Health Consultation

BUCHANAN BULK OIL – MA & PA STORES

WEST 6TH AVENUE AND SOUTH F STREET

OSKALOOSA, MAHASKA COUNTY, IOWA

SEPTEMBER 30, 2006

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

Health Consultation: A Note of Explanation

An ATSDR health consultation is a verbal or written response from ATSDR 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 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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WEST 6TH AVENUE AND SOUTH F STREET

OSKALOOSA, MAHASKA COUNTY, IOWA

Prepared by:

Iowa Department of Public Health
under Cooperative Agreement with the
Agency for Toxic Substances and Disease Registry

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Purpose

The Iowa Department of Natural Resources (IDNR) has requested the Iowa Department of Public Health (IDPH) Hazardous Waste Site Health Assessment Program to evaluate the potential health impacts of the future development at the Buchanan Bulk Oil – Ma & Pa Stores site. A Targeted Brownfields Assessment was completed by the IDNR at this site to measure existing on-site contaminants. Assistance was sought from the IDPH to determine potential health risks if the site was developed for residential use. This health consultation addresses potential health risks to people from exposure to the contaminants found in the soil and groundwater within the property boundary. 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

Site History

The Buchanan Bulk Oil – Ma & Pa Store site is located on the northeast corner of the intersection of West 6th Avenue and South F Street, in Oskaloosa, Mahaska County, Iowa. A retail gas station operated as "Ma & Pa Store" was located at the southeast corner of the site. Associated with the business were four underground storage tanks, a pump island, and an office. An above ground storage tank (AST) bulk oil plant was operated from 1925 to the mid 1980s as Sinclair Oil and most recently as Buchanan Oil. As many as seven ASTs once occupied the south-central portion of the site. An overhead fuel load out and warehouse were also associated with the bulk oil business. An office/storage building was located on the southwest corner of the site next to the railroad right-of way. Almost all structures, including underground and above ground storage tanks, have been removed from the site. Only one building foundation still remains on the site property (1). Figure 1 on page 11 of this consultation is an aerial view of the property prior to when all structures were removed (2).

Site Characterization and Evaluation

A site characterization was completed as part of an investigation of a suspected petroleum release from one or more of the underground storage tanks previously located on the site property (3). Groundwater and soil samples were collected in 1998 and 1999 in the areas where the above ground and underground storage tanks were located. A total of 27 soil borings were advanced with 19 of these soil borings developed into groundwater monitoring wells. The soil and groundwater samples collected from these soil borings and groundwater monitoring wells were analyzed for volatile chemicals that are present in gasoline; benzene, toluene, ethylbenzene, total xylenes; and total extractable hydrocarbons (TEH). The four underground storage tanks were removed in 1990. The above ground storage tanks have now also been removed from the site.

In June 2005 an additional site characterization was completed by the Contaminated Sites Section of the IDNR as part of a Targeted Brownfields Assessment in an effort to evaluate the suitability of the site for residential development. Six locations were chosen for the collection of

soil samples, and seven locations were chosen for the collection of groundwater samples. Six of the seven groundwater samples were collected from groundwater monitoring wells installed during the previous investigation in 1998 and 1999. The seventh groundwater sample was obtained from a temporary well installed in one of the soil borings. The sample locations were selected to address recognized environmental concerns identified by considering previous site use and from the results of the previous site investigative activities. The collection of soil gas samples was attempted, but this was unsuccessful due to the high clay content of the site soil and the relatively high water table at the site. Tables 1 and 2 include laboratory analytical results of the soil and groundwater sampling (1).

Table 1 – Soil Sampling Analytical Results (mg/kg)

