cleanup level.

(2) Other scientifically valid published criteria, such as, but not limited to threshold limit values for air and secondary maximum contaminant levels for water, shall be utilized as cleanup levels for contaminants for which the procedures of this section are not appropriate (e.g., mixtures or substances that do not have toxicological data) or that do not exceed standards or criteria protective of human health as determined by the procedures of this section but otherwise adversely impact environmental quality, or the public welfare and safety, or present objectionable characteristics (e.g., taste, odor, etc.), or make a natural resource unfit for use.

(3) More stringent cleanup levels may be established for a facility than are specified in this section if, by utilizing available guidance or scientific literature, the executive director determines that it is necessary to protect environmental receptors.

§335.564. Post Closure Care not required for Risk Reduction Standard Number 3.

In cases under Risk Reduction Standard Number 3 where the executive director determines that neither engineering nor institutional control measures are required to protect human health and the environment, the person is released from post closure care responsibilities but is required to deed record the facility in accordance with §335.566 of this title (relating to Deed Recordation for Risk Reduction Standard Number 3).

Effective June 28, 1993

§335.565. Post closure care required for Risk Reduction Standard Number 3.

In cases under Risk Reduction Standard Number 3 where the executive director determines that either engineering or institutional control measures are required to protect human health and the environment, the person shall comply with the requirements of paragraphs (1) and (2) below, as applicable, and deed record the facility in accordance with §335.566 of this title (relating to Deed Recordation for Risk Reduction Standard Number 3).

(1) Carry out the post-closure requirements as evaluated and approved by the remedy evaluation process described in §335.562 of this title (relating to Remedy Evaluation Factors).

(2) For hazardous waste storage, processing or disposal facilities, the person must also satisfy the applicable requirements of Subchapters E and F of this chapter (relating to Interim Standards for Hazardous Waste Storage, Processing, or Disposal Facilities; and Permitting Standards for Owners and Operators of Hazardous Waste Storage, Processing, or Disposal Facilities, respectively).

Effective June 28, 1993

§335.566. Deed Recordation for Risk Reduction Standard Number 3.

(a) Within 90 days after acceptance by the executive director of the final report referenced in §335.561(a) of this title (relating to Attainment of Risk Reduction Standard Number 3), the person must record in the county deed records of the county or counties in which such activities take place the information specified in subsections (b) - (e) of this section and submit written proof of such recordation to the executive director. The statements should be worded such that a lay person can easily understand them. An example format is provided in §335.569 of this title (relating to Appendix III).

(b) A certification, signed by the person, showing the person's full name and title, and stating: that remediation of the facility or area was carried out in accordance with a plan designed to meet §335.561 of this title (relating to Risk Reduction Standard Number 3), which mandates that the remedy be designed to eliminate or reduce to the maximum extent practicable, substantial present and future risk; and whether continued post-closure care or engineering or institutional control measures ("Post-Closure Measures") are required to protect human health and the environment together with a description of any required Post-Closure Measures;

(c) A description of any institutional or legal controls placed by the person on the future use of the property. The notice shall indicate that the current or future owner must undertake actions as necessary to protect human health and the environment in accordance with the rules of the commission.

(d) A metes and bounds description of the portion or portions of the tract of land on which closure or remediation of industrial solid waste, municipal hazardous waste or contaminants was achieved; and

(e) A statement that information and documents concerning the closure or remediation of the facility or area are available for inspection upon request at the Texas Water Commission. The statement shall further describe the jurisdiction of the Texas Water Commission to review the establishment of the final cleanup criteria.

Effective June 28, 1993

§335.567. Appendix I.

Derivation of Reduced Equations for Calculation of Medium Specific Concentrations of Risk Reduction Standard Number 2.

Equation 1 - MSC for Ingestion of Water; Carcinogenic Effects:

$$\text{MSC} = \frac{85.16 \text{ TR}}{\text{Sf}_o}$$

is derived from the following expression:

$$\text{MSC} = \frac{\text{TR} \times \text{BW} \times \text{AT}_c \times 365 \text{ days/yr}}{\text{Sf}_o \times \text{IR}_w \times \text{EF} \times \text{ED} \times \text{A}}$$

Equation 2 - MSC for Ingestion of Soils and Inhalation of Volatiles and Particulates; Residential Scenario; Carcinogenic Effects:

$$\text{MSC} = \frac{5110 \text{ TR}}{[(7.98 \times 10^{-3}) \times \text{SF}_o] + (\text{SF}_i \times [(450/\text{VF}) + (9.72 \times 10^{-8})])}$$

is derived from the following expression:

$$\text{MSC} = \frac{\text{TR} \times \text{BW} \times \text{AT}_c \times 365 \text{ days/yr}}{\text{EF} [(\text{BW} \times \text{SF}_o \times 10^{-6} \text{ Kg/mg} \times \text{IF}_{\text{soil/adj.}}) + (\text{SF}_i \times \text{ED} \times \text{IR}_{\text{air}} \times [1/\text{VF} + 1/\text{PEF}])]}$$

Equation 3 - MSC for Ingestion of Water; Systemic Toxicant Effects:

$$MSC = 36.5 RfD_o$$

is derived from the following expression:

$$MSC = \frac{THI \times RfD_o \times BW \times AT_s \times 365 \text{ days/yr}}{I_r_w \times EF \times ED \times A}$$

Equation 4 - MSC for Ingestion of Soils and Inhalation of Volatiles and Particulates; Residential Scenario; Systemic Toxicant Effects:

$$MSC = \frac{2190}{[(7.98 \times 10^{-3}/RfD_o) + ((1/RfD_i) \times [(450/VF) + (9.72 \times 10^{-8})])]}$$

is derived from the following expression:

$$MSC = \frac{THI \times BW \times AT_s \times 365 \text{ days/yr}}{EF [(1/RfD_o) \times BW \times 10^{-6} \text{ Kg/mg} \times I_{F_{soil/adj}}] + ((1/RfD_i) \times ED \times I_{R_{air}} [1/VF + 1/PEF])]}$$

