

# **Letter Health Consultation**

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## **EVALUATION OF FORMER LEAKING UNDERGROUND STORAGE TANK AT FIRE STATION 28**

**DENVER, JEFFERSON COUNTY, COLORADO**

**Prepared by the  
Colorado Department of Public Health and Environment**

SEPTEMBER 3, 2009

Prepared under a Cooperative Agreement with the  
U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES  
Agency for Toxic Substances and Disease Registry  
Division of Health Assessment and Consultation  
Atlanta, Georgia 30333

## **Health Consultation: A Note of Explanation**

A health consultation is a verbal or written response from ATSDR or ATSDR's Cooperative Agreement Partners to a specific request for information about health risks related to a specific site, a chemical release, or the presence of hazardous material. In order to prevent or mitigate exposures, a consultation may lead to specific actions, such as restricting use of or replacing water supplies; intensifying environmental sampling; restricting site access; or removing the contaminated material.

In addition, consultations may recommend additional public health actions, such as conducting health surveillance activities to evaluate exposure or trends in adverse health outcomes; conducting biological indicators of exposure studies to assess exposure; and providing health education for health care providers and community members. This concludes the health consultation process for this site, unless additional information is obtained by ATSDR or ATSDR's Cooperative Agreement Partner which, in the Agency's opinion, indicates a need to revise or append the conclusions previously issued.

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LETTER HEALTH CONSULTATION

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## LETTER HEALTH CONSULTATION

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TO: ALICE LUHAN AND DIANE DELLILLIO (CITY AND COUNTY OF DENVER)

FROM: SHANNON ROSSITER, MPH (CCPEHA/DCEED/CDPHE)

SUBJECT: EVALUATION OF FORMER LEAKING UNDERGROUND STORAGE  
TANK AT FIRE STATION 28

DATE: 9/3/09

CC: RAJ GOYAL, PHD (CCPEHA/DCEED/CDPHE)

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The City requested assistance from the Colorado Cooperative Program for Environmental Health Assessments (CCPEHA) to evaluate the potential health hazards with respect to current and future air quality at Fire Station 28. The purpose of this document is to identify any present or future potential health implications to firefighters resulting from inhalation of volatile organic compounds (VOCs) as a result of vapor intrusion inside Fire Station 28 and recommend actions to reduce the exposure, if necessary.

The site is currently operated by the City as an active fire station. Fire Station 28 was constructed in 1972 and is located at 4306 S. Wolff Street, Denver, Colorado 80236. The Fire Station 28 is located approximately  $\frac{3}{4}$  of a mile northeast of Marston Lake in Jefferson County and approximately 2 miles west of the South Platte River.<sup>1</sup>

On February 10, 1992, a 550-gallon underground storage tank (UST) located adjacent to the northwest corner of the fire station was removed after failing a tank tightness test. The UST basin area was excavated and soil samples were collected to further delineate hydrocarbon impacts in the subsurface. During 1992 and 1993, several groundwater monitoring wells were installed to assess dissolved-phase hydrocarbon impacts in groundwater across the site.<sup>2</sup>

Much remediation has already taken place. A contractor to the City is currently conducting cleanup of the contamination originating from the former leaking UST, which has been removed from the site. Remediation, monitoring, and sampling activities performed historically at the site were conducted in accordance with the amended Corrective Action Plan (CAP) that was submitted to the Colorado Division of Oil and

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1 Camp Dresser & McKee, Inc. (2008). *Monitoring and Remediation Report, Version 1.3*. March 5 2008.

2 Camp Dresser & McKee, Inc. (2008). *Monitoring and Remediation Report, Version 1.3*. March 5 2008.

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Public Safety (OPS) by Pinyon Environmental Engineering Resources, Inc. (Pinyon) in January 2000. In 2006, a CAP modification was approved by OPS; Camp Dresser & McKee (CDM) has subsequently implemented the provisions included therein. Activities being performed at the site currently consist of: 1) groundwater remediation via extraction, treatment, and peroxide injection; 2) groundwater monitoring; and 3) reporting. Recent 2009 groundwater sampling indicated groundwater contamination of benzene (8.86 ppb) and MTBE (798 ppb), with levels above the state health risk-based concentrations. Despite the limited extent of the plume beneath Fire Station 28, and out of an abundance of caution, the remaining site-related concerns include the potential for MTBE and/or benzene exposure via vapor intrusion into Fire Station 28 and impacting City employees.<sup>3</sup> Therefore, indoor air monitoring was conducted at Fire Station 28 to determine if vapor intrusion was potentially exposing city employees to contaminated indoor air.

