

Title 10 – DEPARTMENT OF NATURAL RESOURCES
Division 26 – Petroleum and Hazardous Substance Storage Tanks
Chapter 2 – Underground Storage Tanks – Technical Regulations

PROPOSED RULE

10 CSR 26-2.078 Risk-Based Target Levels

PURPOSE: This rule sets forth the procedures and requirements for developing risk-based target levels at storage tank release sites.

- (1) Risk-based and site-specific target levels for chemicals of concern at storage tank release sites shall be determined in accordance with the requirements of this rule.
- (2) Target levels may include:
 - (A) Default Target Levels in Table 1 of this rule;
 - (B) Tier one risk-based target levels in Tables 2 through 7 of this rule;
 - (C) Tier two site-specific target levels; or
 - (D) Tier three site-specific target levels.
- (3) Target risk level. All target levels shall be calculated for chemicals of concern using the following target risk levels:
 - (A) For chemicals of concern that are carcinogenic, the target risk level for each chemical of concern and route of exposure shall be an individual excess lifetime cancer risk of one in one hundred thousand (1×10^{-5}).
 - (B) For chemicals of concern that are non-carcinogenic, the target risk level for each chemical of concern and route of exposure shall be a hazard quotient of one (1).
- (4) Tier one risk-based target levels. Risk-based target levels for a tier one risk assessment shall be the concentrations for each contaminant of concern in Tables 2 through 7 of this rule.
 - (A) The department may require that owners and operators develop tier two site-specific target levels for a specific site or off-site property if the department demonstrates that the tier one risk-based target levels are not adequately protective of human health or the environment in consideration of conditions specific to the site or property.
- (5) Owners and operators who conduct a tier two or tier three risk assessment shall develop site-specific target levels in accordance with the following:
 - (A) Fate and transport parameter values. Owners and operators may use site-specific fate and transport values to develop tier two and tier three site-specific target levels, except as provided for in subsections (6)(F) and (7)(F) of this rule. The values used shall be technically defensible and subject to approval by the department. Owners and operators shall provide a rationale for each value used, and the values shall be:
 1. Representative of spatial variations in the parameter through measurements at an adequate number of appropriate locations using methods in the *Missouri Risk-Based*

Corrective Action (MRBCA) Process for Petroleum Storage Tanks guidance document dated XXXXXXXX, 2012, published by and available from the Department of Natural Resources, P.O. Box 176, Jefferson City, Missouri 65102-0176, and hereby incorporated by reference without later amendments or additions, or an alternative method approved by the department;

2. Representative of temporal variations in the parameter in accordance with the provisions of the *Missouri Risk-Based Corrective Action (MRBCA) Process for Petroleum Storage Tanks guidance* document dated XXXXXXXX, 2012;

3. Literature values demonstrated to be appropriate;

4. Default values justified as appropriate or shown to be conservative; and/or

5. Values measured at a nearby property that owners and operators have shown to have soil and geological characteristics and a hydrogeological setting that are the same as or very similar to the characteristics and setting of the property to which the values will be applied.

(6) Tier two site-specific target levels. Except as provided for at subsection (6)(F) of this rule, owners and operators shall determine tier two site-specific target levels for each chemical of concern, exposure pathway, and affected media in accordance with section (5)(A) of this rule and the following:

(A) Toxicity factors. Owners and operators shall develop tier two site-specific target levels for chemicals of concern using the most recent department approved default values for the cancer slope factor, inhalation unit risk, dermal toxicity, reference dose, or reference concentration recommended by the United States Environmental Protection Agency;

(B) Physical and chemical properties. Owners and operators shall develop tier two site-specific target levels for chemicals of concern using values for chemical of concern physical and chemical properties established by the department in the *Missouri Risk-Based Corrective Action (MRBCA) Process for Petroleum Storage Tanks guidance* document dated XXXXXXXX, 2012, except as provided in section (6)(F) of this rule;

(C) Exposure factors. Owners and operators shall develop tier two site-specific target levels using exposure factors found in the *Missouri Risk-Based Corrective Action (MRBCA) Process for Petroleum Storage Tanks guidance* document dated XXXXXXXX, 2012;

(D) Mathematical models. Owners and operators shall develop tier two site-specific target levels for chemicals of concern using models for determining uptake and transport and fate found in the *Missouri Risk-Based Corrective Action (MRBCA) Process for Petroleum Storage Tanks guidance* document dated XXXXXXXX, 2012, except as provided in section (6)(F) of this rule;

(E) In developing tier two site-specific target levels for leaching of chemicals of concern from vadose zone soils into groundwater, owners and operators shall use one of the following dilution-attenuation factors, as applicable given site conditions, to account for a reduction in chemical of concern concentration during leaching through the vadose zone:

1. If depth to groundwater is less than twenty feet (20'), a value of one (1);
2. If depth to groundwater is equal to or greater than twenty feet (20') but less than or equal to fifty feet (50'), a value of two (2); and
3. If depth to groundwater is greater than fifty feet (50'), a value of four (4);

(F) Lead. Owners and operators who conduct a tier two risk assessment shall use the tier one risk-based target levels for lead.