Equation 5 - MSC for Worker Ingestion of Soils and Inhalation of Volatiles and Particulates; Carcinogenic Effects:

$$MSC = \frac{286.16 \text{ TR}}{[(5 \times 10^{-5}) \times SF_o] + (SF_i \times [(20/VF) + (4.3 \times 10^{-9})])]}$$

is derived from the following expression:

$$MSC = \frac{TR \times BW \times AT_c \times 365 \text{ days/yr}}{EF \times ED \times [(SF_o \times 10^{-6} \text{ Kg/mg} \times I_{R_{soil}}) + (SF_i \times I_{R_{air}} \times [1/VF + 1/PEF])]}$$

Equation 6 - MSC for Worker Ingestion of Soils and Inhalation of Volatiles and Particulates; Systemic Toxicant Effects:

$$MSC = \frac{102.2}{}$$

$$[(5 \times 10^{-5}/RfD_o) + ((1/RfD_i) \times [(20/VF) + (4.3 \times 10^{-9})])]$$

is derived from the following expression:

$$MSC = \frac{THI \times BW \times AT_s \times 365 \text{ days/yr}}{EF \times ED \times [((1/RfD_o) \times 10^{-6} \text{ Kg/mg} \times IR_{soil}) + ((1/RfD_i) \times IR_{air} \times (1/VF + 1/PEF))]$$

VF: Parameters, Definitions and Values for the Soil to
 Air Volatilization Factor

$$VF(m^3/kg) = \frac{(LS \times V \times DH)}{A} \times \frac{(3.14 \times \alpha \times T)^{1/2}}{(2 \times D_{ei} \times E \times K_{as} \times 10^{-3} \text{ kg/g})}$$

SITE DATA/DEFAULT FACTORS:

LS	Length of contaminated area (m)	=	45
E	true soil porosity (unitless)	=	0.35
V	wind speed in mixing zone (m/s)	=	2.25
ps	true soil density (g/cm ³)	=	2.65
DH	diffusion height (m)	=	2
T	exposure interval (s)	=	7.90e+08
A	area of contamination (cm ²)	=	2.03e+07
OC	organic carbon content, soil fraction (unitless)	=	0.02

CHEMICAL SPECIFIC DATA:

D _i	Molecular Diffusivity (cm ² /s).
H	Henry's Law Constant (atm-m ³ /mol).
K _{oc}	Organic Carbon Partition Coefficient (cm ³ /g).
D _{ei}	Effective Diffusivity (cm ² /sec), calculated from D _i X E ^{0.33} .
K _d	Soil-water partition coefficient (cm ³ /g), calculated from K _{oc} X OC.

$$\alpha \quad \text{Alpha, (cm}^2\text{/s)} = \frac{(\text{Dei X E})}{E + (\text{p}_s)(1-\text{E})/\text{K}_{\text{as}}}$$

K_{as} Soil/air partition coefficient (g soil/cm³ air). Calculated from $\text{K}_{\text{as}} = (\text{H/Kd}) \times 41$.

Parameters, Definitions and Values used in Equations 1 - 6 are displayed in the following table:

Parameters	Definitions (Units)	Values
MSC	Medium Specific Concentration (mg/Kg)	chemical-specific
TR	Target excess individual lifetime cancer risk (unitless)	10 ⁻⁶ for Class A and B carcinogens; 10 ⁻⁵ for Class C carcinogens
	Target hazard index (unitless)	1
THI	Oral cancer slope factor ((mg/Kg-day) ⁻¹)	chemical-specific
SF _o	Inhalation cancer slope factor ((mg/Kg-day) ⁻¹)	chemical-specific
SF _i	Oral chronic reference dose (mg/Kg-day)	chemical-specific
	Inhalation chronic reference dose (mg/Kg-day)	chemical-specific
RfD _o	Adult body weight (Kg)	70 Kg
	Averaging time for carcinogens (yr)	chemical-specific
RfD _i	Averaging time for systemic toxicants (yr)	70 yr
BW	Exposure frequency (days/yr)	70 yr
AT _c	Exposure duration (yr)	30 yr residential 25 yr worker
AT _s	Daily water ingestion rate (liter/day)	350 residential 250 worker
EF	Workday soil ingestion rate (mg/day)	30 yr residential 25 yr worker
ED	Age-adjusted ingestion factor (mg-yr/Kg-day)	2 l/day residential 1 l/day worker
IR _w	Daily indoor inhalation rate (m ³ /day)	50 mg/day
IR _{soil}	Particulate emission factor (m ³ /Kg)	114 mg-yr/Kg-day
IF _{soil/adj}	Soil-to-air volatilization factor	15 m ³ /day residential 20 m ³ /8 hr day worker
	Absorption factor	4.63 x 10 ⁹ m ³ /Kg
IR _{air}		chemical-specific
PEF		1
VF		
A		

Reference: U.S. EPA, OSWER Directive 9285.7-01B, Dec. 13, 1991, Human Health Evaluation Manual, Part B: "Development of Risk-based Preliminary Remediation Goals"

Effective June 28, 1993

§335.568. Appendix II.

Examples of Medium-Specific Concentrations, Standards and Criteria for Health-Based Closure/Remediation (See §335.558 of this title (relating to Medium Specific Concentration of Risk Reduction Standards Number 2.))

