

Health Consultation

SILVER CITY PETROLEUM RELEASE AND MUNICIPAL WELLS

SILVER CITY, MILLS COUNTY, IOWA

APRIL 4, 2005

U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES

Public Health Service

Agency for Toxic Substances and Disease Registry

Division of Health Assessment and Consultation

Atlanta, Georgia 30333

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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 which, in the Agency's opinion, indicates a need to revise or append the conclusions previously issued.

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HEALTH CONSULTATION

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SILVER CITY, MILLS COUNTY, IOWA

Prepared by:

Iowa Department of Public Health
Under Cooperative Agreement with the
U.S. Department of Health and Human Services
Agency for Toxic Substances and Disease Registry

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Silver City Petroleum Release and Municipal Wells

Silver City, Mills County, Iowa

March 24, 2005



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Purpose

A resident of Silver City, Iowa requested the Iowa Department of Public Health (IDPH) Hazardous Waste Site Health Assessment Program to evaluate the health impacts of a petroleum release in Silver City, Iowa, and the health impacts from the presence of chemicals detected in wells utilized as the source of municipal water for the citizens of Silver City and in the treated municipal water supply. This health consultation addresses exposure to residents of Silver City to organic chemicals within the groundwater and water supply and potential health effects at the levels of exposure. The information in this health consultation was current at the time of writing. Data that emerges later could alter this document’s conclusions and recommendations.

Background

Silver City is a town of approximately 282 residents within Mills County, Iowa, approximately 10 miles northeast of Glenwood, Iowa. In 1990 a petroleum release was discovered. It was determined this release came from the former Farm Service Co-Op located at 510 Main Street. The Underground Storage Tank Section of the Iowa Department of Natural Resources (IDNR) has overseen the investigation of this petroleum release. In 1996 a Site Cleanup Report was accepted by the IDNR and the release was classified as high risk because of the proximity of the site to the municipal water supply well field, other non-drinking water wells, the location of plastic water lines, and basements. Since the time of the initial release, groundwater and soil samples have been collected in and around the release site to determine the extent and degree of contamination from petroleum chemicals. Some free-product (liquid gasoline) has been recovered from some of the groundwater monitoring wells installed within the contamination area (1).

Groundwater Monitoring

Figure 1 is a site map showing groundwater monitoring well locations, soil boring locations, and the location of the nearest municipal well, CW-4 (the source of drinking water for Silver City). The location of the petroleum release was near the corner of Main Street and Park Street. The groundwater within monitoring wells installed as part of the investigation has been analyzed for benzene, toluene, ethylbenzene, and xylenes (chemical components of gasoline). Table 1 below includes the maximum concentration of benzene, toluene, ethylbenzene, and xylenes (BTEX) detected within the groundwater in the center of the release location.

Table 1 - Maximum Concentration of BTEX in Monitoring Wells (1)

Chemical	Monitoring Location	Date	Concentration (ppb)
Benzene	MW-GSI-12	7/29/2004	14,400
Toluene	MW-GSI-12	7/29/2004	3,300
Ethylbenzene	MW-GSI-12	7/29/2004	9,410
Xylenes	MW-GSI-12	7/29/2004	42,400

The MCLs for benzene, toluene, ethylbenzene, and xylenes are 5 µg/L (micrograms per liter) or 5 ppb (parts per billion), 1,000 ppb, 700 ppb, and 10,000 ppb, respectively.

Groundwater from monitoring wells MW-24, TMW-25, and MW-28 (located farthest from the release, between the release area and the municipal water supply wells) has been analyzed for BTEX. BTEX have not been detected in these monitoring wells as summarized in Table 2 below, with the exception of toluene found in groundwater from monitoring well MW-28. Monitoring well MW-24 was sampled in 1995, 2000, 2003, and 2004; TMW-25 was sampled in 1995; and MW-28 was sampled in 2004. Monitoring wells MW-24 and TMW-25 are installed to a depth of 25 feet below ground surface. Monitoring well MW-28 is installed to a depth of 40 feet below ground surface, roughly the same depth as the municipal water supply wells.

