Health Consultation

KINDER MORGAN YUMA BOOSTER STATION

An Update for Water Sampling Results

YUMA COUNTY, ARIZONA

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Prepared by

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Summary

INTRODUCTION	In the *Kinder Morgan Yuma Booster Station*, the Arizona Department of Health Services' (ADHS') top priority is to ensure that the community and residents have the best information possible to safeguard their health. This report was written in response to a request from the Arizona Department of Environmental Quality (ADEQ). This health consultation to see if the detected chemicals in the groundwater wells are at levels harmful to human health.
CONCLUSIONS AND BASIS FOR DECISION	At the present time, the chemicals detected in the monitoring wells around the Yuma Booster Station are not expected to cause public health concern. The general public or workers have no contact or limited contact with the well water. If the groundwater is used for vegetable crop irrigation, the general public may uptake very small amounts of ethylbenzene, toluene, xylene and MTBE via food ingestion. The evaluation results indicated that this route of exposure is not likely to result in adverse impact to human health. There would be no public health concern if these wells were to be used as residential wells, because no cancerous or non-cancerous adverse health effects would be expected under the assumed exposure scenarios.
NEXT STEPS	To protect the public health, ADHS recommends continuing to monitor the quality of the well waters, as well as taking necessary corrective actions after the cause of the elevated readings is determined.
FOR MORE INFORMATION	If you have concerns about your health, you should contact your health care provider. Please call ADHS at 602-364-3128 if you would like more information on the this report.

Purpose

The Arizona Department of Health Services (ADHS) received a request from the Arizona Department of Environmental Quality (ADEQ) to conduct an update assessment for the Kinder Morgan Yuma Booster Station. This health consultation evaluated the potential health risks associated with exposure to the detected chemicals in the 3rd quarter 2012 Groundwater Monitoring Report.

Background

The Yuma Booster Station is located at northeast of Yuma, Yuma County. This station provides support for the shipment of refined petroleum products from California to Arizona. It is a fenced facility and has three booster pumps, an office, maintenance shop and other support facilities. There is also buried pipeline connecting a 25,000-barrel jet fuel storage tank to the Yuma Marine Corps Air Station (MCAS) in Yuma, AZ.

Statement of Issues

The most recent groundwater data showed contamination to the west of the site in a surface water canal and on property owned by State Land and leased by Fresh Express. ADEQ wants to know if there is a public health concern due to the discovery of the contaminants.

Discussion

General Assessment Methodology

ADHS generally follows a three-step methodology to assess public health issues related to environmental exposures. First, ADHS obtains representative environmental data for the site of concern and compiles a comprehensive list of site-related contaminants. Second, ADHS identifies exposure pathways, and then uses health-based comparison values to find those contaminants that do not have a realistic possibility of causing adverse health effects. For the remaining contaminants, ADHS reviews recent scientific studies to determine if exposures are sufficient to impact public health.

Available Environmental Data

ADHS conducted the assessment based on the: *Third Quarter 2012 Groundwater Monitoring Report, Yuma Booster Station, Yuma, Arizona*. The report is dated November 14, 2012. This report was prepared by ARCADIS U.S., Inc. located at Scottsdale, Arizona. Nine groundwater samples were collected from groundwater monitoring wells by a standard well volume approach to minimize changes in groundwater chemistry during sample collection and transport to the laboratory, and to maximize the probability of obtaining a representative, reproducible ground-water sample. Environmental Science Corp. Laboratory Services (ESC), an ADHS-certified laboratory, used EPA Method 8260 B to determine the levels of benzene, toluene, ethylbenzene, and total xylenes (BTEX), and methyl tertiary butyl ether (MTBE) in groundwater samples as well as trip blank, field duplicate, and equipment blank samples.

Exposure Pathway Analysis

Identifying exposure pathways is important in a health consultation because adverse health impacts can only happen if people are exposed to contaminants. The presence of a contaminant in the environment does not necessarily mean that people are actually coming into contact with that contaminant. Exposure pathways have been divided into three categories: completed, potential, and eliminated.

There are five elements considered in the evaluation of exposure pathways:

1) a <u>source</u> of contamination
2) a <u>media</u> such as soil or ground water through which the contaminant is transported
3) a <u>point of exposure</u> where people can contact the contaminant
4) a <u>route of exposure</u> by which the contaminant enters or contacts the body
5) a <u>receptor</u> population

Completed pathways exist when all five elements are present and indicate that exposure to a contaminant has occurred in the past and/or is occurring presently. In a potential exposure pathway, one or more elements of the pathway cannot be identified, but it is possible that the element might be present or might have been present. In eliminated pathways, at least one of the five elements is or was missing, and will never be present. Completed and potential pathways, however, may be eliminated when they are unlikely to be significant.