CAS #	=	Chemical Abstracts Service Number for the Specific Compound.
GW	=	Ground Water. Maximum Concentration in Ground Water (mg/L) for residential exposure conditions.
GWP-Res	=	Ground-Water Protection Standard for Residential Use. Concentration in Residential Soil Assumed Protective of Ground Water Considering Cross-media Contamination of Ground Water from Contaminated Soil (mg/kg).
GWP-Ind	=	Ground-Water Protection Standard for Industrial Use. Concentration in Industrial Soil Assumed Protective of Ground Water Considering Cross-media Contamination of Ground Water from Contaminated Soil (mg/kg).
SAI-Res	=	Soil/Air and Ingestion Standard for Residential Use. Maximum Concentration in Residential Soil Considering Cross-media Contamination of Air and the Human Ingestion and Inhalation Pathways (mg/kg).
SAI-Ind	=	Soil/Air and Ingestion Standard for Industrial Use. Maximum Concentration in Industrial Soil Considering Cross-media Contamination of Air and the Human Ingestion and Inhalation Pathways (mg/kg).

CONSTITUENT	CAS #	GW (1-4)	GWP-R es (1,5)	GWP-I nd (1,6)	SAI-R es (1,7,10,11)	SAI-I nd (1,8,10,11)
Acenaphthene	83-32-9	2.19e+00	2.19e+02	6.13e+02	1.34e+04 (13)	4.43e+04 (13)
Acetone	67-64-1	3.65e+00	3.65e+02	1.02e+03	3.82e+03 (13)	4.16e+03 (13)
Acetonitrile	75-05-8	2.19e-01	2.19e+01	6.13e+01	1.65e+03	1.23e+04
Acetophenone	98-86-2	3.65e+00	3.65e+02	1.02e+03	2.26e+04	8.15e+04
Acrolein	107-02-8	7.30e-01 (12)	7.30e+01	2.04e+02	1.56e+03 (12)	2.04e+04 (12)
Acrylamide	79-06-1	1.89e-05	1.89e-03	6.36e-03	1.42e-01	1.27e+00
Acrylonitrile	107-13-1	1.58e-04	1.58e-02	5.30e-02	1.15e-01 (13)	1.44e-01 (13)
Alachlor	15972-60-8	2.00e-03 (9)	2.00e-01	2.00e-01	7.95e+00	7.10e+01
Aldicarb	116-06-3	3.00e-03 (9)	3.00e-01	3.00e-01	5.49e+01	4.09e+02
Aldicarb Sulfone	1646-88-4	2.00e-03 (9)	2.00e-01	2.00e-01	8.23e+01	6.13e+02
Aldicarb Sulfoxide	1646-88-3	4.00e-03 (9)	4.00e-01	4.00e-01	5.49e+01	4.09e+02

CONSTITUENT	CAS #	GW (1-4)	GWP-R (1,5)	GWP-I (1,6)	SAI-R (1,7)	SAI-I (1,8)
Aldrin	309-00-2	5.01e-06	5.01e-04	1.68e-03	3.77e-02	3.36e-01
Aluminum Phosphide	20859-73-8	1.46e-02	1.46e+00	4.09e+00	1.10e+02	8.18e+02
Aniline	62-53-3	1.49e-02	1.49e+00	5.02e+00	4.18e (13) -02	4.80e (13) -02
Anthracene	120-12-7	1.10e+01	1.10e+03	3.07e+03	5.91e (13) +04	1.51e (13) +05
Antimony	7440-36-0	6.00e (9) -03	6.00e-01	6.00e-01	1.10e+02	8.18e+02
Arsenic	7440-38-2	5.00e (9) -02	5.00e+00	5.00e+00	3.66e-01	3.27e+00
Atrazine	1912-24-9	3.00e (9) -03	3.00e-01	3.00e-01	2.88e+01	2.58e+02
Barium (ionic)	7440-39-3	2.00e (9) +00	2.00e+02	2.00e+02	1.91e+04	1.37e+05
Benzene	71-43-2	5.00e (9) -03	5.00e-01	5.00e-01	1.33e (13) +00	1.62e (13) +00
Benzidine	92-87-5	3.70e-07	3.70e-05	1.24e-04	2.78e-03	2.49e-02
Beryllium	7440-41-7	4.00e (9) -03	4.00e-01	4.00e-01	1.49e-01	1.33e+00

CONSTITUENT	CAS #	GW (1-4)	GWP-R (1,5)	GWP-I (1,6)	SAI-R (1,7)	SAI-I (1,8)
Biphenyl	92-52-4	1.83e+00	1.83e+02	5.11e+02	6.68e (13)+03	1.11e (13)+04
Bis (2-chloro-ethyl) ether	111-44-4	7.74e-05	7.74e-03	2.60e-02	2.20e (13)-01	3.77e (13)-01
Bis (2-chloroisopropyl) ether	39638-32-9	1.22e-02	1.22e+00	4.09e+00	4.50e (13)+01	9.05e (13)+01
Bis (2-ethyl-hexyl) phthalate	117-81-7	6.08e-03	6.08e-01	2.04e+00	4.57e+01	4.09e+02
Bromodichloromethane	75-27-4	1.00e (9)-01	1.00e+01	1.00e+01	7.19e (13)-01	9.46e (13)-01
Bromoform	75-25-2	1.00e (9)-01	1.00e+01	1.00e+01	8.11e+01	7.24e+02
Bromomethane	74-83-9	5.11e-02	5.11e+00	1.43e+01	2.44e (13)+01	2.47e (13)+01
Butyl-4,6-dinitrophenol, 2-sec-	88-85-7	3.65e-02	3.65e+00	1.02e+01	2.74e+02	2.04e+03
Cadmium	7440-43-9	5.00e (9)-03	5.00e-01	5.00e-01	1.37e+02	1.02e+03
Carbofuran	1563-66-2	4.00e (9)-02	4.00e+00	4.00e+00	1.37e+03	1.02e+04