	Sampling Location							
Chemical	SG5	SG7	SG8	SG9	SG11	SG12	SG12(Dup)	Comparison Value [a]
Acetone	0.055	-	-	-	.052	-	.061	4,000
Prometon	0.031	-	-	-	-	-	-	800
Benzene	-	-	0.060	-	-	-	-	10
Ethylbenzene	-	8.4	0.540(est)	-	-	-	-	5,000
Xylenes, Total	-	40	0.1	-	-	-	-	400
MTBE	-	-	0.027	5	-	-	-	600
Naphthalene	-	3.7	-	-	-	-	-	1,000
2-Methylnaphthalene	-	14	-	-	-	-	-	200
Phenanthrene	0.31	-	0.350	-	--	-	-	NA
TEH Total	490	2600	320		44	390	90	NA
TEH diesel	490	2600	320	-	-	390	90	NA
TEH waste oil	-	-	-	-	44	-	-	NA
DDD	0.17	-	-	-	-	-	-	3
DDE	0.081	-	-	-	-	-	-	2
Arsenic	**8.1**	**3.6**	**4.6**	**12**	**14**	**7.3**	**5.8**	0.5
Barium	260	140	150	310	170	210	190	4,000
Chromium	23	14	13	19	14	17	18	200
Lead	54	78	59	37	110	40	43	NA

"(mg/kg)" means milligram per kilogram
"Dup" means duplicate sample
[a] Comparison values are screening values established by the Agency for Toxic Substance and Disease Registry and the U.S. Environmental Protection Agency.
"-" means the contaminant was not found to be present above the method detection limit
"NA" means that no comparison value is listed for the contaminant
Bold text indicates the contaminant level exceeds the comparison value

Table 2 – Groundwater Sampling Analytical Results (mg/L)

	Sampling Location								
Chemical	MW1	MW3	MW5	MW8	SG11	MW13	MW16	MW16 (Dup)	Comparison Value [a]
Benzene	**4**	-	-	**2.6**	-	-	-	-	0.0006
Ethylbenzene	1.4	-	-	0.1	-	-	-	-	0.7
Xylenes, Total	2.8	-	-	-	-	-	-	-	10
MTBE	0.15	-	-	-	0.009	-	-	-	0.2
Diethyl Phthalate	-	-	-	-	0.018	-	-	-	8
Di-n-butyl phthalate	-	-	-	-	**9**	-	-	-	1
TEH Total	9.2	-	1.2	11	1.6	-	-	-	NA
TEH diesel	9.2	-	1.2	11	1.6	-	-	-	NA
Arsenic	-	0.02		0.04	0.130	0.30	0.11	0.09	0.00002
Barium	-	3.2	0.68	0.74	18	2.4	16	-	0.7
Chromium	-	-	-	0.03	3.2	0.340	2.7	1	0.03
Lead	-		-	-	0.86	-	0.66	0.26	NA
Selenium	-	-	-	-	0.150	-	0.040	0.050	0.05

"(mg/L)" means milligram per liter
"Dup" means duplicate sample
[a] – Comparison values are screening values established by the Agency for Toxic Substance and Disease Registry and the U.S. Environmental Protection Agency.
"-" means the contaminant was not found to be present above the method detection limit
"NA" means that no comparison value is listed for the contaminant
Bold text indicates the containment level exceeds the comparison value

Figure 2, on page 12 of this consultation, shows the locations of both soil and groundwater samples (1). Soil samples that were analyzed for pesticides and heavy metals were collected from the top one-foot of soil. Soil samples that were analyzed for all other chemicals were collected from 4 to 5 feet below ground surface. Groundwater samples were collected within groundwater monitoring wells that had been previously installed at the site, with the exception of SG11. The groundwater sampled collected at SG11 was obtained from a temporary well that had been installed in soil boring SG11.

Data Gap in Surface Soil Samples

Individuals exposed to soil at the site will normally be exposed to only the upper several inches of surface soil. Therefore, in order to accurately evaluate the risk of exposure to soil at the site, it is necessary to obtain an analysis of soil contamination within the upper three inches of soil. The data that has been collected at the site, so far, includes composite soil samples from the upper one foot of the soil profile. Therefore, the analysis that has been completed is an estimate of the average concentration of contaminants in the upper one foot of soil deposited over the site, not necessarily the upper three inches of soil. As a result, a definitive conclusion as to the health risks of individuals exposed to site soil cannot be made since soil samples were not exclusively obtained from the upper three inches of soil. There is also the issue that during construction activities at the site, there will be excavation and mixing of soils from various depths resulting in surface soils that may not be the same surface soils that were analyzed during site investigation activities.

Exposure Pathways

Exposure to chemicals in the environment is determined by determining human exposure pathways. An exposure pathway has five components:

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 a 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 components is missing and will not occur in the future. For a completed pathway, all five components of the pathway must exist and exposure to a contaminant must have occurred, is occurring, or will occur.