(7) Tier three target levels. Owners and operators shall determine tier three site-specific target levels or human health risk for each chemical of concern, exposure pathway, and affected media in accordance with section (5)(A) of this rule and the following:

(A) With the written approval of the department, owners and operators may develop tier three site-specific target levels using toxicity factors other than those in the *Missouri Risk-Based Corrective Action (MRBCA) Process for Petroleum Storage Tanks* guidance document dated XXXXXXXX, 2012, except as provided for in section (7)(F) of this rule;

(B) With the written approval of the department, owners and operators may develop tier three site-specific target levels using chemical of concern physical and chemical property values other than those in the *Missouri Risk-Based Corrective Action (MRBCA) Process for Petroleum Storage Tanks* guidance document dated XXXXXXXX, 2012;

(C) With the written approval of the department, owners and operators may develop tier three site-specific target levels for chemicals of concern using exposure factors other than those in the *Missouri Risk-Based Corrective Action (MRBCA) Process for Petroleum Storage Tanks* guidance document dated XXXXXXXX, 2012, except as provided in section (7)(F) of this rule;

(D) With the written approval of the department, owners and operators may develop tier three site-specific target levels for chemicals of concern using either the uptake and fate and transport models in the *Missouri Risk-Based Corrective Action (MRBCA) Process for Petroleum Storage Tanks* guidance document dated XXXXXXXX, 2012, or alternative models. Alternative models shall be presented and fully explained in the tier three work plan required by 10 CSR 26-2.077(6)(A);

(E) If owners and operators propose the use of a model or models other than those established by the department to develop target levels or evaluate exposure pathways and the transport and fate of chemicals of concern, the proposed model shall be peer reviewed, publicly available, and technically defensible. In certain cases where specific computer software is used, the department may require that owners and operators provide a copy of the software to the department free of charge to facilitate the department's review of the tier three risk assessment. Use of the proposed model(s) is contingent on approval by the department; and

(F) Lead. Owners and operators may evaluate human health risk or determine tier three site-specific target levels for lead using the United States Environmental Protection Agency's Integrated Exposure Uptake Biokinetic Model for Lead in Children or another model approved by the department. Owners and operators must provide a rationale for selecting the values used for each input parameter.

Table 1 – Default Target Levels

Chemicals of Concern	Soil [mg/kg]		Groundwater [mg/L]	
Benzene	5.61E-02	GWP	5.00E-03	DWG
Toluene	2.98E+01	GWP	1.00E+00	DWG
Ethylbenzene	3.99E+01	GWP	7.00E-01	DWG
Xylenes (total)	2.47E+01	INH	1.00E+01	DWG
Ethylene dibromide (EDB)	4.73E-04	GWP	5.00E-05	DWG
Ethylene dichloride (EDC)	2.06E-02	GWP	5.00E-03	DWG
Methyl tertiary butyl ether (MTBE)	3.98E-01	GWP	1.28E-01	DWG
Acenaphthene	1.74E+02	GWP	1.65E-01	DWG
Anthracene	3.06E+03	GWP	6.96E-01	DWG
Benzo(a)anthracene	6.12E+00	GWP	1.03E-04	DWG
Benzo(a)pyrene	6.20E-01	SDC	1.02E-05	GDC
Benzo(b)fluoranthene	6.19E+00	SDC	6.27E-05	DWG
Benzo(k)fluoranthene	6.20E+01	SDC	6.46E-04	DWG
Chrysene	5.99E+02	SDC	1.03E-02	DWG
Dibenzo(a,h)anthracene	6.20E-01	SDC	4.21E-06	DWG
Fluoranthene	2.28E+03	SDC	1.64E-01	DWG
Fluorene	2.11E+02	GWP	1.03E-01	DWG
Naphthalene	3.25E-01	GWP	1.09E-03	DWG
Pyrene	1.50E+03	GWP	9.61E-02	DWG
TPH-GRO	3.85E+02	INH	1.81E+01	DWG
TPH-DRO	4.15E+03	INH	3.43E+01	DWG
TPH-ORO	1.24E+05	SDC	3.18E+01	DWG
Aliphatics - > C6-C8	2.53E+02	INH	9.94E+00	INH
Aliphatics - > C8-C10	5.24E+01	INH	3.40E-01	INH
Aliphatics - >C10-C12	2.60E+02	INH	2.27E-01	INH
Aliphatics - >C12-C16	1.18E+03	INH	5.23E-02	INH
Aliphatics - >C16-C21	1.22E+05	SDC	3.13E+01	DWG
Aliphatics - >C21-C35	1.22E+05	SDC	3.13E+01	DWG
Aromatics - >C8-C10	4.12E+01	GWP	1.72E-01	DWG
Aromatics - >C10-C12	6.49E+01	GWP	1.72E-01	DWG
Aromatics - >C12-C16	1.29E+02	GWP	1.72E-01	DWG
Aromatics - >C16-C21	1.11E+03	GWP	4.69E-01	DWG
Aromatics - >C21-C35	1.72E+03	SDC	4.69E-01	DWG
Tertiary-amyl-methyl-ether (TAME)	6.77E-01	GWP	8.28E-02	DWG
Tertiary-butyl-alcohol (TBA)	5.58E-01	GWP	2.86E-01	DWG
Ethyl-tert-butyl-ether (ETBE)	1.06E-01	GWP	1.44E-02	DWG
Diisopropyl ether (DIPE)	4.12E+00	GWP	3.51E-01	DWG
Ethanol	7.73E+02	GWP	5.15E+02	DWG
Methanol	2.08E+01	GWP	7.81E+00	DWG
Arsenic	3.89E+00	SDC	1.00E-02	DWG
Barium	2.04E+03	GWP	2.00E+00	DWG
Cadmium	9.31E+00	GWP	5.00E-03	DWG
Chromium (III) total chromium	7.46E+04	SDC	1.00E-01	DWG
Chromium (VI)	1.59E-03	GWP	3.37E-06	DWG
Lead	3.74E+00	GWP	1.50E-02	DWG
Selenium	6.27E+00	GWP	5.00E-02	DWG

Notes:

DWG: Domestic use of groundwater

GDC: GW dermal contact pathway

GWP: Protection of domestic groundwater use pathway

INH: Indoor inhalation pathway

SDC: Soil direct contact pathway

Table 2 – Tier 1 Risk-Based Target Levels for Residential Land Use

Chemicals of Concern	Air	Surficial Soil	Subsurface Soil	Soil Vapor	Groundwater		
	Indoor	Ingestion, Inhalation (Vapor Emissions and Particulates), and Dermal Contact	Indoor Inhalation of Vapor Emissions	Indoor Inhalation of Vapor Emissions	Indoor Inhalation of Vapor Emissions	Dermal Contact	Domestic Water Use
	[mg/m ³ -air]	[mg/kg]	[mg/kg]	[mg/m ³ -air]	[mg/L]		
Benzene	4.98E-03	1.77E+02 *	3.78E-01	1.90E+02	1.00E+00	2.92E-01	5.00E-03 m
Toluene	2.92E+00	6.21E+03 *	4.99E+02 *	1.13E+05 +	5.08E+02 #	8.58E+00	1.00E+00 m
Ethylbenzene	6.06E-01	7.45E+03 *	1.93E+02 *	2.72E+04 +	1.03E+02 #	6.34E+00 #	7.00E-01 m
Xylenes (total)	6.06E-02	7.83E+03 *	2.47E+01	2.91E+03	1.18E+01	2.13E+01 #	1.00E+01 m
Ethylene dibromide (EDB)	4.27E-05	3.02E+00	8.61E-02	6.62E+00	2.30E-01	1.41E-02	5.00E-05 m
Ethylene dichloride (EDC)	9.86E-04	6.65E+01	1.32E-01	3.19E+01	8.62E-01	3.53E-01	5.00E-03 m
Methyl tertiary butyl ether (MTBE)	9.86E-02	3.45E+03	2.16E+01	4.14E+03	1.81E+02	2.35E+01	1.28E-01
Acenaphthene	1.25E-01	3.13E+03 *	6.69E+04 *	1.00E+04 +	1.61E+03 #	1.35E+00	1.65E-01
Anthracene	6.27E-01	1.57E+04 *	3.90E+05 *	6.50E+04 +	2.29E+03 #	3.17E+00 #	6.96E-01 #
Benzo(a)anthracene	2.30E-04	6.20E+00	2.60E+05 *	1.49E+01 +	1.10E+02 #	1.74E-04	1.03E-04
Benzo(a)pyrene	2.30E-05	6.20E-01	2.25E+05 *	1.70E+00 +	3.73E+01 #	1.02E-05	2.00E-04 m
Benzo(b)fluoranthene	2.30E-04	6.19E+00	5.55E+04 *	3.42E+01 +	7.65E+00 #	1.01E-04	6.27E-05
Benzo(k)fluoranthene	2.30E-04	6.20E+01 *	6.83E+06 *	3.14E+01 +	9.37E+02 #	1.04E-03 #	6.46E-04
Chrysene	2.30E-03	5.99E+02 *	1.92E+05 *	3.12E+02 +	8.17E+01 #	1.74E-02 #	1.03E-02 #
Dibenz(a,h)anthracene	2.19E-05	6.20E-01	2.22E+07 *	5.86E-01 +	9.85E+02 #	6.60E-06	4.21E-06
Fluoranthene	8.36E-02	2.28E+03 *	9.01E+06 *	9.27E+03 +	1.42E+04 #	3.00E-01 #	1.64E-01
Fluorene	8.36E-02	2.20E+03 *	2.46E+05 *	7.73E+03 +	3.01E+03 #	6.27E-01	1.03E-01
Naphthalene	7.48E-04	3.63E+01 *	2.59E+01 *	4.26E+01 +	2.25E+00 #	2.06E-02	1.09E-03
Pyrene	6.27E-02	1.71E+03 *	1.07E+07 *	7.69E+03 +	1.73E+04 #	1.64E-01 #	9.61E-02
TPH-GRO	1.18E+01	3.54E+05 *	3.85E+02	3.97E+05 +	2.08E+01	NA	1.81E+01
TPH-DRO	1.45E+00	1.40E+05 *	4.15E+03 *	4.87E+04 +	1.17E+02 #	NA	3.43E+01 #
TPH-ORO	NA	1.24E+05 *	NA	NA	NA	NA	3.18E+01 #
Aliphatics - > C6-C8	1.11E+01	3.44E+05 *	2.53E+02 *	3.72E+05 +	9.94E+00 #	NA	1.73E+01 #
Aliphatics - > C8-C10	6.06E-01	7.45E+03 *	5.24E+01	2.04E+04	3.40E-01	NA	6.83E-01 #
Aliphatics - >C10-C12	6.06E-01	5.88E+03 *	2.60E+02 *	2.04E+04 +	2.27E-01 #	NA	6.83E-01 #
Aliphatics - >C12-C16	6.06E-01	5.88E+03 *	1.18E+03 *	2.04E+04 +	5.23E-02 #	NA	1.56E+00 #
Aliphatics - >C16-C21	NA	1.22E+05 *	NA	NA	NA	NA	3.13E+01 #
Aliphatics - >C21-C35	NA	1.22E+05 *	NA	NA	NA	NA	3.13E+01 #
Aromatics - >C8-C10	1.19E-01	2.84E+03 *	8.03E+01	4.00E+03	1.05E+01	NA	1.72E-01
Aromatics - >C10-C12	1.19E-01	2.26E+03 *	4.33E+02 *	4.00E+03 +	3.34E+01 #	NA	1.72E-01
Aromatics - >C12-C16	1.19E-01	2.26E+03 *	2.28E+03 *	4.00E+03 +	8.29E+01 #	NA	1.72E-01
Aromatics - >C16-C21	NA	1.72E+03 *	NA	NA	NA	NA	4.69E-01
Aromatics - >C21-C35	NA	1.72E+03 *	NA	NA	NA	NA	4.69E-01 #
Tertiary-amy-methyl-ether (TAME)	4.80E-02	2.50E+03 *	5.86E+00	2.31E+03	2.06E+01	1.86E+01	8.28E-02
Tertiary-butyl-alcohol (TBA)	1.80E-01	6.11E+03	1.03E+03	7.07E+03	1.32E+04	1.52E+02	2.86E-01
Ethyl-tert-butyl-ether (ETBE)	1.80E-01	7.81E+01	2.58E+01	8.69E+03	9.90E+01	5.00E-01	1.44E-02
Diisopropyl ether (DIPE)	2.30E-01	6.91E+03 *	3.30E+01	1.13E+04	8.19E+01	3.48E+01	3.51E-01
Ethanol	1.13E+00	2.62E+05 *	7.17E+03	3.28E+04	1.20E+05	2.48E+05	5.15E+02
Methanol	2.30E+00	3.67E+04	2.94E+04	5.11E+04	2.77E+05	6.63E+03	7.81E+00
Arsenic	5.98E-06	3.89E+00	N/A	N/A	N/A	1.58E-01	1.00E-02 m
Barium	2.92E-04	1.50E+04	N/A	N/A	N/A	1.12E+03	2.00E+00 m
Cadmium	1.42E-05	1.68E+01	N/A	N/A	N/A	6.25E-01	5.00E-03 m
Chromium (III) total chromium	6.06E-05	7.46E+04	N/A	N/A	N/A	8.38E+03	1.00E-01 m
Chromium (VI)	2.14E-06	1.47E-01	N/A	N/A	N/A	2.83E-03	3.37E-06
Lead	NA	2.60E+02	2.60E+02	N/A	N/A	NA	1.50E-02 m
Selenium	1.19E-04	3.80E+02	N/A	N/A	N/A	2.79E+01	5.00E-02 m