Table 2 - Highest BTEX Concentration in Monitoring Wells Furthest From Petroleum Release (1)

Monitoring Location	Benzene ppb	Toluene ppb	Ethylbenzene ppb	Xylenes ppb
MW-24	< 1	< 1	< 1	< 2
TMW-25	< 1	< 1	< 1	< 1
MW-28	< 1	3.9	< 1	< 3

The note of < 1, < 2 or < 3 means that the chemical being analyzed was less than the method reporting limit of 1 ppb, 2 ppb, or 3 ppb.

Municipal Water Monitoring

Samples of untreated water from the municipal wells supplying drinking water to Silver City residents were analyzed for BTEX in December 2003 and January 2004. Untreated water from the municipal wells is water that has been pumped from the municipal wells but has not been through the treatment system prior to being delivered to homes and businesses within Silver City. BTEX have not been detected in untreated municipal water or in the single tap water sample collected along Maple Street in July 2004 (2 and 3).

During the on-going petroleum investigation a survey was completed to identify private wells located in the vicinity of the petroleum release. Several wells and cisterns were identified. Only one cistern was available for sampling (CW-4 located near the corner of Maple and Park Streets). BTEX was not detected in the water within this cistern.

On-going routine monitoring of the Silver City municipal water supply has been conducted since 1987. Analyses for a variety of chemicals are currently included in this monitoring program required by the Water Supply Section of the IDNR. Table 3 on the following page, includes the highest detections of all organic chemicals in the municipal water supply since 1987. The location of the sample collection point for all these results is within the water treatment plant just prior to distribution (after treatment by aeration, chlorination, detention and sand filtration).

Table 3 - Highest Detections of Organic Chemicals in Silver City Municipal Water (2)

Chemical	Date	Concentration ppb
Cis-1,2-dichloroethylene	12/21/1993	1.2
Trans-1,2-dichloroethylene	12/21/1993	0.9
Trichloroethylene	12/21/1993	2.1
Xylenes	12/15/1998	1
Bromodichloromethane	9/22/1987	15
Bromoform	9/21/1994	2.6
Chlorodibromomethane	9/22/1987	18
Chloroform	9/21/1994	9.8
1,1-dichloroethane	12/21/1993	2.1

Contaminants of Concern

The contaminants of concern at the site further discussed in this health consultation are BTEX and the several organic chemicals that have been detected in the Silver City municipal water supply. BTEX has been detected in groundwater and soil in the vicinity of the former Farm Service Co-Op. BTEX has not been detected in the groundwater monitoring wells installed closest to the Silver City municipal water supply wells, with the exception of a small amount of toluene in groundwater from MW-28. BTEX has not been detected in the untreated municipal water. BTEX has not been detected in water at the point of use at one residence that is located just to the northwest of the petroleum release contamination area. Municipal water is supplied to this residence via a plastic water line.

Other organic chemicals, not expected to be part of the petroleum release, have been detected in the Silver City municipal water supply. The analytical tests included in the petroleum release investigation did not include these chemicals (with the exception of xylenes), since they would normally not be expected to be present in gasoline. These chemicals were detected in water from the municipal water supply that was sampled at a collection point after going through the treatment system. The chemicals included in Table 3 have a variety of uses including as solvents or degreasers and in the synthesis of other chlorinated solvents (4,5,6,7,8,9,10). Some of these chemicals; bromodichloromethane, bromoform, and chlorodibromomethane; are formed as a by-product of chlorination of water.

Since the organic chemicals have been detected at very low levels, sometimes below the laboratory detection level, it is unlikely the source or sources of these chemicals in the Silver City municipal water supply can be identified. It is not unexpected that low levels of these chemicals have been found in the Silver City municipal water supply, since these chemicals have most likely been utilized by businesses and homes within Silver City. Small quantities of these chemicals that may be accidentally spilled while being used in businesses and homes throughout

Silver City area have the potential to reach the aquifer in which the municipal water supply wells have been installed, since this aquifer is only 30 to 40 feet below the ground surface (1).