Since the IDNR has requested the IDPH to evaluate potential health effects from exposure to the site if developed for residential use, this consultation will focus on any future exposure pathways if the property is used for residential housing. Potential future exposure pathways include exposure to surface soils through incidental ingestion of soils, and exposure to vapors from volatile organic chemicals found in soil and groundwater migrating into basements or into homes or multi-family residential units through cracks in the foundation.

Exposure to groundwater through ingestion of private well water is not anticipated to be a concern at the site since there are currently no direct exposures to groundwater in the vicinity of the site. Currently all property in the vicinity of the site is connected to the City of Oskaloosa public water supply. During the Targeted Brownfields Assessment, a survey of nearby private wells was completed. Two private wells were located within 200 feet of the site. One of these wells was determined to be inactive, and the other well was determined to be plugged (1). According to the City of Oskaloosa City Manager (personal conversation on August 4, 2006), city ordinance prohibits installation of any new private wells on site or on nearby site property; therefore, any future direct exposure to groundwater in the vicinity of the site will be eliminated.

There is a potential exposure pathway for volatile chemicals if new utility lines such as water and sewer are installed within areas of soil and groundwater contamination. Volatile chemicals could follow preferential pathways along the outside of these utility lines and migrate into homes or multi-family residential units if the utility entrance into the homes or multi-family residential unit is not appropriately sealed. If construction is such that these utility conduits are sealed, than the potential for volatile chemicals to migrate into homes or multi-family residential units will be reduced.

Contaminants of Potential Concern

The concentration of chemicals in the soil and groundwater can be measured against comparison values. Comparison values are calculated concentrations of a substance in air, water, food, or soil that is unlikely to cause harmful (adverse) health effects in the most sensitive portions of the

population. Comparison values are developed through human or animal health studies and have safety factors included in their calculation. The comparison values included in Tables 1 and 2 have been developed by either the Agency for Toxic Substances and Disease Registry (ATSDR) or the U.S. Environmental Protection Agency (EPA). Chemicals that are detected in soil and groundwater below comparison values are considered not to present a health concern and will not be further discussed in this health consultation.

Arsenic was the only chemical found in soil samples at concentrations above its comparison value. Although there is not a comparison value listed for lead in soil, there is a cleanup standard establish by the EPA for remediation of bare soil in areas where children routinely play. This cleanup standard is 400 mg/kg (4). All surface soil samples had lead concentrations below this cleanup standard. Exposure to arsenic in surface soil will be further discussed in this health consultation.

Benzene, ethylbenzene, di-n-butyl phthalate, arsenic, barium, chromium, and selenium were found in groundwater at concentrations above their comparison values. Although direct exposure to groundwater in the vicinity of the site can be eliminated by restricting the installation of any private wells in the area, there is a potential of vapor intrusion of volatile chemicals found in the groundwater into basements or into homes or multi-family residential units through cracks in the foundation. Di-n-butyl phthalate and heavy metals are not considered to be volatile chemicals due to their low vapor pressure. Therefore, they will not pose a vapor intrusion threat, and will not be further discussed in this health consultation. The potential of exposure to benzene and ethylbenzene vapors inside homes or multi-family residential units will be further discussed in this health consultation.

Discussion

Background Level of Arsenic in Soil

The levels of arsenic in the soil in the vicinity of the site can be compared to background levels found in soils due to naturally occurring conditions. In 2004 the Iowa Geological Survey collected 532 samples of shallow soil throughout the state in an effort to determine background levels of contaminants. The mean value plus three standard deviations were calculated for several metals detected in the soil samples and are assumed to be representative of an average background or naturally occurring concentration. The background concentration for arsenic was determined to be 17 mg/kg (5). This background concentration is above the concentration of arsenic found in composite soil samples at the site. If true surface samples (from within the top 3 inches of soil) at the site are similar in concentration to the soil samples collected during the Targeted Brownfield Assessment, then exposure to arsenic in the site soils will not pose any greater adverse health impact than living at any other site in Iowa.