Notes:

NA: Not available N/A: Not applicable m: Target level is MCL. Soil concentrations are presented on a dry weight basis.

*: Calculated target level exceeds effective/saturated soil concentration for gasoline. Calculated value is shown.

#: Calculated target level exceeds effective/solubility for gasoline. Calculated value is shown.

+: Calculated target level exceeds effective/saturated vapor concentration for gasoline. Calculated value is shown.

Table 3 – Tier 1 Risk-Based Target Levels for Non-Residential Land Use

Chemicals of Concern	Air	Surficial Soil	Subsurface Soil	Soil Vapor	Groundwater	
	Indoor	Ingestion, Inhalation (Vapor Emissions and Particulates), and Dermal Contact	Indoor Inhalation of Vapor Emissions	Indoor Inhalation of Vapor Emissions	Indoor Inhalation of Vapor Emissions	Dermal Contact
	[mg/m ³ -air]	[mg/kg]	[mg/kg]	[mg/m ³ -air]	[mg/L]	
Benzene	1.06E-02	7.63E+02 *	1.98E+00	9.98E+02	5.25E+00	1.06E+00
Toluene	9.54E+00	8.11E+04 *	4.01E+03 *	9.09E+05 +	4.08E+03 #	4.76E+01
Ethylbenzene	1.98E+00	9.75E+04 *	1.55E+03 *	2.18E+05 +	8.32E+02 #	3.51E+01 #
Xylenes (total)	1.98E-01	1.04E+05 *	1.99E+02 *	2.34E+04 +	9.49E+01 #	1.18E+02 #
Ethylene dibromide (EDB)	9.09E-05	1.25E+01	4.52E-01	3.47E+01	1.21E+00	5.15E-02
Ethylene dichloride (EDC)	2.10E-03	2.76E+02	6.91E-01	1.67E+02	4.52E+00	1.29E+00
Methyl tertiary butyl ether (MTBE)	2.10E-01	1.49E+04 *	1.13E+02	2.17E+04	9.46E+02	8.58E+01
Acenaphthene	4.09E-01	3.07E+04 *	5.38E+05 *	8.05E+04 +	1.29E+04 #	7.50E+00 #
Anthracene	2.04E+00	1.54E+05 *	3.14E+06 *	5.23E+05 +	1.84E+04 #	1.76E+01 #
Benzo(a)anthracene	4.89E-04	2.11E+01	1.36E+06 *	7.83E+01 +	5.79E+02 #	6.37E-04
Benzo(a)pyrene	4.89E-05	2.11E+00	1.18E+06 *	8.93E+00 +	1.95E+02 #	3.74E-05
Benzo(b)fluoranthene	4.89E-04	2.10E+01 *	2.91E+05 *	1.79E+02 +	4.01E+01 #	3.68E-04
Benzo(k)fluoranthene	4.89E-04	2.11E+02 *	3.58E+07 *	1.65E+02 +	4.91E+03 #	3.80E-03 #
Chrysene	4.89E-03	1.99E+03 *	1.01E+06 *	1.63E+03 +	4.28E+02 #	6.37E-02 #
Dibenzo(a,h)anthracene	4.65E-05	2.11E+00	1.16E+08 *	3.07E+00 +	5.16E+03 #	2.41E-05
Fluoranthene	2.73E-01	2.18E+04 *	7.25E+07 *	7.45E+04 +	1.14E+05 #	1.66E+00 #
Fluorene	2.73E-01	2.07E+04 *	1.98E+06 *	6.22E+04 +	2.42E+04 #	3.48E+00 #
Naphthalene	1.59E-03	1.19E+02 *	1.36E+02 *	2.23E+02 +	1.18E+01 #	7.51E-02 #
Pyrene	2.04E-01	1.64E+04 *	8.64E+07 *	6.18E+04 +	1.39E+05 #	9.07E-01 #
TPH-GRO	3.85E+01	4.65E+06 *	3.10E+03 *	3.19E+06 +	1.67E+02 #	NA
TPH-DRO	4.73E+00	1.41E+06 *	3.34E+04 *	3.92E+05 +	9.38E+02 #	NA
TPH-ORO	NA	1.25E+06 *	NA	NA	NA	NA
Aliphatics -> C6-C8	3.61E+01	4.52E+06 *	2.03E+03 *	2.99E+06 +	7.99E+01 #	NA
Aliphatics -> C8-C10	1.98E+00	9.75E+04 *	4.21E+02 *	1.64E+05 +	2.73E+00 #	NA
Aliphatics ->C10-C12	1.98E+00	5.98E+04 *	2.09E+03 *	1.64E+05 +	1.82E+00 #	NA
Aliphatics ->C12-C16	1.98E+00	5.98E+04 *	9.50E+03 *	1.64E+05 +	4.21E-01 #	NA
Aliphatics ->C16-C21	NA	1.23E+06 *	NA	NA	NA	NA
Aliphatics ->C21-C35	NA	1.23E+06 *	NA	NA	NA	NA
Aromatics ->C8-C10	3.89E-01	3.72E+04 *	6.46E+02 *	3.22E+04 +	8.44E+01 #	NA
Aromatics ->C10-C12	3.89E-01	2.33E+04 *	3.48E+03 *	3.22E+04 +	2.69E+02 #	NA
Aromatics ->C12-C16	3.89E-01	2.33E+04 *	1.83E+04 *	3.22E+04 +	6.67E+02 #	NA
Aromatics ->C16-C21	NA	1.65E+04 *	NA	NA	NA	NA
Aromatics ->C21-C35	NA	1.65E+04 *	NA	NA	NA	NA
Tertiary-aryl-methyl-ether (TAME)	1.57E-01	3.29E+04 *	4.71E+01	1.86E+04	1.66E+02	1.03E+02
Tertiary-butyl-alcohol (TBA)	5.86E-01	8.03E+04 *	8.26E+03	5.69E+04	1.06E+05	8.44E+02
Ethyl-tert-butyl-ether (ETBE)	5.86E-01	1.02E+03	2.07E+02	6.99E+04	7.96E+02	2.77E+00
Diisopropyl ether (DIPE)	7.50E-01	9.07E+04 *	2.65E+02	9.12E+04	6.59E+02	1.93E+02
Ethanol	3.68E+00	3.55E+06 *	5.77E+04 *	2.64E+05 +	9.66E+05 #	1.37E+06 #
Methanol	7.50E+00	4.81E+05 *	2.36E+05 *	4.11E+05 +	2.23E+06 #	3.68E+04
Arsenic	1.27E-05	1.59E+01	N/A	N/A	N/A	5.78E-01
Barium	9.54E-04	1.81E+05	N/A	N/A	N/A	6.19E+03
Cadmium	3.03E-05	7.48E+01	N/A	N/A	N/A	2.28E+00
Chromium (III) total chromium	1.98E-04	4.72E+05	N/A	N/A	N/A	4.65E+04
Chromium (VI)	4.54E-06	6.39E-01	N/A	N/A	N/A	1.03E-02
Lead	NA	6.60E+02	6.60E+02	N/A	N/A	NA
Selenium	3.89E-04	4.78E+03	N/A	N/A	N/A	1.55E+02

Notes:

NA: Not available

N/A: Not applicable

Soil concentrations are presented on a dry weight basis.

*: Calculated target level exceeds effective/saturated soil concentration for gasoline. Calculated value is shown.

#: Calculated target level exceeds effective/solubility for gasoline. Calculated value is shown.

+: Calculated target level exceeds effective/saturated vapor concentration for gasoline. Calculated value is shown.