Many chemicals in unleaded gasoline evaporate readily into the air. For example, various combinations of benzene, toluene, ethylbenzene, and xylene (BTEX) are among the most frequently found mixtures in completed exposure pathways at gasoline-contaminated hazardous waste sites. BTEX belong to a class of organic compounds called volatile organic compounds (VOCs). VOCs have high vapor pressures that enable their vapors to readily enter the atmosphere. Vapor intrusion refers to the migration of VOC vapors from a subsurface zone into homes and buildings where people can be exposed. Subsurface sources can include contaminated groundwater and/or soils. Typically, vapors migrate through soils into indoor air spaces of overlying buildings.<sup>4</sup>

## Discussion

For indoor air monitoring, a total of three samples were taken in January 2009, including samples taken in the basement, living area, and sleeping quarters of Fire Station 28.<sup>5</sup> Benzene, toluene, ethylbenzene, and xylene were detected in the living areas and sleeping quarters with the highest concentrations in the living quarters (Table 2). It is important to note that the sample taken in the basement did not detect any of the chemicals sampled. Furthermore, no site-specific background samples are available for comparison. Because there are fewer than ten samples collected, the maximum concentration was chosen as the Exposure Point Concentration (EPC) used in all analyses.

For the indoor air analysis, the maximum concentration was compared with ATSDR health based environmental guidelines or Comparison Values (CVs) to select contaminants of potential concern (COPCs) for further evaluation of potential health

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3 Camp Dresser & McKee, Inc. (2008). *Monitoring and Remediation Report, Version 1.3*. March 5 2008.

4 U. S. Environmental Protection Agency, (EPA 2006). *Introduction to Indoor Air Quality, VOCs*; last update September 2006. Available on the Internet at: <http://www.epa.gov/iaq/voc.html>, accessed August 2008.

5 Origins Laboratory (2009). *Analytical Results for Samples Taken at Fire Station 28*. January 29, 2009.

effects. Exposures to contaminants below the health risk-based environmental guidelines are not expected to result in adverse or harmful health effects and thus are not evaluated further.

Indoor air inhalation cancer risks and noncancer hazards were estimated using exposure assumptions of 8 hours/day for 250 days/year for 25 years, and two different inhalation rates to account for a range of physical activity (i.e., low and high) by Fire Station 28 workers. These calculations yield estimated theoretical cancer risks for benzene that range from 9.65 E-06 (10 excess cancer cases per million persons exposed) at a low activity level to 2.08 E-05 (21 excess cancer cases per million persons exposed) at a high activity level (Table 1). The theoretical cancer risks for benzene are well within the US Environmental Protection Agency's (EPA's) acceptable risk range of 1 in a million to 100 in a million for both activity levels. As a matter of prudent public health practice, CDPHE prefers that any exposures to potential carcinogens be reduced as much as possible and has established a policy goal of reducing potential long-term cancer risks to 1 in a million.

The theoretical cancer risks for MTBE are below the acceptable risk level and are not likely to be of concern (Table 1). However, the cumulative theoretical estimated cancer risks for benzene and MTBE together are above the CDPHE long-term cancer risk goal for both high and low activity levels (Table 1). Significant non-cancer health effects are not likely from indoor air exposures to benzene and MTBE because the maximum detected concentrations are below the ATSDR and/or EPA health guidelines (Table 1).

It is important to note that the above findings are associated with some major uncertainties. Site-related contamination is not the only source of BTEX in indoor air. The contribution of BTEX from indoor sources to the overall indoor air concentration of BTEX introduces a level of uncertainty to the analysis of indoor air samples since it is often difficult to define the contribution of BTEX from each source. Here, in particular, there is anecdotal information that suggests the door adjoining the living quarters of the fire station to the garage where the fire trucks, lawn mowers, etc., are stored is typically left open. This anecdotal information in combination with the failure to detect gasoline constituents in the basement level air sample suggests that the levels of benzene and MTBE detected in the living and sleeping quarters may be attributable to the open door to the garage rather than vapor intrusion. The findings of this health consultation are further limited by a small number of indoor air samples.