CONSTITUENT	CAS #	GW (1-4)	GWP-R es (1,5)	GWP-I nd (1,6)	SAI-R es (1,7,10,11)	SAI-I nd (1,8,10,11)
Carbon Disulfide	75-15-0	3.65e +00	3.65e +02	1.02e +03	2.45e (13) +01	2.34e (13) +01
CarbonTetrachloride	56-23-5	5.00e (9) -03	5.00e -01	5.00e -01	4.14e (13) -01	5.13e (13) -01
Chlordane	57-74-9	2.00e (9) -03	2.00e -01	2.00e -01	4.93e -01	4.40e +00
Chloroanaline, p-	106-47-8	1.46e -01	1.46e +01	4.09e +01	1.10e +03	8.18e +03
Chlorobenzene	108-90-7	1.00e (9) -01	1.00e +01	1.00e +01	2.56e (13) +02	2.56e (13) +02
Chlorobenzilate	510-15-6	7.30e -01	7.30e +01	2.04e +02	5.49e +03	4.09e +04
Chloroethane (Ethylchloride)	75-00-3	7.30e -01	7.30e +01	2.04e +02	4.99e (13) +03	2.30e (13) +04
Chloroform	67-66-3	1.00e (9) -01	1.00e +01	1.00e +01	4.37e (13) -01	5.04e (13) -01
Chloronaphthalene, 2-	91-58-7	2.92e +00	2.92e +02	8.18e +02	2.20e +04	1.64e +05
2-chlorophenol	95-57-8	1.83e -01	1.83e +01	5.11e +01	1.37e +03	1.02e +04
Chromium (total)	7440-47-3	1.00e (9) -01	1.00e +01	1.00e +01	3.91e (12) +02	5.11e (12) +03

CONSTITUENT	CAS #	GW (1-4)	GWP-R (1,5)	GWP-I (1,6)	SAI-R (1,7)	SAI-I (1,8)
Chromium (VI)	7440-47-3	1.00e (9) -01	1.00e +01	1.00e +01	3.91e (12) +02	5.11e (12) +03
Cresol, m-	108-39-4	1.83e (12) +00)	1.83e +02	5.11e +02	3.91e (12) +03	5.11e (12) +04
Cresol, o-	95-48-7	1.83e (12) +00)	1.83e +02	5.11e +02	3.91e (12) +03	5.11e (12) +04
Cresol, p-	106-44-5	1.83e (12) +00)	1.83e +02	5.11e +02	3.91e (12) +03	5.11e (12) +04
Cyanide	57-12-5	2.00e (9) -01	2.00e +01	2.00e +01	5.49e +03	4.09e +04
DDD	72-54-8	3.55e -04	3.55e -02	1.19e -01	2.67e +00	2.38e +01
DDE	72-55-9	2.50e -04	2.50e -02	8.41e -02	1.88e +00	1.68e +01
DDT	50-29-3	2.50e -04	2.50e -02	8.41e -02	1.88e +00	1.68e +01
Di-n-butyl phthalate	84-74-2	3.65e +00	3.65e +02	1.02e +03	2.74e +04	2.04e +05
Di-n-octyl phthalate	117-81-7	7.30e -01	7.30e +01	2.04e +02	5.49e +03	4.09e +04
Dibromo-3-chloropropane, 1,2-	96-12-8	2.00e (9) -04	2.00e -02	2.00e -02	4.57e -01	4.09e +00

CONSTITUENT	CAS #	GW (1-4)	GWP-R (1,5)	GWP-I (1,6)	SAI-R (1,7)	SAI-I (1,8)
Dibromochloromethane	124-48-1	1.00e (9) -01	1.00e +01	1.00e +01	7.62e +01	6.81e +02
Dichlorobenzene (1,2)	95-50-1	6.00e (9) -01	6.00e +01	6.00e +01	6.69e (13) +03	8.39e (13) +03
Dichlorobenzene (1,3)	541-73-1	6.00e (9) -01	6.00e +01	6.00e +01	7.61e (13) +03	9.99e (13) +03
Dichlorobenzene (1,4)	106-46-7	7.50e (9) -02	7.50e +00	7.50e +00	8.64e (13) +01	1.38e (13) +02
Dichlorodifluoromethane	75-71-8	7.30e +00	7.30e +02	2.04e +03	5.00e (13) +01	4.79e (13) +01
Dichloroethane (1,1)	75-34-3	3.65e +00	3.65e +02	1.02e +03	7.30e (13) +03	2.04e (13) +04
Dichloroethane (1,2)	107-06-2	5.00e (9) -03	5.00e -01	5.00e -01	4.17e (13) -01	5.05e (13) -01
Dichloroethylene (1,1)	75-35-4	7.00e (9) -03	7.00e -01	7.00e -01	7.15e (13) -01	8.72e (13) -01
Dichloroethylene, cis-(1,2)	156-59-2	7.00e (9) -02	7.00e +00	7.00e +00	1.08e (13) +02	1.08e (13) +02
Dichloroethylene, trans-(1,2)	156-60-5	1.00e (9) -01	1.00e +01	1.00e +01	2.56e (13) +02	2.56e (13) +02
Dichlorophenol, 2,4-	120-83-2	1.10e -01	1.10e +01	3.07e +01	8.23e +02	6.13e +03

