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DEPARTMENT OF ENVIRONMENTAL QUALITY REMEDIATION DIVISION

Technical Guidance Document #7

Soil and Groundwater Action Levels for Petroleum Releases

- * This document summarizes the VPH/EPH analytical methodology for petroleum contaminated soil and groundwater. These methods are an integral part of the Risk-Based Corrective Action (RBCA) approach used by the DEQ at petroleum release sites in Montana. Decisions regarding "how clean is clean?" are typically based on site-specific risk based factors (depth to groundwater and the existence of nearby receptors that could be impacted by the release), and are called Risk-Based Screening Levels (RBSLs).
- * The following standards apply to corrective action associated with releases from petroleum storage tanks: 1) Montana Numerical Water Quality Standards (DEQ-7) for specific compounds such as benzene; and 2) TCLP if the contaminant could be classified as a hazardous waste.
- * If a DEQ-7 standard exists, that standard is the clean-up requirement. For the aromatic and aliphatic fractions the RBSLs apply.

Implementation of the Volatile Petroleum Hydrocarbons (VPH) Method

The Montana Department of Environmental Quality (DEQ) has required the Volatile Petroleum Hydrocarbon (VPH) Method for analysis of soil and groundwater samples submitted to analytical laboratories since October 15, 1999. The VPH method replaced Gasoline Range Organics/ methyl tertiary butyl ether, benzene, toluene, ethylbenzene, xylenes, and naphthalene (GRO/MBTEXN) for all samples collected from sites where a release of gasoline, jet fuel JP-4, mineral spirits, Stoddard, crude oil, diesel, solvent, aviation gas or other similar petroleum products has or is thought to have occurred. DEQ decided to employ the VPH method because it provides a better analysis of the composition and environmental behavior of the contaminant and generates a better data set from which to evaluate health risks.

Soils

The RBCA Tier 1 soil targets are utilized for site assessments. The VPH analysis allows for direct comparison of the analytical results to the soil targets presented in the RBCA Tier 1 lookup tables. The soil targets were generated by the DEQ for the gasoline range aliphatic and aromatic hydrocarbon fractions, and MBTEXN using EPA risk equations, beneficial use criteria and soil leaching to groundwater modeling. The soil targets are protective of the Risk-Based Screening Levels (RBSLs) and Montana Numerical Water Quality Standards (DEQ-7) for groundwater, as well as dermal contact and ingestion pathways for surface soils.

Groundwater

Numerical water quality standards for MBTEXN plus RBSLs for aromatic hydrocarbon and aliphatic hydrocarbon fractions have been developed for groundwater. The RBCA Tier 1 groundwater RBSLs and numerical water quality standards are utilized for site assessments. The

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VPH analysis allows for direct comparison of analytical results to the RBCA Tier 1 lookup table for groundwater.

Implementation of the Extractable Petroleum Hydrocarbons (EPH) Method

The DEQ has required the Extractable Petroleum Hydrocarbon Method (EPH) for analysis of soil and groundwater samples submitted to analytical laboratories since **October 15, 1999**. The EPH method has replaced DRO for all samples collected from a site where a release or a suspected release of diesel #1, diesel #2, jet-A, kerosene, waste oil, heating (fuel) oil #3-6, crude oil, mineral/dielectric fluids or other similar petroleum product has or is thought to have occurred. DEQ utilizes the EPH method because it provides a better analysis of the composition and environmental behavior of the contaminant and generates a better data set from which an evaluation of health risks can be made.

Soils

The RBCA Tier 1 soil targets are utilized for site assessments. **A concentration of 200 parts per million (ppm) Extractable Petroleum Hydrocarbons (EPH) Screen is used as the investigatory limit for site assessments at diesel release sites.** 200 ppm coincides with the most conservative RBSL scenario for EPH (C11-C22 aromatics, surface soil, residential scenario, <10 feet to groundwater). The EPH method provides fractionation and polycyclic aromatic hydrocarbon (PAH) data, none of which are determined by the DRO method, plus the EPH analysis allows for direct comparison of the analytical results to the soil targets presented in the RBCA Tier 1 lookup tables. The soil targets were generated by the DEQ for the diesel range aliphatic and aromatic hydrocarbon fractions and PAHs using EPA risk equations, beneficial use criteria and soil leaching to groundwater modeling. The soil targets are protective of the RBSLs and HHSs for groundwater.

In an attempt to reduce the analytical costs for the EPH analysis the DEQ, in consultation with a number of regional laboratories, has adopted a two-step screening technique that is outlined in the EPH Method to evaluate soils at diesel #1, diesel #2, jet-A, kerosene, waste oil, heating (fuel) oil #3-6, crude oil, mineral/dielectric fluids or other similar petroleum product release sites. The first step in the screening technique is similar to a DRO analysis and generates an EPH Screen concentration. A concentration of 200 parts per million (ppm) has been selected for the screening action level. If the initial screening result is 200 ppm or less, then fractionation of the sample into aromatic and aliphatic fractions is not required. However, if the screening result is greater than 200 ppm, then the sample will be subjected to the EPH fractionation step and possibly PAH analysis (on a case by case basis). The purpose of using the screening technique is to eliminate performing a \$240 analysis (EPH with PAHs) on a “clean” soil sample.