Exposure to Benzene and Ethylbenzene Vapors

As previously discussed, there is a potential for benzene and ethylbenzene vapors found in the groundwater to migrate up through site soils and into basements or into homes or multi-family residential units through cracks in the foundation. A vapor transport model was been developed

by P. Johnson and R. Ettinger in 1991 and subsequently modified by EPA in 1998, 2001, and 2002 (J&E Model) (6). The J&E Model enables the potential concentration of volatile chemicals inside a home of multi-family residential unit to be estimated from known concentration of volatile chemicals found in soil and groundwater. This model has been determined to be in qualitative agreement with case studies. Spreadsheets have been developed that calculate an estimated indoor air concentration of volatile chemicals from known concentrations of chemicals in soil and groundwater.

The model spreadsheets can be downloaded from the following web address:

http://www.epa.gov/oswer/riskassessment/airmodel/zip/excel.zip

The highest levels of benzene and ethylbenzene found in groundwater during the Targeted Brownfields Assessment were input into the model spreadsheets. It was assumed that site soils consisted of mainly clay, since during the assessment the soils were determined to very tight – unable to yield soil-gas samples. Default values for clay soil were input into the J&E Model. It was also assumed that any future home or multi-family residential unit constructed on site property would be built upon a slab foundation due to the high elevation of the water table (4 to 5 feet below ground surface).

Copies of the input and output of the spreadsheets are included in Appendix A. The J&E Model predicted the following indoor concentrations of benzene and ethylbenzene:

Benzene –12.5 $\mu g/m^3$ Ethylbenzene – 3.94 $\mu g/m^3$

($\mu g/m^3$ – microgram per cubic meter)

Toxicological Evaluation

The following is a toxicological evaluation of exposure to indoor air to benzene and ethylbenzene at the concentrations predicted by the J&E Model. This toxicological evaluation will compare the predicted air concentrations to the following health comparison values: ATSDR Inhalation Minimum Risk Levels (MRLs), the EPA Chronic Reference Concentration (RfC), and the level of exposure that translates to a one-in-ten-thousand (10^{-4}) increased risk of cancer utilizing the EPA air unit risk.

Minimum Risk Levels

Minimum risk levels (MRLs) are established by the 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 (7)." MRLs are based upon human and animal studies, include several safety factors, and are reported for acute exposure ($\leq$ 14 days), intermediate exposure (15 – 364 days), and chronic exposure ($\geq$ 365 days).

Chronic Oral Reference Concentration

The EPA chronic oral RfC is defined as "an estimate (with uncertainty spanning perhaps an order of magnitude) of a continuous inhalation exposure to the human population (including sensitive subgroups) that is likely to be without an appreciable risk of adverse effects during a lifetime" (8). The chronic inhalation RfCs are based upon human and animal studies, include safety factors, and are reported for lifetime exposures.

Increased Risk of Cancer

The EPA has developed inhalation unit risk for evaluating increased risk of cancer from a lifetime of exposure to certain chemicals. The unit risk is defined as "the upper-bound excess lifetime cancer risk estimated to result from continuous exposure to an agent at a concentration of 1 µg/m^3 in air (9)." The interpretation of unit risk would be as follows: if unit risk = 2 x 10^{-6} per µg/m^3, 2 excess cancer cases (upper bound estimate) are expected to develop per 1,000,000 people if continually exposed for a lifetime to 1 µg of the chemical in 1 cubic meter of air.

This unit risk can be converted to an air concentration that would equate to an excess cancer incidence risk of one-in-ten-thousand as shown below:

Air Concentration = 1 x 10^{-4} / 2 x 10^{-6} (µg/m^3)$^{-1}$ (unit risk) = 50 µg/m^3

Evaluation of Predicted Inhalation Exposure Levels

An evaluation can be made by comparing the predicted indoor air concentrations of benzene and ethylbenzene to the ATSDR Inhalation MRLs, the EPA RfC, and the level of exposure that translates to a one-in-ten-thousand (10^{-4}) increased risk of cancer utilizing the EPA air unit risk. The following table includes these published screening levels for the selected chemicals of concern. All screening levels are expressed as µg/m^3.

Table 3 – Screening Levels for Chemicals of Concern (µg/m3)

Chemical of Concern	Acute Inhalation MRL	Intermediate Inhalation MRL	Chronic Inhalation MRL	Chronic RfC	Increased Cancer
Benzene	30	20	10	30	10
Ethylbenzene	-	4,000	-	1,000	-

"-" means that particular screening level is not currently established or available.