Nonetheless, EPA, IARC, and the Department of Health and Human Services have concluded that benzene is a human carcinogen. The Department of Health and Human Services determined that benzene is a known carcinogen based on human evidence showing a causal relationship between exposure to benzene and cancer. Under EPA's most recent guidelines for carcinogen risk assessment, benzene is characterized as a known human carcinogen for all routes of exposure. Since, benzene is a known human carcinogen, no matter what the source, exposure to benzene should be minimized based on prudent public health practice.

## Conclusions

Based on the review of the available indoor data, CCPEHA and ATSDR reached three important conclusions for the workers of Fire Station 28 in this health consultation:

CCPEHA and ATSDR conclude that breathing benzene, toluene, ethylbenzene, MTBE, and xylene in the indoor air at Fire Station 28 is not expected to harm people's health. The reason for this is that the theoretical cancer risks for long-term exposure to measured levels of benzene and MTBE are within or below the US Environmental Protection Agency's (EPA's) acceptable cancer risk range. Furthermore significant non-cancer health effects are not likely from breathing indoor air contaminated with benzene and MTBE because the maximum detected concentrations are below the ATSDR and/or EPA health guidelines (or "safe levels"). It is however, important to note that benzene has the potential for increased cancer risk since the theoretical estimates exceed the low-end of the acceptable cancer risk range, and it is a known human carcinogen. Therefore, CCPEHA considers it prudent to reduce inhalation of the VOC-contaminated indoor air.

CCPEHA and ATSDR cannot conclude whether breathing benzene, toluene, ethylbenzene, MTBE, and xylene in the indoor air at Fire Station 28, in the future, could harm people's health. The reason for this is that the information we need to make a decision is not available because it is not known if the levels of VOCs currently measured in the indoor air at Fire Station 28 will remain at current levels. It is likely that they will decrease with time if new guidelines/policies are implemented to ensure that the door between the garage and living quarters remains closed.

The levels of benzene and MTBE detected in the living and sleeping quarters may be attributable to the open door to the garage rather than vapor intrusion. The reason for this is that anecdotal information in combination with the failure to detect gasoline constituents in the basement level air sample suggests that the levels of benzene and MTBE detected in the living and sleeping quarters may be attributable to garage contaminants (e.g., fire trucks, lawn mowers, and other gas-powered equipment) migrating to these areas.