CONSTITUENT	CAS #	GW (1-4)	GWP-R (1,5)	GWP-I (1,6)	SAI-R (1,7)	SAI-I (1,8)
Dichlorophenoxyacetic acid, 2,4-	94-75-7	7.00e (9) -02	7.00e +00	7.00e +00	2.74e +03	2.04e +04
Dichloropropane (1,2)	78-87-5	5.00e (9) -03	5.00e -01	5.00e -01	6.88e (13) -01	8.43e (13) -01
Dieldrin	60-57-1	5.32e -06	5.32e -04	1.79e -03	4.00e -02	3.57e -01
Diethyl phthalate	84-66-2	2.92e +01	2.92e +03	8.18e +03	2.20e +05	NHHB (16)
Diethylhexyl adipate	103-23-1	5.00e (9) -01	5.00e +01	5.00e +01	5.34e +03	4.77e +04
Dimethoate	60-51-5	7.30e -03	7.30e -01	2.04e +00	5.49e +01	4.09e +02
Dimethyl phenol, 2,4-	105-67-9	7.30e -01	7.30e +01	2.04e +02	5.49e +03	4.09e +04
Dinitrobenzene, 1,3-	99-65-0	3.65e -03	3.65e -01	1.02e +00	2.74e +01	2.04e +02
Dinitrophenol, 2,4-	51-28-5	7.30e -02	7.30e +00	2.04e +01	5.49e +02	4.09e +03
Dioxane (1,4)	123-91-1	7.74e -03	7.74e -01	2.60e +00	1.55e (13) +01	2.31e (13) +01
Diphenylamine	122-39-4	9.13e -01	9.13e +01	2.56e +02	6.86e +03	5.11e +04

CONSTITUENT	CAS #	GW (1-4)	GWP-R (1,5)	GWP-I (1,6)	SAI-R (1,7)	SAI-I (1,8)
Diphenylhydrazine, 1,2-	122-66-7	1.06e-04	1.06e-02	3.58e-02	8.00e-01	7.15e+00
Disulfoton	298-04-4	1.46e-03	1.46e-01	4.09e-01	1.10e+01	8.18e+01
Endosulfan	115-29-7	1.83e-03	1.83e-01	5.11e-01	1.37e+01	1.02e+02
Endothall	145-73-3	1.00e (9) -01	1.00e +01	1.00e +01	5.49e +03	4.09e +04
Endrin	72-20-8	2.00e (9) -03	2.00e -01	2.00e -01	8.23e +01	6.13e +02
Ethoxy ethanol, 2-	110-80-5	1.46e +01	1.46e +03	4.09e +03	1.10e +05	8.17e +05
Ethoxyethanol acetate, 2-	111-15-9	1.10e +01	1.10e +03	3.07e +03	8.23e +04	6.13e +05
Ethyl benzene	100-41-4	7.00e (9) -01	7.00e +01	7.00e +01	1.14e (13) +04	1.70e (13) +04
Ethylene dibromide	106-93-4	5.00e (9) -05	5.00e -03	5.00e -03	7.09e (13) -03	4.53e (13) -02
Ethylene glycol	107-21-1	7.30e +01	7.30e +03	2.04e +04	5.49e +05	NHHB (16)
Ethylene oxide	75-21-8	8.35e -05	8.35e -03	2.80e -02	1.11e (13) -01	1.51e (13) -01

CONSTITUENT	CAS #	GW (1-4)	GWP-R (1,5)	GWP-I (1,6)	SAI-R (1,7,10,11)	SAI-I (1,8,10,11)
Fluoranthene	206-44-0	1.46e+00	1.46e+02	4.09e+02	1.10e+04	8.18e+04
Fluorene	86-73-7	1.46e+00	1.46e+02	4.09e+02	9.60e+03 (13)	3.87e+04 (13)
Fluorides	7782-41-4	4.00e+00 (9)	4.00e+02	4.00e+02	1.65e+04	1.23e+05
Formaldehyde	50-00-0	7.30e+00 (12)	7.30e+02	2.04e+03	1.56e+04 (12)	2.04e+05 (12)
Heptachlor	76-44-8	4.00e-04 (9)	4.00e-02	4.00e-02	1.42e-01	1.27e+00
Heptachlor epoxide	1024-57-3	2.00e-04 (9)	2.00e-02	2.00e-02	7.04e-02	6.29e-01
Hexachlorobenzene	118-74-1	1.00e-03 (9)	1.00e-01	1.00e-01	4.00e-01	3.57e+00
Hexachlorobutadiene	87-68-3	1.09e-02	1.09e+00	3.67e+00	8.21e+01	7.33e+02
Hexachlorocyclohexane, alpha	319-84-6	1.35e-05	1.35e-03	4.54e-03	1.02e-01	9.08e-01
Hexachlorocyclohexane, beta	319-85-7	4.73e-04	4.73e-02	1.59e-01	3.56e+00	3.18e+01
Hexachlorocyclohexane, gama	58-89-9	2.00e-04 (9)	2.00e-02	2.00e-02	8.23e+01	6.13e+02

CONSTITUENT	CAS #	GW (1-4)	GWP-R (1,5)	GWP-I (1,6)	SAI-R (1,7)	SAI-I (1,8)
Hexachloroethane	67-72-1	6.08e-02	6.08e+00	2.04e+01	4.57e+02	4.09e+03
Isobutyl alcohol	78-83-13	1.10e+01	1.10e+03	3.07e+03	8.23e+04	6.13e+05
Lead (inorganic)	7439-92-1	1.50e (9) -02	1.50e +00	1.50e +00	5.00e (14) +02	1.00e (14) +03
Mercury	7439-97-6	2.00e (9) -03	2.00e -01	2.00e -01	8.23e +01	6.13e +02
Methomyl	16752-77-5	9.13e-01	9.13e+01	2.56e+02	6.86e+03	5.11e+04
Methoxy ethanol	109-86-4	1.46e-01	1.46e+01	4.09e+01	1.10e+03	8.18e+03
Methoxychlor	72-43-5	4.00e (9) -02	4.00e +00	4.00e +00	1.37e +03	1.02e +04
Methoxyethanol acetate	110-49-6	7.30e-02	7.30e+00	2.04e+01	5.49e+02	4.09e+03
Methyl Ethyl Ketone	78-93-3	1.83e+00	1.83e+02	5.11e+02	7.58e (13) +03	1.40e (13) +04
Methyl isobutyl ketone	108-10-1	1.83e+00	1.83e+02	5.11e+02	1.37e+04	1.02e+05
Methyl methacrylate	80-62-6	2.92e+00	2.92e+02	8.18e+02	6.74e (13) +02	6.63e (13) +02