To pose a human health risk, the source of contaminants must be linked to receptors via different exposure pathways (e.g. inhalation, ingestion or skin contact). Monitoring wells are designed and installed to obtain representative groundwater quality samples and hydrogeological information from an aquifer. They allow potential environmental concerns to be identified early and aggressively evaluated and corrected (when necessary) in accordance with regulations. Workers may contact chemicals though ingestion or skin contact. However, the exposure pathways are considered insignificant due to the limited amount and frequency of exposure. It should be noted that workers performing routine monitoring in these wells would typically follow a health and safety plan (HASP) designed to minimize or eliminate potential contact and exposure.

The public is not likely to have direct contact with chemical in these monitoring wells through inhalation, ingestion or dermal contact. However, if groundwater in the same area is used for vegetable crop irrigation, the public may uptake these chemicals via food ingestion if they can be bioaccumulated in crops. ADHS evaluated the potential of these chemicals to be concentrated or accumulated in plants. Our research results indicated that the bioaccumulation potential of these chemicals is low. Benzene does not build up in plants or animals (ATSDR 2007a). Only small amounts of toluene, ethylbenzene, xylene and MTBE could be taken up into plants but they are not expected to concentrate to high levels in plants (ATSDR 1996, 2000, 2007b,c). Hence, no public health concern would be expected via bioaccumulation route.

Although there is no known residential wells in the area, as precaution, ADHS further evaluated the potential public health impacts associated with these monitoring wells if they were used for drinking, cooking or personal hygiene. In Arizona, all aquifers are identified as drinking water source aquifers unless specifically exempt (ARS§49-224). The Arizona Aquifer Water

Quality Standards (AAWQSs) are enforceable standards developed to protect groundwater sources for drinking water use (AAC§R18-11-406) and protective of human health.

Comparison to Health-based Comparison Values for Groundwater Well Samples

Health-based comparison values (CVs) are screening tools used with environmental data relevant to the exposure pathways. The health-based CVs are concentrations of contaminants that the current public health literature suggests are "harmless." These comparison values are quite conservative, because they include ample safety factors that account for the most sensitive populations. ADHS typically uses comparison values as follows: if a contaminant is never found at levels greater than its CV, ADHS concludes the levels of corresponding contamination are "safe" or "harmless." If, however, a contaminant is found at levels that are greater than its comparison value, ADHS designates the pollutant as a *contaminant of interest* and examines potential human exposures in greater detail.

Comparison values are based on extremely conservative assumptions. Depending on site-specific environmental exposure factors (e.g. duration and amount of exposure) and individual human factors (e.g. personal habits, occupation, and/or overall health), exposure to levels greater than the comparison value may or may not lead to a health effect. Therefore, the comparison values should not be used to predict the occurrence of adverse health effects.

The evaluation results showed that none of the detected chemical levels exceeded their respective comparison values (Table 1). Therefore, the detected chemical concentrations in monitoring water wells are not likely to result in non-cancerous adverse effects if the monitoring well water were used for domestic purposes.

Table 1: Summary of the analytical results in micrograms per liter (µg/L) and the comparison values used in the assessment

Well ID	Benzene (µg/L)	Toluene (µg/L)	Ethylbenzene (µg/L)	Xylene, total (µg/L)	MTBE[1] (µg/L)
MW-1R	NS[2]	NS	NS	NS	NS
B-2	<1	<5	<1	<3	23
B-3	<1	<5	<1	<3	<1
B-4	<1	<5	<1	<3	<1
B-5	<1	<5	<1	<3	<1
MW-6	<1	<5	<1	<3	<1
MW-7	<1	<5	<1	<3	<1
MW-8	<1	<5	<1	<3	12
MW-9	<1	<5	<1	<3	<1
MW-10	<1	<5	<1	<3	<1
AWQA[3]	5	1000	700	10,000	
EMEG-Ch[4]	5	200	1,000	2,000	3,000

1. MTBE: methyl tertiary butyl ether
2. NS: not sampled
3. AWQA: Arizona Aquifer Water Quality Standards
4. EMEG-Ch: Environmental Media Evaluation Guides for Children established by the Agency for Toxic Substances and Disease Registry (ATSDR).

