Investigation requirements for fuel releases containing lead scavengers

Petroleum Remediation Program

This guidance document describes site investigation requirements for leaded fuel releases investigated under the Minnesota Pollution Control Agency's (MPCA) Petroleum Remediation Program (PRP). The lead scavengers addressed in this guidance document are 1,2-dibromoethane (ethylene dibromide, or EDB) and 1,2-dichloroethane (DCA).

These requirements are for:

- Sites that have had a confirmed leaded fuel release;
- Sites that store or have stored leaded fuel;
- Sites where the released product is unknown (potential leaded fuel release); or
- Any leak sites where lead scavengers (DCA or EDB) have been detected.

I. Introduction

Lead scavengers are synthetic organic chemicals added to leaded gasoline to prevent buildup of lead deposits in internal combustion engines. According to the U.S. Environmental Protection Agency (USEPA), the use of EDB began in 1925, and in the 1940s, DCA was added as a partial replacement of EDB. The USEPA initiated the reduction of lead content in leaded fuel in 1973 and lowered the lead fuel standards in 1982 and 1986. In 1996, the use of leaded fuel for on-road uses was banned. Leaded fuel is still used in some off-road vehicles and in aviation.

EDB and DCA are recalcitrant compounds that exhibit low to moderate adsorption to particulates and are therefore highly mobile in groundwater. Groundwater with large amounts of dissolved contamination tends to be more dense than uncontaminated groundwater, often resulting in a diving contamination plume. Due to the physical properties of EDB and DCA, leaded fuel releases require investigation beyond that described in the PRP's Soil and groundwater assessments performed during site investigations, Risk evaluation and site management decision at petroleum release sites, and Groundwater sample collection and analysis procedures. The degree of additional investigation varies depending on if the release is confirmed or potential. Confirmed releases generally require a Remedial Investigation (RI). For potential releases, the need for additional investigation is determined by leaded fuel release-specific data collected during the Limited Site Investigation (LSI).

The MPCA's Site Remediation Section has guidance documents for sites where chlorinated solvents have been released. Guidance documents c-rem3-22 through c-rem3-26 are based on guidance published by the Interstate Technology Regulatory Council (ITRC) and can be found on the MPCA's Cleanup guidance and assistance webpage. Although these guidance documents largely focus on chlorinated solvent releases and dense non-aqueous phase liquid (DNAPL), reference them in conjunction with PRP's guidance documents when planning and implementing site investigation and cleanup at leaded fuel leak sites.

II. Additional investigation and monitoring requirements at leaded fuel release sites

A. Limited site investigation

1. **Shallow and deep groundwater samples are required:** Since DCA and EDB are known to persist, assess groundwater at shallow and deep depths. In addition to collecting a "shallow" groundwater sample at the water table in the source area, collect a second, discrete "deep" groundwater sample in the source area. Utilize an appropriate drilling technology that seals off the borehole with multiple casings during sample collection, such as sonic drilling or direct push using a dual tube® sampler. Collect the deep groundwater sample from an underlying aquifer or from the underlying saturated unit/layer of different soil type than the shallow sample interval, which will be determined in the field. Determine the presence of an underlying aquifer prior to field sampling via literature review and/or review of nearby leaksite files and well logs. If the depth to an underlying aquifer or different soil type is more than 20 feet, then collect the deep groundwater sample at a depth of at least 20 feet below the water table. Use a well screen no longer than 5 feet in length when collecting deep groundwater samples.

   Additionally, collect a second deep groundwater sample from the nearest (inferred) downgradient sample location. Determine the inferred downgradient groundwater flow direction prior to field sampling via literature review and/or nearby leak site file review if the flow direction is not known. Determine the well screen depth in the downgradient boring as with the source boring and may differ slightly in depth but should not be shallower than the source boring well screen interval. Use a well screen no longer than 5 feet in length.

   These deep groundwater samples are required and can be collected from either temporary wells or permanent wells.

2. **Additional groundwater sample analysis:** In addition to analysis of volatile organic compounds (VOCs) as required in Soil and groundwater assessments performed during site investigations, analyze all groundwater samples for low level EDB via EPA SW-846 Method 8011 or Method 8260/SIM. Laboratory data with elevated reporting limits may not be accepted.

