



**STATE OF TENNESSEE
DEPARTMENT OF ENVIRONMENT AND CONSERVATION
DIVISION OF UNDERGROUND STORAGE TANKS**

TECHNICAL GUIDANCE DOCUMENT - 008

**Effective Date - January 13, 1992
Revised Date - November 19, 1993
Revised Date - August 1, 1996
Revised Date - July 1, 2002**

RE: Exposure Assessment

PURPOSE AND CLARIFICATION

The purpose of this Technical Guidance Document (TGD) is to outline a step by step procedure for complying with the minimum requirements necessary to perform an exposure assessment. An Exposure Assessment Report shall be submitted after all contaminant plumes have been defined to the applicable cleanup levels as required by Rule 1200-1-15-.06(6) and an Environmental Assessment Report (EAR) has been prepared and submitted in accordance with instructions supplied by the Division. The Exposure Assessment is being required by the Division of Underground Storage Tanks in accordance with Rule 1200-1-15-.06(7)(a), which authorizes the Division to require owners and/or operators to submit additional information. The Exposure Assessment should be performed in accordance with this guidance document. Development of the Exposure Assessment Report shall be based on a current comprehensive monitoring event that includes all chemicals of concern (COCs) identified as applicable.

This guidance document shall be used to determine site-specific cleanup levels for the COCs that will provide adequate protection of human health and/or the environment. As a result of this determination, corrective action activities may be necessary to reduce the presence of certain COCs to achieve the site-specific cleanup levels¹. The determination for Total Petroleum Hydrocarbon (TPH) will be based on the presence of naphthalene and the Division's other PAH listed chemicals. Determination of the site-specific cleanup levels of naphthalene and other PAH chemical concentrations will determine the corresponding site conditions to be achieved to render a no further action status for TPH.

The Exposure Assessment Report shall be prepared and submitted in report format in accordance with this guidance document. Each section of the report shall contain the required elements of

¹ The site-specific cleanup levels are aqueous phase levels that will provide adequate protection of human health and/or the environment. The relationship between aqueous phase contamination and non-aqueous phase contamination shall be evaluated to design an appropriate corrective action solution for the site. In accordance with Rule 1200-1-15-.06(4), non-aqueous phase contamination shall be removed to the maximum extent practicable as determined by the Division.

that section and provide reference to any associated tables and maps. Any information that is not specifically requested but is relevant to the evaluation shall also be included². The preparer shall assemble the required information in the order presented within this document so as to provide a comprehensive report. Each section and item heading shall be clearly identified in the report. A table of contents shall be provided listing the location of all sections, maps, tables, and appendices. All calculations must be shown.

Through evaluation in accordance with this guidance document, owners and/or operators that determine no further corrective action activities are necessary may request site-specific cleanup levels indicative of current site conditions by submitting a site-specific standard request (SSR) according to the instructions and format in Attachment 6. Site-specific standard requests for concentrations significantly higher than current site conditions will not be granted, since increases to those levels may denote a change in site conditions. A site-specific standard may be requested for levels to account for seasonal ground water fluctuations. If a higher standard is requested, the risk evaluation must be performed using the requested levels.

Owners and/or operators may also submit a SSR according to the instructions and format in Attachment 6 to petition for the site-specific cleanup levels that this guidance indicates will provide adequate protection of human health and/or the environment. The site-specific cleanup levels will then be used to design a Corrective Action Plan (CAP) to meet these corrective action level goals.

Submittal does not assure approval of an SSR by the Commissioner. The owner and/or operator may petition the Commissioner of the Department of Environment and Conservation to grant a site-specific standard if:

1. "The owner and/or operator has treated petroleum contamination at a site for an extended period of time and the treatment system for soil and/or ground water has reached asymptotic levels for contaminant removal" as stated in Rule 1200-1-15-.06(7)(e)4.
2. "The owner and/or operator believes that a particular site should not be subject to the cleanup requirements in Appendices 4 and 5" as stated in Rule 1200-1-15-.06(7)(e)5. This includes submittal of a SSR to establish site-specific standards for use in designing a CAP to remediate a site. If the SSR is approved, the site shall be remediated to the newly established site-specific standards rather than to the generic cleanup levels listed in Appendices 4 and 5 following Rule 1200-1-15-.07.