Table 4 – Tier 1 Risk-Based Target Levels for Construction Worker

Chemicals of Concern	Air	Soil	Groundwater	
	Outdoor	Ingestion, Inhalation (Vapor Emissions and Particulates), and Dermal Contact	Outdoor Inhalation of Vapor Emissions	Dermal Contact
	[mg/m ³ -air]	[mg/kg]	[mg/L]	
Benzene	1.51E-01	1.82E+03 *	1.16E+04 #	1.48E+01
Toluene	2.45E+01	1.38E+05 *	1.77E+06 #	1.32E+02 #
Ethylbenzene	5.08E+00	5.81E+04 *	3.73E+05 #	9.76E+01 #
Xylenes (total)	5.08E-01	7.21E+03 *	4.10E+04 #	3.28E+02 #
Ethylene dibromide (EDB)	5.84E-03	7.74E+01	1.83E+03	3.58E+00
Ethylene dichloride (EDC)	2.45E-02	3.51E+02	3.98E+03	8.95E+01
Methyl tertiary butyl ether (MTBE)	1.35E+01	1.65E+05 *	2.95E+06 #	5.96E+03
Acenaphthene	1.05E+00	2.57E+04 *	7.91E+05 #	2.08E+01 #
Anthracene	5.26E+00	1.35E+05 *	1.82E+06 #	4.89E+01 #
Benzo(a)anthracene	3.15E-02	1.19E+03 *	6.56E+05 #	4.42E-02 #
Benzo(a)pyrene	3.15E-03	1.19E+02 *	2.20E+05 #	2.59E-03 #
Benzo(b)fluoranthene	3.15E-02	1.14E+03 *	5.39E+04 #	2.55E-02 #
Benzo(k)fluoranthene	3.15E-02	1.19E+04 *	5.53E+06 #	2.64E-01 #
Chrysene	3.15E-01	6.57E+04 *	5.60E+05 #	4.42E+00 #
Dibenzo(a,h)anthracene	2.99E-03	1.19E+02 *	5.80E+06 #	1.67E-03
Fluoranthene	7.01E-01	4.38E+04 *	5.32E+06 #	4.62E+00 #
Fluorene	7.01E-01	2.75E+04 *	1.23E+06 #	9.66E+00 #
Naphthalene	1.51E-02	2.15E+02 *	4.82E+03 #	5.21E+00 #
Pyrene	5.26E-01	3.37E+04 *	6.36E+06 #	2.52E+00 #
TPH-GRO	9.90E+01	1.29E+06 *	9.06E+04 #	NA
TPH-DRO	1.22E+01	3.01E+06 *	2.42E+05 #	NA
TPH-ORO	NA	2.89E+06 *	NA	NA
Aliphatics - > C6-C8	9.29E+01	1.22E+06 *	4.76E+04 #	NA
Aliphatics - > C8-C10	5.08E+00	5.81E+04 *	1.63E+03 #	NA
Aliphatics - >C10-C12	5.08E+00	4.83E+04 *	1.09E+03 #	NA
Aliphatics - >C12-C16	5.08E+00	4.83E+04 *	2.51E+02 #	NA
Aliphatics - >C16-C21	NA	2.85E+06 *	NA	NA
Aliphatics - >C21-C35	NA	2.85E+06 *	NA	NA
Aromatics - >C8-C10	9.99E-01	1.27E+04 *	4.14E+04 #	NA
Aromatics - >C10-C12	9.99E-01	1.15E+04 *	9.37E+04 #	NA
Aromatics - >C12-C16	9.99E-01	1.15E+04 *	1.46E+05 #	NA
Aromatics - >C16-C21	NA	3.72E+04 *	NA	NA
Aromatics - >C21-C35	NA	3.72E+04 *	NA	NA
Tertiary-amyl-methyl-ether (TAME)	4.03E-01	5.51E+03 *	5.49E+04 #	2.86E+02
Tertiary-butyl-alcohol (TBA)	1.51E+00	2.00E+04 *	5.04E+06 #	2.35E+03
Ethyl-tert-butyl-ether (ETBE)	1.51E+00	2.51E+03 *	2.35E+05 #	7.70E+00
Diisopropyl ether (DIPE)	1.93E+00	2.52E+04 *	2.39E+05 #	5.36E+02
Ethanol	9.46E+00	1.36E+05 *	4.46E+07 #	3.81E+06 #
Methanol	1.93E+01	2.32E+05 *	1.02E+08 #	1.02E+05
Arsenic	1.51E-04	6.54E+02	N/A	2.58E+01
Barium	2.45E-03	4.39E+05	N/A	1.72E+04
Cadmium	1.95E-03	2.81E+03	N/A	8.60E+01
Chromium (III) total chromium	5.08E-04	5.21E+05	N/A	1.29E+05
Chromium (VI)	4.03E-05	4.30E+01	N/A	7.17E-01
Lead	NA	NA	N/A	NA
Selenium	9.99E-04	1.28E+04	N/A	4.30E+02

Notes:

NA: Not available

N/A: Not applicable