3. **Expanded receptor survey:** Expand the receptor survey radius from 500 to 1,000 feet. Sample all identified water supply wells within 1,000 feet for VOCs via EPA Method 524 and low-level EDB via EPA Method 504.1. Use the most recent versions of EPA Methods 524 and 504 when analyzing drinking water samples.

4. **Remedial Investigation (RI) determination:** An RI is required if DCA or EDB are detected in groundwater and an aquifer has been or is likely to become contaminated.

B. Remedial investigation

In addition to the RI steps presented in Soil and groundwater assessments performed during site investigations, an RI at a leaded fuel release site requires vertical as well as horizontal delineation of the EDB/DCA plume, and long-term monitoring of groundwater. Additional characterization of the plume will likely be required prior to installing deep monitoring wells. This section explains monitoring well placement, aquifer characterization, and the expanded receptor survey for leaded gas releases.

1. **Site characterization:** To determine the most effective monitoring well locations and screen depths, obtain a more thorough understanding of the site geology, hydrology and movement of EDB and DCA in the saturated and unsaturated zones. Characterize low-permeability zones vertically and horizontally since contamination can become entrapped in fine-grained soil, which can act as an ongoing source of contamination. Dense non-aqueous phase liquids guidance: Site characterization and the ITRC Tool Selection Worksheet provide resources for selecting the appropriate technologies to characterize lithology, permeability, and hydraulic conductivity. High-resolution site characterization may be appropriate for sites with complex hydrology (see Dense non-aqueous

phase liquids guidance: Site characterization). High frequency sampling from multiple discrete sample depths in temporary wells may be appropriate.

2. **Monitoring well placement and construction:** Similar to non-leaded release sites, a source well and delineation wells are needed to delineate the horizontal and vertical extent of the groundwater plume. As indicated in Dense non-aqueous phase liquids guidance: Site characterization, the selection of intervals for well screens should not be solely dependent on photo ionization detector (PID) readings. Site characterization may have identified a complex flow pattern both horizontally and vertically at depth, which may require well screens to be set at varying depths and potentially at more than just two depths.
    a. For example: a nested well grouping may include three or more wells screened at various depths, depending upon the size and complexity of the plume.

    Submerged well screens should be no longer than 5 feet in length. Take extra precautions to prevent creation of new contaminant migration pathways. Delineate the horizontal and vertical extent of DCA and EDB in groundwater prior to submittal of the Remedial investigation report, and collect at least two rounds of quarterly groundwater samples from all monitoring wells.

3. **Sample analysis:** In addition to analysis of VOCs, analyze all groundwater samples for low level EDB via EPA SW-846 Method 8011. Alternatively, all groundwater samples may be analyzed for VOCs via Method 8260/SIM. Refer to Groundwater sample collection and analysis procedures for further information.

C. Remediation and long-term monitoring

1. **Long-term monitoring:** Due to the persistence of DCA and EDB in the subsurface and low drinking water standards for these compounds, groundwater monitoring is required for at least twelve quarters over a three-year period. The need for monitoring beyond three years depends on plume stability and risk to aquifer(s). Include a graph of DCA and/or EDB concentrations and water levels over time in Monitoring reports.

2. **Corrective action:** As presented in Risk evaluation and site management decision at petroleum release sites, Section VI(A), corrective action will usually be required when risk to a receptor is considered high. In addition to the high-risk conditions noted in Section VI(A) of Risk evaluation and site management decision at petroleum release sites, corrective action will usually be required at sites with DCA and/or EDB detections in a drinking water aquifer; that is, an aquifer that is tapped by a well or may become tapped by a well. Consider future use of the aquifer in this determination, and it may be helpful to interview city officials or other personnel knowledgeable about local water use and local water well regulations.

List of additional information:

Lead Scavengers Compendium: Overview of Properties, Occurrence, and Remedial Technologies (EPA, 2006)

Natural Attenuation of the Lead Scavengers 1,2-Dibromoethane (EDB) and 1,2-Dichloroethane (1,2-DCA) at Motor Fuel Release Sites and Implications for Risk Management (EPA/600/R-08/107, September 2008)