If a site-specific standard is granted, it may be revoked in accordance with Rule 1200-1-15-.06(7)(e)6 if it is later determined that the information supplied in the request was not accurate or there has been a change in the information supplied or in actual site conditions. Should the Commissioner deny the properly completed SSR or revoke the site-specific standard, the owner

² It should be noted that costs associated with the collection and reporting of non-required information may not be reimbursable by the Tennessee Petroleum Underground Storage Tank Fund. Pre-approval of such work by the Division case manager is recommended to assure the tank owner and/or operator will know in advance if the cost must be born solely by the owner/operator.

and/or operator may petition the Petroleum Underground Storage Tank Board for the site-specific standard in accordance with Rule 1200-1-15-.06(7)(e)5.

DEFINITIONS

Asymptotic – “Asymptotic” means a graphical representation of the level of contaminant remaining in soil and/or ground water, where the y-axis of the graph indicates contaminant levels and the x-axis represents length of treatment. Samples of the soil and/or ground water shall be taken quarterly. After the slope of the graph approximates the slope of the x-axis, using the data from four consecutive quarters, an asymptotic level of treatment would have been reached, provided that the contaminant treatment system has been properly designed and operated.

Chemicals of Concern (COCs) – “Chemicals of concern” means those chemicals that have been designated as such by the Division in a chemicals of concern table (the most recent is attached as Reference 1). The COCs shall be chemicals that are constituents of or result from the degradation of petroleum product(s) and/or additives released from regulated petroleum underground storage tanks.

PAH – “PAH” means the polycyclic aromatic hydrocarbons listed by the Division in Reference 2 of this document.

Petroleum Site – “Petroleum Site” means any site or area where a petroleum underground storage tank is located.

Source Area – “Source area” means either the location of free product or the location of highest soil and/or ground water concentrations of the chemical(s) of concern.

REQUIRED INFORMATION AND REPORT FORMAT

I. Executive Summary

Provide an Executive Summary describing case development to date. Include conclusions and interpretation of data derived from implementing all environmental assessment and corrective action activities. The summary shall include the applicable cleanup levels as established in the Initial Site Characterization Report (ISCR) and/or the Environmental Assessment Report (EAR) and the site-specific cleanup levels for the COC.

II. Physical and Chemical Characteristics of the Contaminant Plume(s)

Provide the information listed in this section.

A. Physical

1. Scaled plan view maps showing the extent of contamination in accordance with Sections C.4.a. and D.6.a. of the Environmental Assessment Report Guidelines. The maps shall be constructed from the most recent comprehensive monitoring data. Maps shall be constructed for free product, if applicable, and any COC present above detection limits in more than 1 monitoring well.
2. The known source(s) of petroleum contamination, type of petroleum product released, and estimated amount released.
3. The interpreted source area(s) from historical contaminant plume maps constructed as described in Item A.1 of this section if release points are unknown. Areas where soil contamination continues to act as a secondary source for groundwater contamination must be part of this data interpretation even if the soil contaminant levels are below the level in Appendix 5 following Rule 1200-1-15-.07.
4. The background level of each constituent in both the soil and ground water of the area if **naturally-occurring** petroleum is suspected to exist upgradient of the contaminant plume(s).
5. The media (i.e., soil, ground water, etc.) through which the release is spreading or is likely to spread, the direction, and the rate (note: permeability is not acceptable for use as hydraulic conductivity in calculation of ground water flow velocity).