Discussion

Exposure To BTEX and Other Organic Chemicals

Exposure to BTEX and other organic chemicals in Silver City is determined by examining human exposure pathways. An exposure pathway has five parts:

1. a source of contamination,
2. an environmental medium such as air, water, or soil that can hold or move the contamination,
3. a point at which people come in contact with a contaminated medium, such as, in drinking water, or in surface soil,
4. an exposure route such as, drinking water from a well, or eating contaminated soil on homegrown vegetable, and
5. a population who could come in contact with the contaminants.

An exposure pathway is eliminated if at least one on the five parts is missing and will not occur in the future. For a completed pathway, all five pathway parts must exist and exposure to a contaminant must have occurred, is occurring, or will occur.

Exposure Through Ingestion of Contaminated Drinking Water

In Silver City, an exposure pathway to several organic chemicals has been completed via residents of Silver City ingesting drinking water containing low levels of these organic chemicals. At times these chemicals have not been detected in the Silver City municipal water supply.

Exposure through Vapor Inhalation and Dermal Exposure

Since the organic chemicals detected in the Silver City municipal water supply are volatile organic chemicals, there is a potential exposure pathway for these chemicals to be completed due to inhalation of the vapors during bathing and showering with contaminated water. In addition to inhalation of vapors, a person bathing and showering in contaminated water has the potential to be exposed to these organic chemicals through adsorption of these chemicals through the skin.

In addition to vapor inhalation from bathing or showering, there is a potential for vapors from the chemicals within the petroleum release to migrate from the soil and groundwater into buildings and homes through basements or crawl spaces. The potential for vapors migrating into buildings and homes can be assessed initially by analyzing the amount of volatile chemicals present within soil gas located at the depth of basements or crawl spaces. Limited soil gas sampling has been completed in Silver City. One of the soil gas samples was obtained near the basement of a home just to the north of the petroleum spill area (SVW-32 on Figure 1). Benzene and toluene were not detected in this soil gas sample and was below the action level set by the IDNR Underground Storage Tank rules (1). Sampling and analysis for volatile organic chemicals of indoor air from homes within Silver City has not been completed at the present

time.

Toxicological Evaluation

The following information has been prepared as a toxicological evaluation for exposure to the various organic chemicals detected in the Silver City municipal water supply. This evaluation will include ingestion of drinking water and inhalation of the chemicals and vapors during showering and bathing using the highest documented levels of the various organic chemicals found in the Silver City municipal water supply. This toxicological evaluation will compare exposures levels to the following comparison values: U.S. Environmental Protection Agency (EPA) Maximum Contaminant Levels (MCLs), the Agency for Toxic Substances and Disease Registry (ATSDR) Minimum Risk Levels (MRLs), and the EPA Chronic Oral Reference Dose (RfD)

Maximum Contaminant Levels

EPA MCLs are defined as, “The highest level of a contaminant that EPA allows in drinking water. MCLs ensure that drinking water does not pose either a short-term or long-term health risk. EPA sets MCLs at levels that are economically and technologically feasible (11).” MCLs are based upon human and animal studies, include safety factors, and are reported for lifetime exposures. The units of MCLs are milligrams per liter (mg/L) – this is a measure of concentration of the chemical in water.

Minimum Risk Levels

This toxicological evaluation will compare the levels of exposure in Silver City to minimum risk levels (MRLs) established by the Agency for Toxic Substances and Disease Registry (ATSDR). The MRL is defined as, “an estimate of daily exposure to a human being to a chemical that is likely to be without an appreciable risk of deleterious effects (non-carcinogenic) over a specified period of time (12).” MRLs are based upon human and animal studies, include several safety factors, and are reported for acute exposure (≤ 14 days), intermediate exposure (15 – 364 days), and chronic exposure (≥ 365 days). The units of MRLs are milligrams per kilogram per day (mg/kg/day) – this is a dose measure. In order to convert to a concentration in water, assumptions need to be made regarding the average weight of exposed person and the average daily consumption of water.