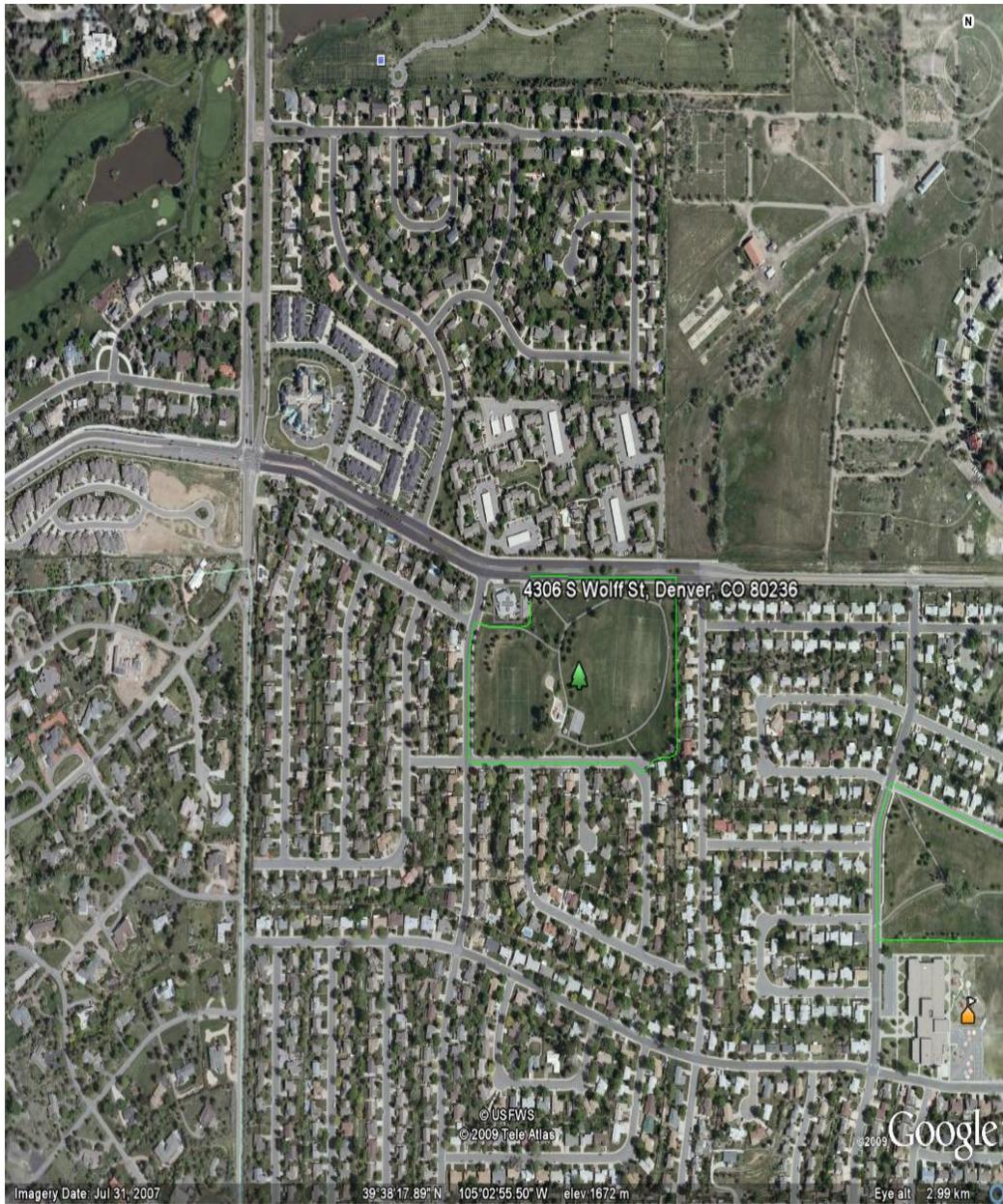
## **Recommendations**

Based on prudent public health practice, the following recommendations should be implemented:

- Continue with remediation on-site.
- The City should consider implementing new guidelines/policies or institutional controls to ensure that the door between the garage and living quarters remains closed and limits any exposure to VOCs emanating from the garage.
- The City should ensure that benzene levels in the indoor air are kept to a minimum even if exposure to benzene is not related to the former leaking underground storage tank. This can be achieved by considering periodic indoor air monitoring in Fire Station 28.

## Tables and Figures

Figure 1. Ariel Photograph Outlining Approximate Location of Fire Station 28, Google Earth



**Table 1. Theoretical Cancer Risks and Noncancer Hazards for Benzene and MTBE Using Risk-Based Concentrations in Indoor Air**

| <b>Contaminant</b>     | <b>EPC<br/>(<math>\mu\text{g}/\text{m}^3</math>)</b> | <b>Activity Level</b> | <b>Cancer Risk</b> | <b>Noncancer<br/>HQ <small>Health guideline</small></b> |
|------------------------|--|-----------------------|--------------------|---|
| Benzene                | 11   | Low                   | 9.65E-06           | 0.12 <sup>b</sup>                                       |
| MTBE                   | 1.8  | Low                   | 5.32E-08           | 0.0002  |
| Cumulative Cancer Risk |  |                       | 9.71E-06           |   |
| Benzene <sup>a</sup>   | 11   | High                  | 2.08E-05           | 0.25 <sup>b</sup>                                       |
| MTBE                   | 1.8  | High                  | 1.14E-07           | 0.0004  |
| Cumulative Cancer Risk |  |                       | 2.09E-05           |   |

<sup>a</sup> The EPC of 11  $\mu\text{g}/\text{m}^3$  for benzene is well below the ATSDR acute MRL of 30  $\mu\text{g}/\text{m}^3$ , the ATSDR intermediate MRL of 20  $\mu\text{g}/\text{m}^3$ .

<sup>b</sup> These HQs will be 3-fold higher based on the ATSDR chronic MRL of 10  $\mu\text{g}/\text{m}^3$  (vs. EPA RfC of 30  $\mu\text{g}/\text{m}^3$  used to derive HQs).