B. Chemical

List the COCs for soil and ground water that are applicable, as determined from the most recent comprehensive monitoring event. Properties of the COCs are listed in Reference 3. Toxicity parameters for the COCs are listed in Reference 4.

III. Hydrogeologic Characteristics of the Petroleum Site and the Surrounding Land

Provide the information listed in this section.

- A. The soil permeability as reported in the ISCR and/or EAR
- B. Ground water recharge area, including map
- C. A summary of the hydrology (ground water flow gradient, direction, hydrologic boundaries and the occurrence of main aquifers or water bearing zones) as presented in the ISCR and/or EAR

IV. Proximity, Quality, and Current and Future Uses of Ground Water

Provide the information listed in this section.

- A. The ground water classification of the aquifer or water source (i.e., drinking water supply or non-drinking water supply) as reported in the ISCR and/or EAR
- B. The results from performing a current water use survey, including any current and/or reasonably expected future uses of the ground water within a one half (0.5) mile radius of the petroleum site (Provide a color topographic map showing the location of all wells and springs as required in Section D.6.a. of the ISCR Guidelines)
- C. The depth to each aquifer or water bearing zone encountered during the investigation

V. Proximity, Quality, and Current and Future Uses of Surface Waters

Provide the information listed in this section.

- A. Any surface waters within a one half (0.5) mile radius and the petroleum site location indicated on a color topographic map. (This map shall be on 8.5 x 11 or 11 x 17 inch paper.)
- B. Any current and/or reasonably expected future uses of surface waters within a one half (0.5) mile radius (i.e., drinking water use, recreation, etc.)

VI. Risk Evaluation

Perform the risk evaluation by providing the information listed in this section. Completed Attachments 1 and 2 shall be included in the report. **Please pay careful attention when using the Risk-Based Screening Level (RBSL) tables in this section due to the use of scientific notation. Incorrect decimal placement may significantly alter the outcome of this evaluation.**

A. Determine Pathways

Using Attachment 1, determine if the potential transport mechanisms and exposure routes exist for the petroleum contamination. Once a decision has been made concerning the applicability of a pathway, indicated by a “Yes” or a “No” in the third column of the table entitled “Exposure Assessment; Potential Human Exposure Pathways”. The rationale for the decision must be included in Column 4 of the table.

The potential for degradation of water supply lines, the movement of vapors into storm and sanitary sewers, and damages to underground gas, phone, and electrical utilities must be evaluated as part of this subsection. An evaluation must be made

which (1) delineates the presence and location, including depth, of various utilities on and adjacent to the petroleum release site, (2) determines the vulnerability of these utilities based on the construction materials used, and (3) reports any potential incompatibility of those materials with petroleum products present in the environment.

B. Determine On-site and Off-site Receptors

Using Attachment 2, determine the current and reasonably expected future receptors (on and off-site). The reason for selection or exclusion of each receptor must be included. Receptors shall be included where any of the following conditions exist or have previously existed:

- A drinking water supply has been impacted
- Presence of petroleum vapors in an enclosed space
- Any surface water on or near the petroleum site has been visibly, or otherwise confirmed, to have been impacted by petroleum

C. Compare Receptors to On-site Risk-Based Screening Levels

Evaluate all on-site receptors that have complete pathways for exposure. Compare the actual on-site concentrations and requested site-specific standards (if applicable) of the COCs, excluding TPH, to the applicable RBSL table values³ in Tables 1 through 4 (derived from the default parameters in References 3 and 4) and the applicable Surface Water Criteria in Table 5.

Provide a table for each applicable receptor formatted as shown in Attachment 3. Enter "NA" for source medium transport mechanisms and exposure routes that are not applicable as indicated in Attachment 1. All RBSLs and Surface Water Criteria that are exceeded shall be highlighted in the table.