Extent and Magnitude of Soil Contamination

The extent and magnitude of a release is defined when the investigation through laboratory data obtained from excavations, test pits, or soil borings, etc. demonstrate that the contaminant concentrations are decreasing both horizontally and vertically to where there are no EPH or VPH RBSL exceedances.

Groundwater

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Numerical water quality standards for PAHs plus RBSLs for the aromatic and aliphatic hydrocarbon fractions have been developed for groundwater. The RBCA Tier 1 groundwater Numerical water quality standards and RBSLs are utilized for site assessments. The EPH analysis allows for direct comparison of analytical results to the RBCA Tier 1 lookup table for groundwater. The RBSLs for the C11-C22 aromatic fraction and the C9-C18 aliphatic fraction are 1000 ppb and 500 ppb, respectively. The beneficial use threshold for the C19-C36 aliphatic hydrocarbons is 1,000 ppb. In RBCA Tier 1 scenarios, the summation of the analytical results for the three fractions cannot exceed the beneficial use criteria of 1,000 ppb TEH providing there are no individual fraction exceedances.

MBTEXN have been detected at diesel release sites at concentrations that exceed the DEQ-7 standards for those compounds. Consequently, VPH analysis is required in addition to the EPH method at all diesel release sites to analyze for MBTEXN and the C5-C8, C9-C12 aliphatic fractions and C9-C10 aromatic fraction.

PAH analysis for groundwater must be performed using EPA Method 8270.

Cost Reduction

To reduce analytical costs, the EPH screening technique is utilized. The screening technique approach is similar to that as described above for soils. On a case-by-case basis the EPH Screen concentration can be used in lieu of the TEH concentration derived after the silica gel extraction process to track contaminant contamination trends. Utilizing the EPH Screen approach eliminates the need to perform the significantly more expensive fractionation analysis.

Turn Around Times for VPH/EPH

Currently the rush turn around time for VPH is approximately 48 – 72 hours and for EPH, it is approximately 5 days. For diesel impacted sites, if the EPH screening technique is used, the turn-around time is estimated to be as rapid as 48 hours. The actual turn around times will depend on laboratory capabilities.

Analytical Requirements for Soils

Table 1 (below) outlines the analytical methods that are recommended for individual petroleum products. For example, VPH and EPH screen is required for the initial soil analysis for diesel #2. VPH will be run to determine the concentrations of MBTEXN and gasoline range aromatic and aliphatic fractions that are present in the soil. If the result of the EPH screening concentration is greater than 200 ppm then further analytical work is needed. The diesel range aliphatic and aromatic fractions will be obtained using the EPH fractionation step. PAH concentrations may be also be required on a site specific basis regardless of the EPH screen concentration.

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Table 1- Testing Procedures for Soils

Petroleum Product	VPH	EPH Screen	EPH Fractionation	EPH for PAHs	RCRA Metals	EPA Method 8260B for Volatiles	Oxygenates & Lead Scavengers
Gasoline/Aviation Gas	R						SS
Diesel #1	R	R	X				
Diesel #2	R	R	X				
#3- #6 Fuel Oils		R	X				
Waste Oil	R	R	X	SS	R	R	SS
Jet Fuel/Kerosene	R	R	X				
Jet Propellants (JP-4, JP-5, JP-8, etc.)	R	R	X				SS
Mineral/Dielectric Oils		R	X				
Heavier Wastes	SS	R	X	X			
Crude Oil	R	R	X	X			
Unknown Oils/Sources	R	R	X	SS	R	R	SS

R- required analysis

X - analysis to be run if the EPH screen concentration is >200 ppm TEH

SS- Site specific determination. Analysis may be required if the EPH screen concentration is >200 ppm TEH.

Analytical Requirements for Groundwater

The testing procedure for groundwater is somewhat similar to the approach used for soils. In Table 2, using diesel #2 as an example, the required analyses are VPH for MBTEXN and gasoline range aromatic and aliphatic fractions plus the EPH screen. The VPH analysis is required for all products that may contain volatile organic compounds. The EPH screening technique is employed to generate an EPH Screen concentration. If the EPH Screen concentration is greater than 500 ppb then additional EPH fractionation with or without PAH analysis may be required. PAH concentrations may be also be required regardless of the EPH screen concentration. The decision for requiring EPH fraction data and/or PAH analysis by EPA Method 8270 will be a site-specific determination.

Table 2- Testing Procedures for Groundwater

Petroleum Product	VPH	EPH Screen	EPH Fractionation	EPA Method 8270 for PAHs	EPA Method 8260B for Volatiles	Oxygenates & Lead Scavengers
Gasoline/Aviation Gas	R					SS
Diesel #1	R	R	SS	SS		
Diesel #2	R	R	SS	SS		
#3- #6 Fuel Oils		R	SS	SS		
Waste Oil	R	R	SS	SS	R	SS
Jet Fuel/Kerosene	R	R	SS	SS		
Jet Propellants (JP-4, JP-5, JP-8, etc.)	R	R	SS	SS		SS
Mineral/Dielectric Oils		R	SS	SS		
Heavier Wastes	SS	R	SS	SS		
Crude Oil	R	R	SS	SS		
Unknown Oils/Sources	R	R	SS	SS	R	SS

R - required analysis

SS – Site-Specific determination. Analysis may be required if the EPH screen concentration is >500 ppb TEH.

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