Public Health Implications*: This section will provide general toxicological information and site-specific exposure evaluation for each contaminant of interest.*

Benzene:

Overview:

Eating foods or drinking liquids containing high levels of benzene can cause vomiting, irritation of the stomach, dizziness, sleepiness, convulsions, rapid heart rate, coma, and death. The health effects that may result from eating foods or drinking liquids containing lower levels of benzene are not known. If you spill benzene on your skin, it may cause redness and sores. Benzene in your eyes may cause general irritation and damage to your cornea.

Benzene causes problems in the blood. People who breathe benzene for long periods may experience harmful effects in the tissues that form blood cells, especially the bone marrow. These effects can disrupt normal blood production and cause a decrease in important blood components. A decrease in red blood cells can lead to anemia. Reduction in other components in the blood can cause excessive bleeding. Blood production may return to normal after exposure to benzene stops. Excessive exposure to benzene can be harmful to the immune system, increasing the chance for infection and perhaps lowering the body's defense against cancer (ATSDR 2007).

Long-term exposure to benzene can cause leukemia. Exposure to benzene has been associated with development of a particular type of leukemia called acute myeloid leukemia (AML). The Department of Health and Human Services has determined that benzene is a known carcinogen (can cause cancer). Both the International Agency for Cancer Research and the EPA have determined that benzene is carcinogenic to humans (ATSDR 2007).

Exposure to benzene may be harmful to reproductive organs. Some female workers who breathed air with high levels of benzene for many months had irregular menstrual periods. When examined, these women showed a decrease in the size of their ovaries. However, exact exposure levels were unknown, and the studies of these women did not prove that benzene caused these effects. It is not known what effects exposure to benzene might have on the developing fetus in pregnant women or on fertility in men. Studies with pregnant animals show that breathing benzene has harmful effects on the developing fetus. These effects include low birth weight, delayed bone formation, and bone marrow damage (ATSDR 2007).

Non-cancerous adverse health effects: The levels of benzene in all sampled monitoring wells were below the detection limit of 1 microgram per liter (µg/L). This concentration is below both the Arizona Aquifer Water Quality Standards (AAWQS) and the U.S. Environmental Protection Agency's (EPA's) Maximum Contaminant Level (MCL) of 5 µg/L. Therefore, ADHS does not expect to see people experiencing non-cancerous adverse health effects during household water use, such as showering or bathing.

Cancerous adverse health effects: ADHS also used a mathematical model to estimate the opportunity of a person developing cancer via all exposure routes. The detection limit (1 µg/L) was used in the estimation. This calculation cannot be used to predict actual cancer rates or individual risk. It is a tool in determining unsafe levels of chemical exposure over a population's lifetime (a 30-year exposure over a 70 years life span). Cancer risk is typically reported as a number. For example: 4.5×10^{-4}, which means that the excess cancer risk is 4.5 cases per 10,000 people. ADHS also assigns a qualitative descriptor (ranging from very low to very high risk) to understand the potential cancer risk. In this example, the cancer risk (4.5×10^{-4}) is high. For the purpose of these types of calculations, EPA has determined that calculations within the range of 10^{-6} to 10^{-4} are within the public health guideline to protect public health. This corresponds to the qualitative descriptors very low, low, and moderate (Appendix B).

The estimated cancer risk from benzene exposure from the monitoring wells was 3×10^{-6}, which is within the EPA's guidance and represents a low risk of cancer for lifetime exposure.

ATSDR Child Health Concern

ATSDR recognizes that the unique vulnerabilities of infants and children demand special emphasis in communities faced with contaminants in environmental media. A child's developing body systems can sustain permanent damage if toxic exposures occur during critical growth stages. Children ingest a larger amount of water relative to body weight, resulting in a higher burden of pollutants. Furthermore, children often engage in vigorous outdoor activities, making them more sensitive to pollution than healthy adults. All health analyses in this report take into consideration the unique vulnerability of children.

Conclusions

This health consultation evaluated the health risks associated with exposure to groundwater monitoring wells. Based on the available information, ADHS concludes the following for exposure to groundwater monitoring wells:

At the present time, the chemicals detected in the monitoring wells around the Yuma Booster Station are not expected to cause public health concern. The general public or workers have no contact or limited contact with the well water. If the groundwater is used for vegetable crop irrigation, the general public may uptake very small amounts of ethylbenzene, toluene, xylene and MTBE via food ingestion. The evaluation results indicated that this route of exposure is not likely to result in adverse impact to human health.