Chronic Oral Reference Dose

The EPA chronic oral RfD is defined as “an estimate (with uncertainty spanning perhaps an order of magnitude) of a daily oral exposure to the human population (including sensitive subgroups) that is likely to be without an appreciable risk of deleterious effects during a lifetime (13).” The chronic oral RfDs are based upon human and animal studies, include safety factors, and are reported for lifetime exposures. The units of chronic oral RfDs are milligrams per kilogram per day (mg/kg/day) – this is a dose measure. In order to convert to a concentration in water, assumptions need to be made regarding the average weight of exposed person and the average daily consumption of water.

Comparison Values

Table 4 includes the highest detected concentrations of all organic chemicals in the municipal water supply since 1987 and the comparison level for that chemical. The comparison value will be the MCL for that chemical. If a MCL does not exist for any chemical, then the corresponding concentration in water derived from the chronic MRL or chronic oral RfD will be used, whichever is smaller. In determining the corresponding concentration in water derived from the MRL or chronic oral RfD, the assumptions of 10 kilograms body weight for a child and 1 liter per day water consumption rate for a child will be utilized.

Table 4 - Highest Detections of Organic Chemicals in Silver City Municipal Water and Comparison Value

Chemical	Concentration ppb	Comparison Level ppb	Based Upon MCL, MRL, or RfD
Cis-1,2-dichloroethylene	1.2	70	MCL
Trans-1,2-dichloroethylene	0.9	100	MCL
Trichloroethylene	2.1	5	MCL
Xylenes	1	10,000	MCL
Bromodichloromethane	15	200	MRL and RfD
Bromoform	2.6	200	RfD
Chlorodibromomethane	18	200	RfD
Chloroform	9.8	100	MRL and RfD
1,1-dichloroethane	2.1	none	none

Comparison values are levels or concentrations of a chemical considered to be safe for human contact. The presence of all organic chemicals detected in the Silver City municipal water supply have been below the published comparison values. Although there are no comparison values for 1,1-dichloroethane, the concentration of 1,1-dichloroethane in the Silver City municipal water supply has been very low – similar to the low levels of chemicals for which there are comparison values. The highest detected level of 1,1-dichloroethane in Silver City municipal water was 2.1 ppb, most likely much lower than any health effect level for this chemical.

All the comparison values utilized in this toxicological evaluation are based upon human and animal health studies. The best available scientific data indicates if a person is exposed to chemicals at or below these levels, the health of even sensitive persons would not be expected to be negatively impacted. An evaluation of the current data collected from the petroleum release and from the monitoring of the municipal water supply indicates past or present exposure to chemicals in the Silver City public water supply or to chemicals from the petroleum release has most likely not negatively impacted the health of Silver City residents.

Children’s Health Concerns

Children have unique vulnerabilities to some environmental chemicals, and IDPH’s Hazardous Waste Site Health Assessment Program evaluated the potential impact of the presence of BTEX and the various organic chemicals detected within the Silver City municipal water supply on children’s health. Since the levels of BTEX and other organic chemicals within the Silver City municipal water supply are in most cases below the comparison values, it is concluded children’s health would not be negatively impacted by the presence of these chemicals at the levels detected within the Silver City municipal water supply.

Community Health Concerns

The IDPH is aware some of the residents in Silver City are concerned regarding personal exposure to chemicals from the petroleum release and other chemicals present in the municipal water supply. Among the concerns of residents in Silver City are the potential conduits for the contamination including utility lines, private wells, and cisterns; the presence of unhealthy levels of chemical vapors in basements and homes; and whether chemicals within the groundwater and indoor air can cause lymphoma or arthritis.