The predicted air concentration of benzene in a home or multi-family residential unit constructed on a slab at the site location (12.5 µg/m^3) is slightly above the lowest published screening levels. Several safety factors are built into the determination of comparison values, therefore even though the predicted concentration is just slightly above the chronic MRL and increased cancer level, no adverse health effects would be expected, even during a lifetime of exposure at this level.

The predicted air concentration of ethylbenzene in a home or multi-family residential unit constructed on a slab at the site location (3.94 µg/m^3) is several orders of magnitude lower than published health effect levels. It can be concluded that exposure to ethylbenzene in a home or multi-family residential unit constructed on a slab at the site will not cause any adverse health effects, even during a lifetime of exposure.

The conclusion of the toxicological evaluation is that individuals living in future homes or multi-family residential units constructed on the site exposed to volatile chemicals that may migrate into the homes from contaminated groundwater will not experience adverse health effects. This conclusion is based on future homes or multi-family residential units being constructed upon slab foundations not upon basement foundations. A greater potential for exposure to volatile chemicals exists in construction with basement foundations.

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 the chemical of concern detected in the soil and groundwater samples at the site on children's health. Since the exposure to chemicals of concern are at or lower that published health effect levels, and that these health effect levels consider the most sensitive portion of the population, it is concluded that children's health would not be negatively impacted by the presence of the various chemicals of concern detected within the site soil and groundwater samples.

Community Health Concerns

The IDPH understands that the community of Oskaloosa has concerns regarding the health of individuals that may be exposed to the site if the site is developed for residential use. The community understands that, at the present time, contamination in the soil and groundwater remains on the site property from previous site uses and activities. This health consultation has attempted to provide answers to these concerns by evaluating the health impacts from exposure to the current levels of chemicals in surface site soil and the potential levels of volatile chemicals that may migrate into homes or multi-family residential units if constructed on site property.

Conclusions

From a review of the environmental samples collected at the site and through completion of the toxicological evaluation, the Buchanan Bulk Oil – Ma & Pa Stores site poses no apparent public health hazard. The following statements include specific conclusions from analyzing the soil sampling and groundwater sampling analytical data.

From the soil sampling and analytical data collected during the Targeted Brownfields Assessment, it is concluded that:

- Exposure to the surface soils through incidental ingestion at the levels detected during the Targeted Brownfields Assessment would not be expected to produce any adverse health effects; however, definitive conclusions as to the health risks of employees working at

the site cannot be made since samples were not exclusively obtained from the upper three inches of surface soil.

From the groundwater sampling and analytical data collected during the Targeted Brownfields Assessment, it is concluded that:

- Small amounts of volatile chemicals present in site groundwater have the potential to migrate into homes or multi-family residential unit if they are constructed on site property.

- Exposure to volatile chemicals within future homes or residential housing units, at the levels predicted by the Johnson & Ettinger (1991) Model for Subsurface Vapor Intrusion into Buildings, is not expected to produce any adverse health effects.

- Any conclusions regarding the exposure to volatile chemicals is based upon the assumption that future homes or multi-family residential units constructed on the site will not have basements, but will be built upon a slab foundation.

Recommendations

- The collection of additional soil samples should be considered to determine the concentration of chemicals of potential concern in the top three inches of soil.

- If new homes or multi-family residential units are constructed on the site property, it is recommended that slab foundations be exclusively used. Basements should not be constructed due to the high water table and the increased potential for volatile chemicals to migrate into homes or multi-family residential units with basements.

- The use of a vapor barriers installed under the slab construction should be considered to further control the migration of volatile chemicals into any future homes or multi-family residential units constructed on site property.

- The entrance of utility lines into homes or multi-family residential units should be sealed properly to limit the potential of vapor migration into the homes or multi-family residential units, through this preferential pathway.

- There is evidence that, in some cases, volatile chemicals can migrate through plastic piping used in water mains and supply lines leading to the home or multi-family residential units if these lines are installed in areas of soil contamination. If the site is used for residential construction, copper or other metal piping should be used to limit the possibility of volatile chemical migration.

Public Health Action Plan

- IDPH will provide assistance with community health education as needed and requested.
- IDPH will review any additional sampling data and update health recommendations as necessary.