D. Evaluate Off-site Receptors Using Fate/Transport Models

Evaluate all off-site receptors that have complete pathways for exposure by using the Fate and Transport Models and the Cross-Media Transfer Definitions and Fate and Transport Parameters in Attachment 4. If site-specific data are unobtainable, the default values provided in Attachment 4 shall be used. This evaluation must include a comparison of the predicted fate and transport of the COCs to the actual contaminant plume. This comparison must indicate that the predicted fate and transport is equivalent to or more conservative than contaminant plume conditions based on (1) known properties of the aquifer as discovered in the investigation, (2)

³ RBSL values for inhalation are based on shallow source depths (i.e., worst case scenario). Concentrations that exceed the RBSL values for inhalation should be further evaluated using equations, such as those provided in ASTM Standard E 1739-95, applicable to evaluation of the chemical of concern according to the exposure pathway, route, and receptor, using the source depth applicable to the site. Only variables for which site-specific data are available may be changed (i.e., variables that are measures of distance and/or specific hydrogeologic properties). Variables that are chemical specific and risk constants may not be changed. All variables and calculations shall be shown.

historical contaminant concentrations, and (3) behavior of the plume. If fate and transport is higher than the model predicts, discuss the reasons for higher transport. There must be at least one compliance monitoring point between the source area monitoring point and the receptor to perform this comparison. If a monitoring well does not exist between the source area and a receptor, the Division case manager shall be notified.

1. The maximum soil concentrations of the COCs, excluding TPH, from the most recent sampling event shall be evaluated using the Soil to Ground Water Leaching Equation.
2. The actual on-site concentrations and requested site-specific standards (if applicable) for the COCs, excluding TPH, shall be evaluated using the Domenico Ground Water Solute Transport Model.
3. The groundwater concentration at the receptor point shall be compared to the applicable RBSLs and Surface Water Criteria in Tables 1 through 5.
4. Provide a table for each applicable receptor that reports LF_{sw} , $C_{max\ soil}$, $C_{leaching}$, $C_{max\ gw}$, $C_{source\ gw}$ and compare the $C(x)$ to the applicable RBSLs and Surface Water Criteria for all COCs. The table shall be formatted as shown in Attachment 5. Enter "NA" for source, medium/transport mechanisms and exposure routes that are not applicable. All RBSLs and Surface Water Criteria that are exceeded shall be highlighted in the table.
5. If any RBSLs or Surface Water Criteria are exceeded in item 4, re-evaluate them using this section to determine the C_{source} value that will not result in a value greater than the applicable RBSLs and Surface Water Criteria. All calculations shall be shown.

VII. Summary

- A. The summary shall list the most restrictive soil and ground water cleanup level for each COC that was determined through the exposure assessment. The most restrictive cleanup levels for soil will be the lowest soil RBSLs highlighted in the table generated in Section VI.C. The most restrictive cleanup levels for ground water will be the lower of (1) the lowest ground water RBSLs and Surface Water Criteria highlighted in the table generated in Section VI.C or (2) the $C_{source\ gw}$ level which will not result in a value greater than the applicable RBSLs and Surface Water Criteria in the off-site exposure assessment.
- B. The summary shall state whether a potential for degradation of water supply lines, movement of vapors into storm and sanitary sewers, or damages to underground gas, phone, and electrical utilities exists or is likely to exist.
- C. The summary shall include a recommendation for corrective action activities, monitoring, and/or a site-specific standard request based on conclusions supported by the exposure assessment. (Note: Site-specific standard requests for concentrations higher than the most

restrictive cleanup level for each COC will not be granted unless site-specific data is used to demonstrate that a higher concentration of the chemical of concern will provide adequate protection of human health and/or the environment. The Division does not currently provide software to complete the calculations necessary for this demonstration. This demonstration shall use equations, such as those provided in ASTM Standard E 1739-95, applicable to evaluation of the chemical of concern according to the exposure pathway, route, and receptor. Only variables for which site-specific data are available may be changed in this demonstration (i.e. variables that are measures of distance and/or specific hydrogeologic properties). Variables that are chemical specific and risk constants may not be changed.)