CONSTITUENT	CAS #	GW (1-4)	GWP-R (1,5)	GWP-I (1,6)	SAI-R (1,7)	SAI-I (1,8)
Methylene Chloride	75-09-2	5.00e (9) -03	5.00e -01	5.00e -01	1.07e (13) +01	1.38e (13) +01
Naphthalene	91-20-3	1.46e +00	1.46e +02	4.09e +02	4.91e (13) +03	7.72e (13) +03
Nickel	7440-02-0	1.00e (9) -01	1.00e +01	1.00e +01	1.56e (12) +03	2.04e (12) +04
Nitrate	14797-55-8	1.00e (9) +01	1.00e +03	1.00e +03	4.39e +05	NHHB (16)
Nitrite	14797-65-0	1.00e (9) +00	1.00e +02	1.00e +02	2.74e +04	2.04e +05
Nitrobenzene	98-95-3	1.83e -02	1.83e +00	5.11e +00	6.48e (13) +01	1.06e (13) +02
Nitroso-methyl-ethyl-amine, n-	10595-95-6	3.87e -06	3.87e -04	1.30e -03	2.91e -02	2.60e -01
Nitrosodi-n-propylamine, n-	621-64-7	1.22e -05	1.22e -03	4.09e -03	9.15e -02	8.17e -01
Nitrosodiethylamine, n-	55-18-5	5.68e -07	5.68e -05	1.91e -04	4.27e -03	3.81e -02
Nitrosodimethylamine, n-	62-75-9	1.67e -06	1.67e -04	5.61e -04	1.26e -02	1.12e -01
Nitrosopyrrolidine, n-	930-55-2	4.06e -05	4.06e -03	1.36e -02	3.05e -01	2.72e +00

CONSTITUENT	CAS #	GW (1-4)	GWP-R (1,5)	GWP-I (1,6)	SAI-R (1,7,10,11)	SAI-I (1,8,10,11)
Pentachloronitrobenzene	82-68-8	3.28e-03	3.28e-01	1.10e+00	2.46e+01	2.20e+02
Pentachlorophenol	87-86-5	1.00e (9) -03	1.00e -01	1.00e -01	5.34e +00	4.77e +01
Phenol	108-95-2	2.19e +01	2.19e +03	6.13e +03	1.65e +05	NHHB (16)
Phthalic anhydride	85-44-9	7.30e +01	7.30e +03	2.04e +04	5.49e +05	NHHB (16)
Polychlorinated biphenyls	1336-36-3	5.00e (9) -04	5.00e -02	5.00e -02	1.00e (15) +01	2.50e (15) +01
Pronamide	23950-58-5	2.74e +00	2.74e +02	7.67e +02	2.06e +04	1.53e +05
Pyrene	129-00-0	1.10e +00	1.10e +02	3.10e +02	8.20e +03	6.10e +04
Pyridine	110-86-1	3.65e -02	3.65e +00	1.02e +01	2.74e +02	2.04e +03
Selenium	7782-49-2	5.00e (9) -02	5.00e +00	5.00e +00	1.37e +03	1.02e +04
Silver	7440-22-4	1.83e -01	1.83e +01	5.11e +01	1.37e +03	1.02e +04
Strychnine	57-24-9	1.10e -02	1.10e +00	3.07e +00	8.23e +01	6.13e +02

CONSTITUENT	CAS #	GW (1-4)	GWP-R (1,5)	GWP-I (1,6)	SAI-R (1,7)	SAI-I (1,8)
Styrene	100-42-5	1.00e (9) -01	1.00e +01	1.00e +01	2.13e +01	1.91e +02
Tetrachlorobenzene, 1,2,4,5-	95-94-3	1.10e -02	1.10e +00	3.07e +00	8.23e +01	6.13e +02
Tetrachloroethane (1,1,1,2)	630-20-6	3.28e -02	3.28e +00	1.10e +01	4.59e (13) +01	6.29e (13) +01
Tetrachloroethane (1,1,2,2)	79-34-5	4.26e -03	4.26e -01	1.43e +00	8.00e (13) +00	1.17e (13) +01
Tetrachloroethylene	127-18-4	5.00e (9) -03	5.00e -01	5.00e -01	7.93e (13) +01	2.07e (13) +02
Tetrachlorophenol, 2,3,4,6-	58-90-2	1.10e +00	1.10e +02	3.07e +02	8.23e +03	6.13e +04
Tetraethyl dithiopyrophosphate	3689-24-5	1.83e -02	1.83e +00	5.11e +00	1.37e +02	1.02e +03
Toluene	108-88-3	1.00e (9) +00	1.00e +02	1.00e +02	3.58e (13) +03	3.63e (13) +03
Toxaphene	8001-35-2	3.00e (9) -03	3.00e -01	3.00e -01	5.82e -01	5.20e +00
TP Silvex, 2,4,5-	93-72-1	5.00e (9) -02	5.00e +00	5.00e +00	2.20e +03	1.64e +04
Trichlorobenzene (1,2,4)	120-82-1	7.00e (9) -02	7.00e +00	7.00e +00	6.78e (13) +02	8.28e (13) +02