There would be no public health concern if these wells were to be used as residential wells, because no cancerous or non-cancerous adverse health effects would be expected under the assumed exposure scenarios.

Recommendations

- To protect the public health, ADHS recommends continuation of monitoring the quality of the well waters on a regular basis as well as taking necessary corrective actions after the cause of the elevated readings is determined.

References/Information Sources

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REPORT PREPARATION

This Public Health Assessment/Health Consultation for the Kinder Morgan Yuma Booster Station Site was prepared by the Arizona Department of Health Services under a cooperative agreement with the federal Agency for Toxic Substances and Disease Registry (ATSDR). It is in accordance with the approved agency methods, policies, procedures existing at the date of publication.

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Appendix A

Estimated chemical concentration in bathroom air (C_{air}):

$$C_{air} = \frac{C_w \times K \times F \times T_s}{V}$$

C_{air}: chemical concentration in bathroom air (mg/m^3)
C_w: chemical concentration in water (mg/L) = 0.001 mg/L
K: Volatilization rate = 0.6
F: water flow rate through the shower head (L/min) = 8 L/min
T_s: time in shower (min) =15 min
V: bathroom volume (L) = 10L

While showing in VOC-contaminated water, a resident may be exposed from (1) inhalation during shower, (2) inhalation standing in the bathroom immediately after shower, and (3) skin absorption during shower. This model estimated a worst case air concentration since it does not take into account dilution from ventilation in the bathroom, and it assumes exposure at a maximum air concentration through duration of the bathroom use.

Estimated exposure dose during shower (D):

$$D = \frac{C_{air} \times B \times T_s}{BW}$$

D: exposure dose (mg/day)
Cair: chemical concentration in bathroom air (mg/m^3) = 0.0072 mg/m^3
B: breathing rate (m^3/min) = 0.014 m^3/min
T_s: time in shower (min) = 15 min
BW: body weight (kg) = 70 kg

Estimated Cancer Risk (R):

$$R = CDI \times SF$$

R: Cancer Risk
CDI: chronic Daily Intake (mg/kg/day)
SF: slope factor (mg/kg/day)$^{-1}$

Parameter			
R	Oral	Inhale	Dermal
CDI	0.00001	0.00004	0.00002
SF	0.055	0.0273	0.0567
Total Cancer Risk	3×10^{-6}		

Appendix B

Qualitative Descriptors for Excess Lifetime Cancer Risk

ADHS estimated increased excess lifetime cancer risks by using site-specific information on exposure levels, and cancer potency derived by authoritative agencies, such as USEPA, Cal EPA and others. ADHS then ranked the excess lifetime cancer risk from very low to very high based on the qualitative ranking of cancer risk estimates developed by the New York State Department of Health (http://www.health.ny.gov/environmental/investigations/hopewell/appendc.htm). For example, if the qualitative descriptor was "low", then the excess lifetime cancer risk from that exposure is in the range of greater than one per million to less than one per ten thousand. Other qualitative descriptors are listed below:

Cancer Risk	Qualitative Descriptor
Equal to or less than one per million (Cancer Risk $\leq 10^{-6}$)	Very Low
Greater than one per million to less than one per ten thousand (10^{-6} < Cancer Risk $\leq 10^{-5}$)	Low
Greater than one per ten thousand to less than one per thousand (10^{-5} < Cancer Risk $\leq 10^{-4}$)	Moderate
Greater than one per thousand to less than one per ten (10^{-4} < Cancer Risk < 10^{-1})	High
Equal to or greater than one per ten (Cancer Risk $\geq 10^{-1}$)	Very High

An estimated increased excess lifetime cancer risk is not a specific estimate of expected cancers. Rather, it is a plausible upper-bound estimate of the probability that a person may develop cancer sometime in his or her lifetime following exposure to that contaminant.

There is insufficient knowledge of cancer mechanisms to decide if there exists a level of exposure to a cancer-causing agent below which there is no risk of getting cancer, namely, a threshold level. Therefore, every exposure, no matter how low, to a cancer-causing compound is assumed to be associated with some increased risk. As the dose of a carcinogen decreases, the chance of developing cancer decreases, but each exposure is accompanied by some increased risk.

There is general consensus among the scientific and regulatory communities on what level of estimated excess cancer risk is acceptable. The EPA considers an acceptable cancer risk range from 10^{-6} to10^{-4}.