Soil concentrations are presented on a dry weight basis.

*: Calculated target level exceeds effective/saturated soil concentration for gasoline. Calculated value is shown.

#: Calculated target level exceeds effective/solubility for gasoline. Calculated value is shown.

+: Calculated target level exceeds effective/saturated vapor concentration for gasoline. Calculated value is shown.

**Table 5 – Tier 1 Risk-Based Target Levels
 Soil Concentration Protective of Domestic Use of Groundwater (Distance to POE of Zero)**

Chemicals of Concern	Depth from Soil Source to Groundwater Table		
	< 20 ft	20 - 50 ft	> 50 ft
Benzene	5.61E-02	1.12E-01	2.24E-01 *
Toluene	2.98E+01	5.95E+01 *	1.19E+02 *
Ethylbenzene	3.99E+01 *	7.97E+01 *	1.59E+02
Xylenes (total)	6.34E+02 *	1.27E+03 *	2.54E+03 *
Ethylene dibromide (EDB)	4.73E-04	9.46E-04	1.89E-03 *
Ethylene dichloride (EDC)	2.06E-02	4.11E-02	8.22E-02 *
Methyl tertiary butyl ether (MTBE)	3.98E-01	7.96E-01	1.59E+00 *
Acenaphthene	1.74E+02	3.49E+02 *	6.97E+02 *
Anthracene	3.06E+03 *	6.11E+03 *	1.22E+04
Benzo(a)anthracene	6.12E+00	1.22E+01	2.45E+01
Benzo(a)pyrene	3.04E+01 *	6.07E+01 *	1.21E+02
Benzo(b)fluoranthene	1.15E+01 *	2.30E+01 *	4.59E+01 *
Benzo(k)fluoranthene	1.18E+02 *	2.37E+02 *	4.73E+02
Chrysene	6.12E+02 *	1.22E+03 *	2.45E+03
Dibenzo(a,h)anthracene	2.38E+00	4.76E+00	9.52E+00
Fluoranthene	2.61E+03 *	5.21E+03 *	1.04E+04 *
Fluorene	2.11E+02 *	4.22E+02 *	8.44E+02 *
Naphthalene	3.25E-01	6.50E-01	1.30E+00
Pyrene	1.50E+03 *	3.01E+03 *	6.01E+03
TPH-GRO	1.81E+04 *	3.61E+04 *	7.22E+04 *
TPH-DRO	2.94E+09 *	5.88E+09 *	1.18E+10 *
TPH-ORO	2.94E+09 *	5.88E+09 *	1.18E+10
Aliphatics - > C6-C8	1.45E+04 *	2.91E+04 *	5.81E+04
Aliphatics - > C8-C10	3.48E+03 *	6.97E+03 *	1.39E+04 *
Aliphatics - >C10-C12	2.59E+04 *	5.19E+04 *	1.04E+05 *
Aliphatics - >C12-C16	1.17E+06 *	2.34E+06 *	4.68E+06
Aliphatics - >C16-C21	2.94E+09 *	5.88E+09 *	1.18E+10
Aliphatics - >C21-C35	2.94E+09 *	5.88E+09 *	1.18E+10
Aromatics - >C8-C10	4.12E+01	8.24E+01	1.65E+02
Aromatics - >C10-C12	6.49E+01	1.30E+02	2.59E+02
Aromatics - >C12-C16	1.29E+02	2.58E+02 *	5.16E+02
Aromatics - >C16-C21	1.11E+03 *	2.21E+03 *	4.43E+03
Aromatics - >C21-C35	8.79E+03 *	1.76E+04 *	3.52E+04
Tertiary-amyl-methyl-ether (TAME)	6.77E-01	1.35E+00	2.71E+00
Tertiary-butyl-alcohol (TBA)	5.58E-01	1.12E+00	2.23E+00 *
Ethyl-tert-butyl-ether (ETBE)	1.06E-01	2.12E-01	4.24E-01 *
Diisopropyl ether (DIPE)	4.12E+00	8.24E+00	1.65E+01 *
Ethanol	7.73E+02	1.55E+03	3.09E+03
Methanol	2.08E+01	4.16E+01	8.32E+01 *
Arsenic	7.21E+00	1.44E+01	2.88E+01 *
Barium	2.04E+03	4.07E+03	8.15E+03 *
Cadmium	9.31E+00	1.86E+01	3.72E+01 *
Chromium (III) total chromium	4.47E+06	8.93E+06	1.79E+07
Chromium (VI)	1.59E-03	3.19E-03	6.37E-03 *
Lead	3.74E+00	7.48E+00	1.50E+01 *
Selenium	6.27E+00	1.25E+01	2.51E+01 *