CONSTITUENT	CAS #	GW (1-4)	GWP-R (1,5)	GWP-I (1,6)	SAI-R (1,7)	SAI-I (1,8)
Trichloroethane (1,1,1)	71-55-6	2.00e (9) -01	2.00e +01	2.00e +01	9.63e (13) +03	1.40e (13) +04
Trichloroethane (1,1,2)	79-00-5	5.00e (9) -03	5.00e -01	5.00e -01	1.27e (13) +01	1.62e (13) +01
Trichloroethylene	79-01-6	5.00e (9) -03	5.00e -01	5.00e -01	2.40e (13) +00	2.85e (13) +00
Trichlorofluoromethane	75-69-4	1.10e +01	1.10e +03	3.07e +03	8.73e (13) +00	8.36e (13) +00
Trichlorophenol (2,4,5)	95-95-4	3.65e +00	3.65e +02	1.02e +03	8.08e (13) +03	1.04e (13) +04
Trichlorophenol, 2,4,6-	88-06-2	7.74e -03	7.74e -01	2.60e +00	5.82e +01	5.20e +02
Trichlorophenoxyacetic acid, 2,4,5-	93-76-5	3.65e -01	3.65e +01	1.02e +02	2.74e +03	2.04e +04
Trichloropropane, 1,1,2-	598-77-6	1.83e -01	1.83e +01	5.11e +01	1.37e +03	1.02e +04
Trichloropropane, 1,2,3-	96-18-4	2.19e -01	2.19e +01	6.13e +01	1.65e +03	1.23e +04
Trinitrobenzene, 1,3,5-	99-35-4	1.83e -03	1.83e -01	5.11e -01	1.37e +01	1.02e +02
Vinyl acetate	108-05-4	3.65e +01	3.65e +03	1.02e +04	2.74e +05	2.04e +06

CONSTITUENT	CAS #	GW (1-4)	GWP-R (1,5)	GWP-I (1,6)	SAI-R (1,7)	SAI-I (1,8)
Vinyl Chloride	75-01-4	2.00e (9) -03	2.00e -01	2.00e -01	1.99e (13) -02	2.41e (13) -02
Xylene	1330-20-7	1.00e (9) +01	1.00e +03	1.00e +03	5.47e (13) +03	5.80e (13) +03

(1) Concentrations for constituents are expressed in scientific notation. Examples $2.20E-00 = 2.2$; $2.20E+02 = 220$; and $2.20E-01 = 0.22$.

(2) The development of final cleanup levels may involve other factors as described in this subchapter, such as cumulative health effects, that are not considered in this chapter.

(3) Ground-water concentrations are based on Maximum Contaminant Levels (MCLs) or the formula and parameters for residential use of ground water which are contained in 31 TAC §335.567 (relating to Appendix I). For non-residential exposure conditions, the ground water concentrations are calculated using the procedures of §335.559(d)(2) or (3).

(4) For some constituents, the Practical Quantitation Limit (PQL) may be the appropriate Ground Water MSC as described in 31 TAC 335.555(d)(1) of this rule. See 40 Code of Federal Regulations Part 264 (Appendix IX) for a list of ground-water PQLs.

(5) Residential soil ground-water protection concentrations are based on a multiplication factor of 100 times the ground-water MSC.

(6) Industrial soil ground-water protection concentrations are based on a multiplication factor of 100 times the MCL or, when an MCL is not available, a factor of 100 times the ground-water concentration calculated using the formula and parameters which are contained in 31 TAC §335.559(d)(2) or (3) of this title.

(7) Residential soil concentrations (maximum) are calculated using the formula and parameters for residential land use which are contained in §335.567 of this title (relating to Appendix I). The person must also demonstrate that ground water is protected and that no nuisance conditions exist (31 TAC §335.559(a)-(h) of this title).

(8) Industrial soil concentrations (maximum) are calculated using the formula and parameters for industrial land use which are contained in 31 TAC §335.567 of this title (relating to Appendix I). The person must also demonstrate that ground water is protected and that no nuisance conditions exist (31 TAC §335.559(a)-(h) of this title).

(9) The final, proposed or listed Maximum Contaminant Level (MCL), from Section 141 of the Federal Safe Drinking Water Act. For lead, the Action Level for lead in drinking water is used as the MSC.

(10) All concentrations were calculated using data from the Integrated Risk Information System (IRIS) Chemical Files, or data from the Health Effects Assessment Summary Tables (HEAST), developed by the United States Environmental Protection Agency, Office of Research and Development and Office of Health and Environmental Assessment, Washington, D.C. 20460. The toxicity information, and the MSCs, will be updated as new information becomes available.

(11) In some cases, an oral Reference Dose (RFD) or an oral Slope Factor (SF) was substituted for the inhalation RFD or inhalation SF in calculating MSC. This MSC will be updated when this information becomes available.

(12) The MSCs calculated for this compound are based on noncarcinogenic effects. The following formula was used for calculating the soil MSCs: $MSC = [(oral\ RFD)(Body\ Weight)(ED)(365\ days/yr)]/[(EF)(ED)(IR)(CF)]$. For residential soils, the following exposure factors were used: BW = 15 Kg; ED = 5 years; EF = 350 days/year; IR = 200 mg/day. For industrial soils, the following exposure factors were used: BW = 70 Kg; ED = 25 years; EF = 250 days/year; IR = 100 mg/day. In both cases, the CF is 0.000001 kg/mg. When oral slope factors become available, these MSCs will be revised.