Figure 1 – Aerial View of Site Prior to Removal of Structures

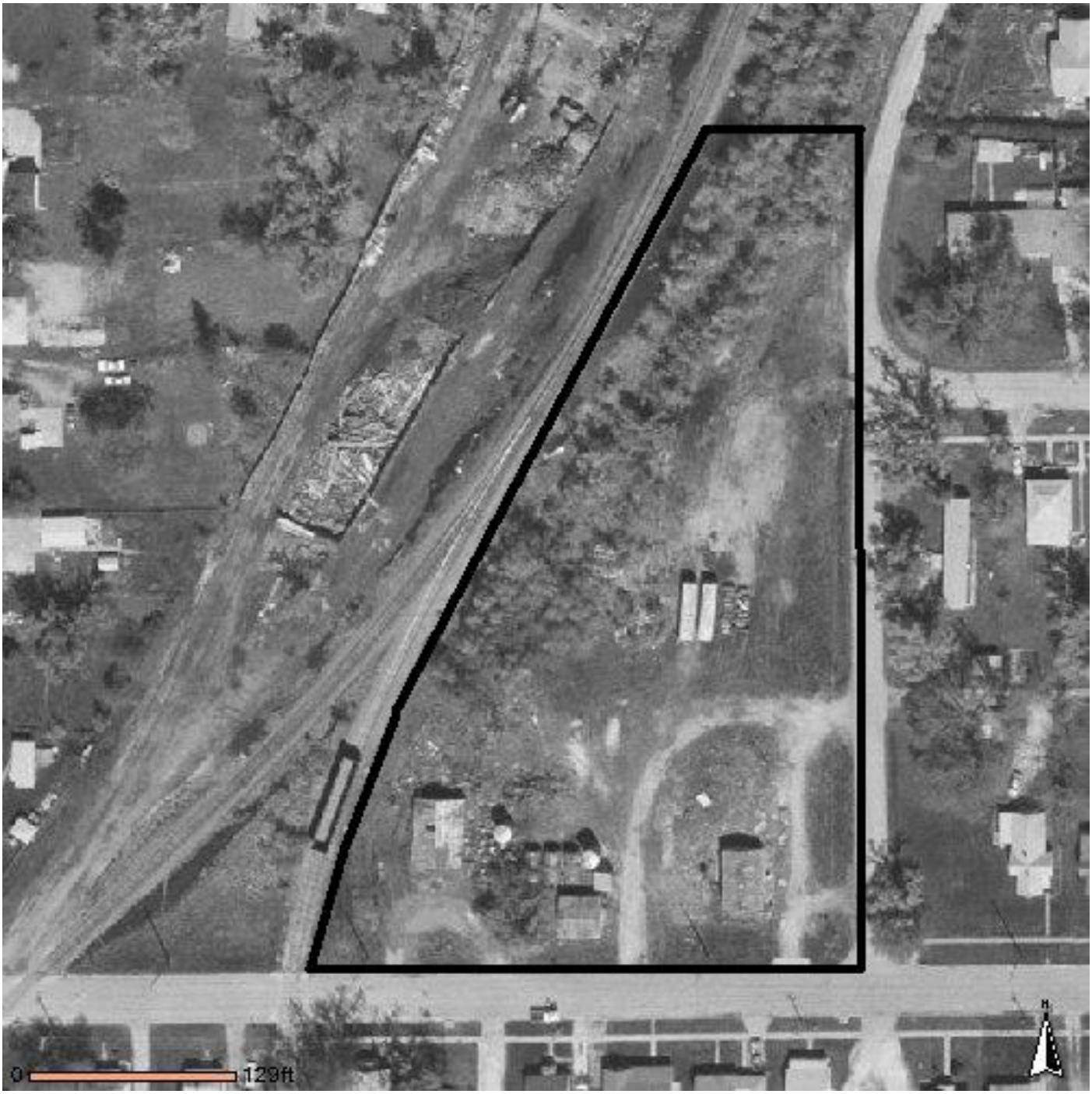
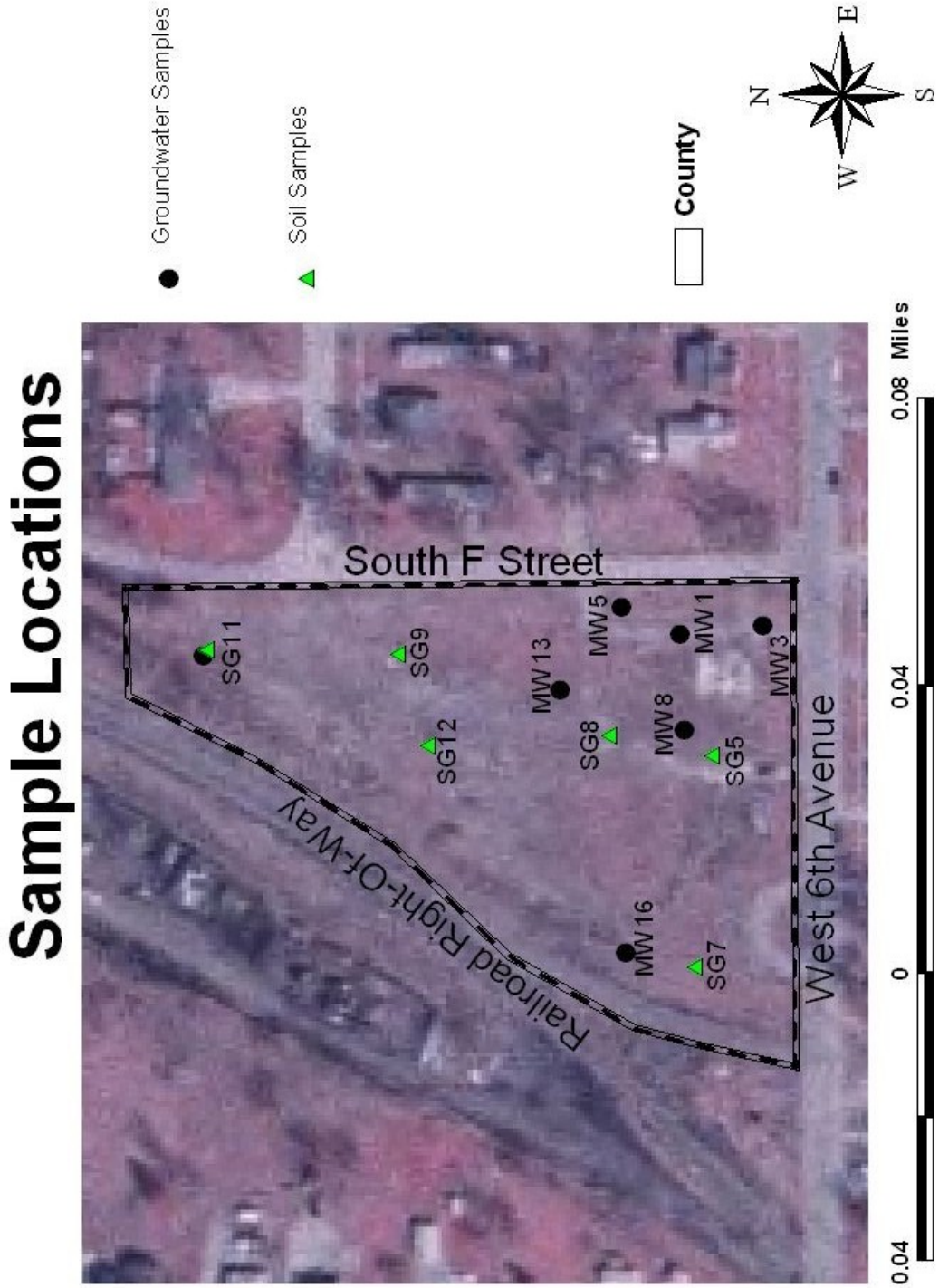


Figure 2 – Sample Locations



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9. United States Environmental Protection Agency, Integrated Risk Information System. EPA Web Site Link: http://www.epa.gov/iris/gloss8.htm#u

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CERTIFICATION

The Iowa Department of Public Health, Hazardous Waste Site Health Assessment Program, has prepared this health consultation evaluating contamination in soil and groundwater at a former bulk petroleum storage area located in Oskaloosa, Iowa 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. The editorial review of this document was completed by the cooperative agreement partner.

Technical Project Officer, SPS, CAPEB, DHAC, ATSDR

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

Team Lead, SPS, CAPEB, DHAC, ATSDR

Appendix A – Johnson & Ettinger Model Input and Output