Potential Conduits for Petroleum Contamination

It is recognized underground utility lines, private wells and cisterns can all be conduits to provide for the movement of chemicals from the initial petroleum release location. The existing groundwater and soil monitoring network installed in Silver City provides for some measure of assessing the movement of chemicals within groundwater and soil. The monitoring network indicates that the chemicals have moved in the general direction of the horizontal groundwater flow – to the northeast from the initial petroleum release. The groundwater within monitoring wells located furthest from the initial petroleum release (MW-24, TMW-25, and MW-28) does not contain detectable amounts of BTEX. These wells are located approximately 400 feet from the municipal water supply wells for Silver City.

As previously stated, there has been limited sampling and analysis of water from within private wells and cisterns in Silver City. The information collected during the petroleum release investigation indicates that water from private wells and cisterns in Silver City are not currently used for human consumption. Water from the one cistern was sampled and analyzed for BTEX and did not contain detectable quantities of BTEX.

Vapors in Basements or Homes

Volatile organic chemicals that are present in groundwater and soil beneath homes with basements and crawl spaces can migrate through preferential pathways in the soil and reach the indoor air with the homes through sump locations and utility entry points. One method of determining if vapors have the potential to migrate into homes is to sample chemical vapors within soil near homes with basements. Soil vapor sampling was completed at one location in Silver City. Benzene and toluene were not detected within the soil vapor, although the detection limit was fairly high due to the action limit of the IDNR rules.

Another method of determining if vapors can migrate into homes or basements is to directly sample and analyze indoor air. This has not been completed within any homes in Silver City. Completing some indoor air sampling and analysis would provide some additional information to determine if residents of Silver City are being exposed to unsafe levels of volatile organic chemicals. It should be noted that certain activities and the storage of chemicals in basements could bias this type of sampling.

Concerns About Lymphoma and Arthritis

As previously stated, some residents have a concern if the chemicals found within the municipal water supply and the chemicals present in the petroleum contamination can cause lymphoma or arthritis. At the present time there is no information that documents exposures to high levels of BTEX from petroleum release contamination either through ingestion, dermal contact, or through inhalation. The levels of the chemicals that residents within Silver City have been exposed to within the municipal water supply are so low (mostly below MCLs and other comparison values) that no negative health impact to the residents of Silver City are expected, including lymphoma and arthritis.

Very high levels of exposure to BTEX, much higher than the levels of exposure in Silver City, can cause health effects including confusion, weakness, dizziness, and possibly – over many years of exposures – leukemia, (14,15,16,17). But after a review of the toxicological information regarding BTEX, it appears that even exposure to high levels of these chemicals would be unlikely to cause lymphoma or arthritis.

Conclusions

From the data collected so far, it is concluded that:

- The petroleum release from the former Farm Service Coop and other chemicals detected within the municipal water supply of Silver City currently pose no public health threat to the residents of Silver City through ingestion of drinking water.
- There are insufficient data to assess the health impacts from vapor intrusion into basements and homes.