(13) As described in 31 TAC §335.559(e) of this title, the sum of concentrations of the volatile organic compounds in vapor phase in soil shall not exceed 1,000 ppm by weight or volume.

(14) The MSC for lead in soil is based on values calculated by the United States EPA using the Lead Uptake/Biokinetic Model, Version 0.4, which has been developed by the United States EPA Office of Health & Environmental Assessment.

(15) Soil MSCs for polychlorinated biphenyls are based upon the 4/2/87 TSCA regulations, 40 Code of Federal Regulation 761.125 (see 52 FR 10688).

(16) NHHB = Not Human Health Based. The SAI-Ind MSC for this compound exceeds $10e+6$ ppm, which means it is not toxic to humans when exposed to soils under these assumptions. Persons must consider other criteria of 31 TAC §335.559 of this title (relating to Medium Specific Requirements and Adjustments for Risk Reduction Standards Number 2.) to develop numeric cleanup values.

Effective June 28, 1993

§335.569. Appendix III.

For the purposes of this subchapter, the following is the model deed certification language.

MODEL DEED CERTIFICATION LANGUAGE

STATE OF TEXAS
() COUNTY

**INDUSTRIAL SOLID WASTE
CERTIFICATION OF REMEDIATION**

KNOW ALL MEN BY THESE PRESENTS THAT:

Pursuant to the Rules of the Texas Natural Resource Conservation Commission pertaining to Industrial Solid Waste Management, this document is hereby filed in the Deed Records of County, Texas in compliance with the recordation requirements of said rules:

I

(Company Name) has performed a remediation of the land described herein. A copy of the Notice of Registration (No.), including a description of the facility, is attached hereto and is made part of this filing. A list of the known waste constituents, including known concentrations (i.e., soil and ground water, if applicable), which have been left in place is attached hereto and is made part of this filing. Further information concerning this matter may be found by an examination of company records or in the Notice of Registration (No.) files, which are available for inspection upon request at the central office of the Texas Natural Resource Conservation Commission in Austin, Texas.

The Texas Natural Resource Conservation Commission derives its authority to review the remediation of this tract of land from Texas Health and Safety Code, §361.002, which enables the Texas Natural Resource Conservation Commission to promulgate closure and remediation standards to safeguard the health, welfare and physical property of the people of the State and to protect the environment by controlling the management of solid waste. In addition, pursuant to the Texas Water Code, §5.012 and §5.013, Texas Water Code, Annotated, Chapter 5, the Texas Natural Resource Conservation Commission is given primary responsibility for implementing the laws of the State of Texas relating to water and shall adopt any rules necessary to carry out its powers and duties under the Texas Water Code. In accordance with this authority, the Texas Natural Resource Conservation Commission requires certain persons to provide certification and/or recordation in the real property records to notify the public of the conditions of the land and/or the occurrence of remediation. This deed certification is not a representation or warranty by the Texas Natural Resource Conservation Commission of the suitability of this land for any purpose, nor does it constitute any guarantee by the Texas Natural Resource Conservation Commission that the remediation standards specified in this certification have been met by (Company name).

II

Being a acre tract, more or less, out of the (Company Name)'s acre tract in the (Name) League (No.), Abstract (No.), recorded in Volume (No.), Page (No.) of the Deed of Records County, Texas, said acre tract being more particularly described as follows:

(Insert metes and bounds description here)

For Standard 2 cleanups: (Contaminants/contaminants and waste) deposited hereon have been remediated (to meet residential soil criteria/ to meet non-residential (i.e., industrial/commercial) soil criteria)), in accordance with a plan designed to meet the Texas Natural Resource Conservation Commission's requirements in 30 Texas Administrative Code, §335.555), which mandates that the remedy be designed to eliminate substantial present and future risk such that no post-closure care or engineering or institutional control measures are required to protect human health and the environment. Future land use is considered suitable for (residential, non-residential (i.e., industrial/commercial)) purposes in accordance with risk reduction standards applicable at the time of this filing. Future land use is intended to be (residential, non-residential).

For Standard 3 cleanups: (Contaminants/contaminants and waste) deposited hereon have been remediated (to meet residential soil criteria/to meet non-residential (i.e., industrial/commercial) soil criteria) in accordance with a plan designed to meet the requirements of 30 Texas Administrative Code, §335.561 (Risk Reduction Standard Number 3), which mandates that the remedy be designed to eliminate or reduce to the maximum extent practicable, substantial present or future risk. The remediation plan (does/ does not) require continued post-closure care or engineering or institutional control measures. Future use of the property is considered appropriate for (describe) in accordance with risk reduction standards applicable at the time of this filing. Institutional or legal controls placed on the property to ensure appropriate future use include (describe).

For both Standard 2 and 3 cleanups where the remedy is based upon non-residential soil criteria: The current or future owner must undertake actions as necessary to protect human health or the environment in accordance with the rules of the Texas Natural Resource Conservation Commission.

III

The owner of the site is (Company Name), a Texas corporation, and its address is (P.O. Box or Street), (City), Texas (Zip Code), where more specific information may be obtained from the (plant manager, owner).

EXECUTED this the day of , 20 .

(Company Name)
a Texas corporation

(Name)
Plant Manager

STATE OF TEXAS
() COUNTY

BEFORE ME, on this the day of , personally appeared (Name), (Plant Manager, Owner) of (Company Name), a Texas corporation, known to me to be the person and agent of said corporation whose name is subscribed to the foregoing instrument, and he acknowledged to me that he executed the same for the purposes and in the capacity therein expressed.

GIVEN UNDER MY HAND AND SEAL OF OFFICE, this the day of , 20__.

Notary Public in and
for the State of Texas,
County of

Adopted October 24, 2001

Effective November 15, 2001