Notes:

*: Calculated target level exceeds effective/saturated soil concentration for gasoline. Calculated value is shown.

Default vadose zone DAF: 1 for < 20 ft, 2 for 20 - 50 ft, and 4 for > 50 ft

All concentrations in mg/kg

**Table 6 – Tier 1 Risk-Based Target Levels
Soil Concentration Protective of Indoor Inhalation of Vapors from Groundwater to
Building (Distance to Building of Zero) for Residential Land Use**

Chemicals of Concern	Depth from Soil Source to Groundwater Table		
	< 20 ft	20 - 50 ft	> 50 ft
Benzene	1.12E+01	2.25E+01 *	4.50E+01 *
Toluene	1.51E+04 *	3.02E+04 *	6.05E+04 *
Ethylbenzene	5.89E+03 *	1.18E+04 *	2.36E+04 *
Xylenes (total)	7.48E+02 *	1.50E+03 *	2.99E+03 *
Ethylene dibromide (EDB)	2.18E+00	4.36E+00	8.72E+00
Ethylene dichloride (EDC)	3.54E+00	7.09E+00	1.42E+01
Methyl tertiary butyl ether (MTBE)	5.62E+02	1.12E+03	2.25E+03
Acenaphthene	1.69E+06 *	3.39E+06 *	6.78E+06 *
Anthracene	1.00E+07 *	2.01E+07 *	4.02E+07 *
Benzo(a)anthracene	6.55E+06 *	1.31E+07 *	2.62E+07 *
Benzo(a)pyrene	5.66E+06 *	1.13E+07 *	2.26E+07 *
Benzo(b)fluoranthene	1.40E+06 *	2.80E+06 *	5.60E+06 *
Benzo(k)fluoranthene	1.72E+08 *	3.43E+08 *	6.87E+08 *
Chrysene	4.84E+06 *	9.68E+06 *	1.94E+07 *
Dibenzo(a,h)anthracene	5.57E+08 *	1.11E+09 *	2.23E+09 *
Fluoranthene	2.27E+08 *	4.54E+08 *	9.07E+08 *
Fluorene	6.19E+06 *	1.24E+07 *	2.48E+07 *
Naphthalene	6.72E+02 *	1.34E+03 *	2.69E+03 *
Pyrene	2.70E+08 *	5.41E+08 *	1.08E+09 *
TPH-GRO	1.26E+04 *	2.52E+04 *	5.04E+04 *
TPH-DRO	1.22E+05 *	2.45E+05 *	4.89E+05 *
TPH-ORO	NA	NA	NA
Aliphatics - > C6-C8	8.37E+03 *	1.67E+04 *	3.35E+04 *
Aliphatics - > C8-C10	1.73E+03 *	3.47E+03 *	6.94E+03 *
Aliphatics - >C10-C12	8.61E+03 *	1.72E+04 *	3.44E+04 *
Aliphatics - >C12-C16	3.92E+04 *	7.83E+04 *	1.57E+05 *
Aliphatics - >C16-C21	NA	NA	NA
Aliphatics - >C21-C35	NA	NA	NA
Aromatics - >C8-C10	2.51E+03 *	5.02E+03 *	1.00E+04 *
Aromatics - >C10-C12	1.26E+04 *	2.51E+04 *	5.03E+04 *
Aromatics - >C12-C16	6.20E+04 *	1.24E+05 *	2.48E+05 *
Aromatics - >C16-C21	NA	NA	NA
Aromatics - >C21-C35	NA	NA	NA
Tertiary-amyl-methyl-ether (TAME)	1.68E+02	3.37E+02	6.74E+02
Tertiary-butyl-alcohol (TBA)	2.59E+04 *	5.17E+04 *	1.03E+05 *
Ethyl-tert-butyl-ether (ETBE)	7.28E+02	1.46E+03	2.91E+03 *
Diisopropyl ether (DIPE)	9.63E+02	1.93E+03 *	3.85E+03 *
Ethanol	1.80E+05 *	3.61E+05 *	7.22E+05 *
Methanol	7.39E+05 *	1.48E+06 *	2.95E+06 *
Arsenic	N/A	N/A	N/A
Barium	N/A	N/A	N/A
Cadmium	N/A	N/A	N/A
Chromium (III) total chromium	N/A	N/A	N/A
Chromium (VI)	N/A	N/A	N/A
Lead	N/A	N/A	N/A
Selenium	N/A	N/A	N/A