Recommendation

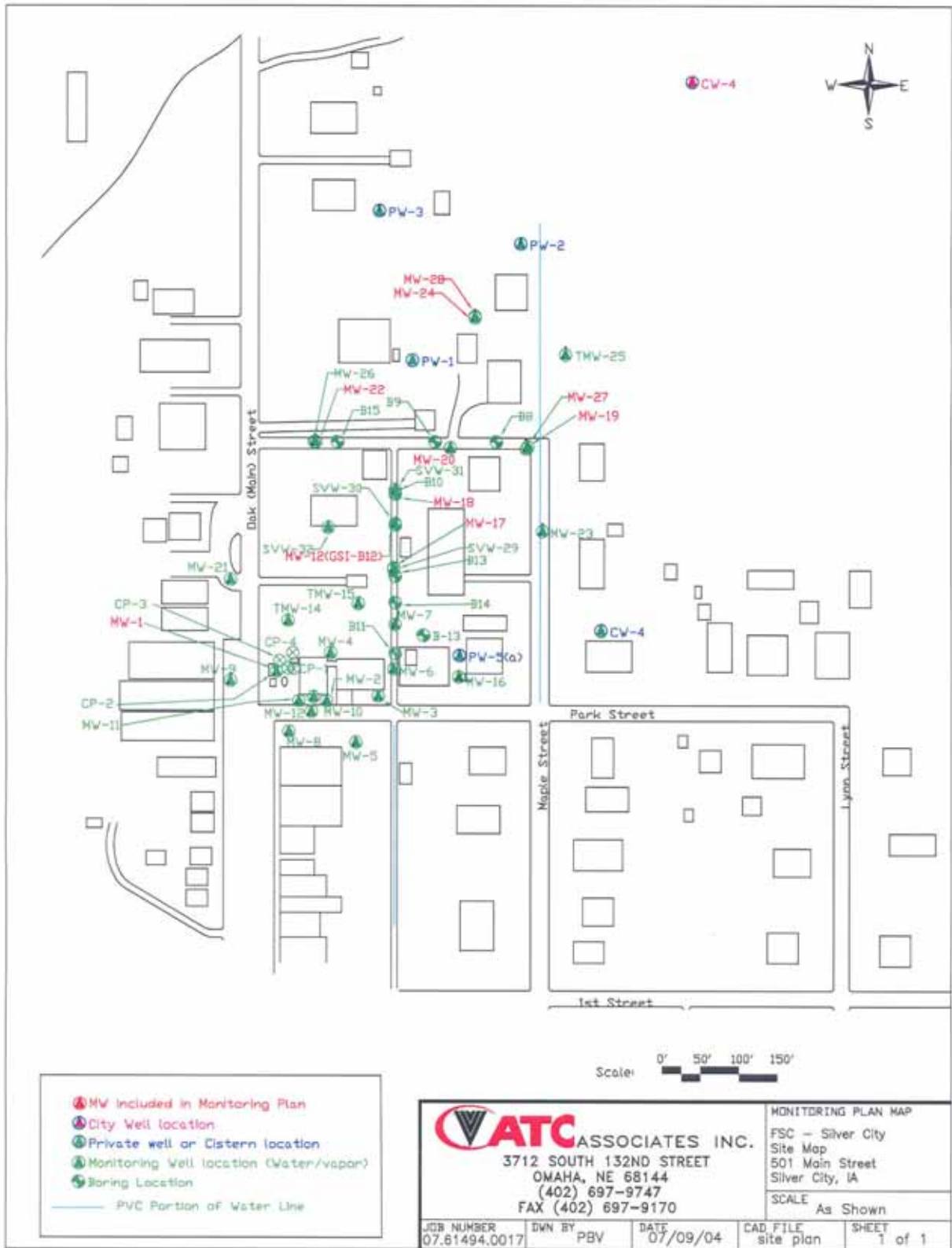
- It is strongly urged that consideration be given to having indoor air samples collected within the basements and first floors of residences and analyzed for benzene and toluene concentrations to determine if there is ongoing exposure to vapors.

Public Health Action Plan

- IDPH will present the results of this consultation at a public meeting in Silver City.

- IDPH will provide assistance with community health education as needed and requested.
- IDPH will continue to review monitoring data provided by IDNR and update health recommendations as necessary.

Figure 1: Site Map



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Preparers of the Report

Author

Stuart Schmitz, P.E., Sara Colboth, and Charles Barton, Ph.D., DABT
Hazardous Waste Site Health Assessment Program
Iowa Department of Public Health

CERTIFICATION

The Iowa Department of Public Health, Hazardous Waste Site Health Assessment Program, has prepared this health consultation for the Hills, Iowa, perchlorate groundwater contamination site under a cooperative agreement with the Agency for Toxic Substances and Disease Registry (ATSDR). The document is in accordance with approved methodology and procedures existing when the health consultation was being prepared.

Technical Project Officer, SPS, SSAB, DHAC, ATSDR

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

Chief, SPS, SSAB, DHAC, ATSDR