**Note:**

- Exposure doses estimated using the following assumptions:
  - Low activity level inhalation rate = 1.1625  $\text{m}^3/\text{hour}$  or 9.3  $\text{m}^3/\text{day}$
  - High activity level inhalation rate = 2.5  $\text{m}^3/\text{hour}$  or 20  $\text{m}^3/\text{day}$
  - Exposure duration = 25 years
  - Exposure frequency = 250 days/year
  - Exposure time = 8 hours/day
  - Body weight = 70 kg
- HQ = Hazard Quotient = Calculated by dividing the estimated exposure dose with the EPA health guideline or LOAELs. ATSDR MRLs or LOAELs are also taken into consideration through discussions in the text.
- $\mu\text{g}/\text{m}^3$  = Micrograms per Cubic Meter of Air
- EPC = Exposure Point Concentration (the maximum detected value)
- HQ = Hazard Quotient

**Table 2. Summary of Indoor Air Data Collected at Fire Station 28**

| Sample Location   | Date      | Benzene<br>( $\mu\text{g}/\text{m}^3$ ) | Toluene<br>( $\mu\text{g}/\text{m}^3$ ) | Ethylbenzene<br>( $\mu\text{g}/\text{m}^3$ ) | o-Xylene<br>( $\mu\text{g}/\text{m}^3$ ) | m p-Xylene<br>( $\mu\text{g}/\text{m}^3$ ) | MTBE<br>( $\mu\text{g}/\text{m}^3$ ) |
|-------------------|-----------|---|---|--|--|--|--------------------------------------|
| Basement          | 1/15/2009 | ND                                      | ND                                      | ND   | ND                                       | ND   | ND                                   |
| Living Area       | 1/15/2009 | 11                                      | 31                                      | 5.2  | 5.9                                      | 15   | ND                                   |
| Sleeping Quarters | 1/15/2009 | 7                                       | 22                                      | 3.9  | 4.4                                      | 12   | ND                                   |
|                   |           |   |   |  |  |  |                                      |
| <b>Max Value</b>  |           | <b>11</b>                               | <b>31</b>                               | <b>5.2</b>                                   | <b>5.9</b>                               | <b>15</b>                                  | <b>1.8</b>                           |

**Note:**

- $\mu\text{g}/\text{m}^3$  = Micrograms per Cubic Meter of Air
- UCL = Upper Confidence Limit
- The maximum value for MTBE is equivalent to  $\frac{1}{2}$  of the reporting limit of the sample taken in the living area ( $3.6 \mu\text{g}/\text{m}^3$ ). This is the highest reporting limit of the three samples.

**Table 3. Selection of Chemicals of Potential Concern (COPCs) in Indoor Air at Fire Station 28**

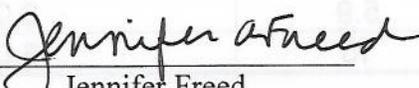
| Compound     | Maximum Conc. ( $\mu\text{g}/\text{m}^3$ ) | ATSDR Comparison Value CREG/EMEG ( $\mu\text{g}/\text{m}^3$ ) | Selected COPCs |
|--------------|--|---|----------------|
| MTBE         | 1.8  | NA  | Y              |
| Benzene      | 11   | 0.1   | Y              |
| Toluene      | 31   | 300   | N              |
| Ethylbenzene | 5.2  | 3,000   | N              |
| o-Xylene     | 5.9  | 3,000   | N              |
| m, p-Xylene  | 15   | 3,000   | N              |

**Note:**

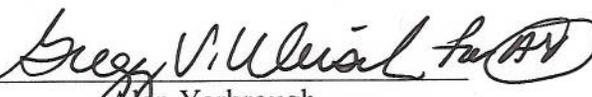
- $\mu\text{g}/\text{m}^3$  = Micrograms per Cubic Meter of Air
- UCL = Upper Confidence Limit
- CREG = Cancer Risk Evaluation Guide
- EMEG = Environmental Media Evaluation Guide
- COPC = Contaminant of Potential Concern
- The maximum value for MTBE is equivalent to  $\frac{1}{2}$  of the reporting limit of the sample taken in the living area ( $3.6 \mu\text{g}/\text{m}^3$ ). This is the highest reporting limit of the three samples.

**CERTIFICATION**

This Health Consultation was prepared by the Colorado Department of Public Health and Environment under a cooperative agreement with the Agency for Toxic Substances and Disease Registry (ATSDR). It is in accordance with approved methodology and procedures existing at the time the health consultation was begun. Editorial review was completed by the Cooperative Agreement partner.

  
Jennifer Freed  
Technical Project Officer  
CAT, CAPEB, DHAC, ATSDR

The Division of Health Assessment and Consultation, ATSDR, has reviewed this health consultation and concurs with its findings.

  
Alan Yarbrough  
Team Lead  
CAT, CAPEB, DHAC, ATSDR