Notes:

NA: Not available

N/A: Not applicable

*: Calculated target level exceeds effective/saturated soil concentration for gasoline. Calculated value is shown.

Default vadose zone DAF: 1 for < 20 ft, 2 for 20 - 50 ft, and 4 for > 50 ft

All concentrations in mg/kg

**Table 7 – Tier 1 Risk-Based Target Levels
 Soil Concentration Protective of Indoor Inhalation of Vapors from Groundwater to
 Building (Building Distance of Zero) for Non-Residential Land Use**

Chemicals of Concern	Depth from Soil Source to Groundwater Table		
	< 20 ft	20 - 50 ft	> 50 ft
Benzene	5.89E+01 *	1.18E+02 *	2.36E+02 *
Toluene	1.22E+05 *	2.43E+05 *	4.86E+05 *
Ethylbenzene	4.74E+04 *	9.48E+04 *	1.90E+05 *
Xylenes (total)	6.02E+03 *	1.20E+04 *	2.41E+04 *
Ethylene dibromide (EDB)	1.14E+01	2.29E+01	4.57E+01
Ethylene dichloride (EDC)	1.86E+01	3.71E+01	7.43E+01
Methyl tertiary butyl ether (MTBE)	2.94E+03	5.89E+03	1.18E+04 *
Acenaphthene	1.36E+07 *	2.73E+07 *	5.45E+07 *
Anthracene	8.08E+07 *	1.62E+08 *	3.23E+08 *
Benzo(a)anthracene	3.43E+07 *	6.86E+07 *	1.37E+08 *
Benzo(a)pyrene	2.97E+07 *	5.94E+07 *	1.19E+08 *
Benzo(b)fluoranthene	7.34E+06 *	1.47E+07 *	2.94E+07 *
Benzo(k)fluoranthene	9.00E+08 *	1.80E+09 *	3.60E+09 *
Chrysene	2.54E+07 *	5.07E+07 *	1.01E+08 *
Dibenzo(a,h)anthracene	2.92E+09 *	5.84E+09 *	1.17E+10 *
Fluoranthene	1.82E+09 *	3.65E+09 *	7.29E+09 *
Fluorene	4.98E+07 *	9.96E+07 *	1.99E+08 *
Naphthalene	3.52E+03 *	7.04E+03 *	1.41E+04 *
Pyrene	2.17E+09 *	4.35E+09 *	8.69E+09 *
TPH-GRO	1.01E+05 *	2.03E+05 *	4.06E+05 *
TPH-DRO	9.84E+05 *	1.97E+06 *	3.93E+06 *
TPH-ORO	NA	NA	NA
Aliphatics - > C6-C8	6.73E+04 *	1.35E+05 *	2.69E+05 *
Aliphatics - > C8-C10	1.39E+04 *	2.79E+04 *	5.58E+04 *
Aliphatics - >C10-C12	6.92E+04 *	1.38E+05 *	2.77E+05 *
Aliphatics - >C12-C16	3.15E+05 *	6.30E+05 *	1.26E+06 *
Aliphatics - >C16-C21	NA	NA	NA
Aliphatics - >C21-C35	NA	NA	NA
Aromatics - >C8-C10	2.02E+04 *	4.03E+04 *	8.07E+04 *
Aromatics - >C10-C12	1.01E+05 *	2.02E+05 *	4.04E+05 *
Aromatics - >C12-C16	4.98E+05 *	9.97E+05 *	1.99E+06 *
Aromatics - >C16-C21	NA	NA	NA
Aromatics - >C21-C35	NA	NA	NA
Tertiary-amyl-methyl-ether (TAME)	1.35E+03	2.71E+03 *	5.42E+03 *
Tertiary-butyl-alcohol (TBA)	2.08E+05 *	4.16E+05 *	8.32E+05 *
Ethyl-tert-butyl-ether (ETBE)	5.86E+03 *	1.17E+04 *	2.34E+04 *
Diisopropyl ether (DIPE)	7.74E+03 *	1.55E+04 *	3.10E+04 *
Ethanol	1.45E+06 *	2.90E+06 *	5.80E+06 *
Methanol	5.94E+06 *	1.19E+07 *	2.38E+07 *
Arsenic	N/A	N/A	N/A
Barium	N/A	N/A	N/A
Cadmium	N/A	N/A	N/A
Chromium (III) total chromium	N/A	N/A	N/A
Chromium (VI)	N/A	N/A	N/A
Lead	N/A	N/A	N/A
Selenium	N/A	N/A	N/A

Notes:

NA: Not available

N/A: Not applicable

*: Calculated target level exceeds effective/saturated soil concentration for gasoline. Calculated value is shown.

Default vadose zone DAF: 1 for < 20 ft, 2 for 20 - 50 ft, and 4 for > 50 ft

All concentrations in mg/kg

AUTHORITY: sections 319.111, RSMo 2000 and 319.109 and 319.137, RSMo Supp. 2007. Original rule filed February 13, 2009.