Health Consultation

JONESBORO MUNICIPAL LANDFILL

CITY OF JONESBORO, CRAIGHEAD COUNTY, ARKANSAS

MARCH 22, 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

Jonesboro Municipal Landfill

Jonesboro, Craighead County, Arkansas

February 24, 2005

Prepared by
Arkansas Department of Health

Under a Cooperative Agreement with
Agency for Toxic Substances and Disease Registry

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Summary and Statement of Issues

The Arkansas Department of Health (ADH) prepared this Health Consultation under a cooperative agreement with the Agency for Toxic Substances and Disease Registry (ATSDR) in response to a request made by members of a Jonesboro, Arkansas community group. In July of 2002, Citizens Against More Pollution (CAMP) members raised concerns that leachate (a liquid that has seeped into or out of some substance) from the Jonesboro Municipal Landfill may be adversely affecting the health of people living near the landfill (Appendix A, Figure 1). This document reviews available environmental data collected both on- and off-site to evaluate the potential for adverse health effects associated with the Jonesboro Municipal Landfill.

The Jonesboro Municipal Landfill is an operating facility located on West Matthews Road at the southwestern edge of Jonesboro. In June of 1983, a routine inspection of the Jonesboro Municipal Landfill by members of the Arkansas Department of Environmental Quality (ADEQ), known during that time as the Arkansas Department of Pollution Control and Ecology, discovered partially buried barrels containing hazardous waste. Some of the barrels' contents had emptied onto the ground, threatening to contaminate the groundwater.

As a result of the discovery of the barrels, groundwater monitoring wells were installed in 1986. Because of their improper installation, to date many of the monitoring wells are dry and do not yield adequate data. In fact, adequate historical data are available for only eight of the 13 monitoring well locations (Appendix A, Figure 2). The monitoring well summary data taken from the initial sampling in April of 1986 indicate concentrations of inorganic chemicals above the US Environmental Protection Agency's (EPA) maximum contaminant level (MCL) for arsenic and manganese. MCL is the maximum permissible level of a contaminant in drinking water that is considered not to pose a significant health risk to people ingesting the water on a daily basis. Similarly, an EPA action level is the level that if exceeded, triggers treatment or other requirements that a water treatment system must follow. The concentration for lead was above the action level for several of the monitoring wells (Appendix B, Table 1) [1].

In March 2002, CAMP contracted with Southern Ecological Services (SES) to collect and analyze 21 grab surface water samples and 2 composite surface soil samples off site of the landfill. While collecting samples, SES identified a significant leachate stream originating from the southwest corner of the landfill and flowing into a tributary of Big Creek. This tributary is reported to serve as a water source for nearby cattle and horses; nothing indicates that people are using the tributary. The lab analysis indicated both arsenic and lead above the MCL and action level (Appendix B, Table 2).

On the basis of the limited available information, ADH has concluded that the Jonesboro Municipal Landfill site poses an *indeterminate public health hazard*, the category used in ATSDR's documents when a professional judgment about the level of health hazard cannot be made because information critical to such a decision is lacking; data or information are not available for all environmental media to which humans may be exposed; and no community-specific health outcome data exist to indicate that the site has had an adverse impact on human health. On the basis of the review of the limited data available, arsenic in the leachate is not expected to cause adverse health effects in children or adults, although more information is needed to better characterize the site. More environmental sampling is recommended.

Background

Site Description and History

Jonesboro Municipal Landfill, formerly a rock quarry, has been in operation for more than 40 years. The landfill covers approximately 58 acres located on the western side of the city, just southeast of the U.S. Highway 63 bypass and north of Casey Springs Road on West Matthews Road (Appendix A, Figure 1). Neighborhoods surround the landfill on all sides. Several of the residential areas, including Wood Springs Estate, Duckswater, and Ridge Point, are new and upscale. Ridgefield Christian School (grades kindergarten–12) is approximately 2 miles down gradient from the site.

Jonesboro's Municipal Landfill operated as a Class I Landfill from 1962 until its reclassification to a Class IV Landfill in December 1986. Jonesboro Municipal Landfill is an active facility that continues to operate today as a Class IV Landfill. When it operated as a Class I Landfill, the facility was allowed to accept all types of solid, non-hazardous wastes from households, commercial businesses, and industry. Now as a Class IV Landfill, the facility is permitted to accept for disposal only wastes that do not become putrid and wastes that do not degrade, or that degrade very slowly. The findings of a June 1983 site inspection performed by ADEQ prompted, in part, the reclassification. The inspection revealed exposed drums, some of which were later characterized as containing hazardous waste. An unknown quantity of hazardous substances had been released on the site through the handling of the containers, threatening to contaminate the groundwater.

Hess Environmental Services, Inc. (HES) was contracted to assist in sampling, characterizing and properly disposing of the drums containing waste that were excavated from the site. A total of 514 drums that contained liquid wastes and 1,479 drums containing solid waste were excavated. HES collected 55 composite and 24 single samples to be analyzed from the 514 drums that contained liquid wastes, along with four drums that contained wastewater from decontamination operations, and one drum of liquid from the containment pond. HES also collected 14 composite and 11 single samples that represented the 1,479 drums of solid waste. From April 18, 1985, through April 23, 1985, barrels of materials that were shown to be hazardous were removed from the site and properly disposed of at a permitted facility by CECOS International, Incorporated [2].

On October 9, 1985, a Consent Order between ADEQ and the city of Jonesboro was signed requiring the city to install a groundwater monitoring system. Thirteen wells were installed for monitoring purposes [1]. The wells range in drilled depths of 20–120 feet [3]. However, the wells extend through areas (zones) of the soil that do not easily permit groundwater to pass through, thus isolating the monitored zones from the volume of waste contained in the landfill [4]. This could result in sampling data that do not represent the true impact that the landfill contents have had on groundwater. The Review of Hydrogeologic Conditions at the City of Jonesboro Class IV Landfill, conducted and summarized by the University of Memphis, stated that "most monitoring wells in the Wilcox aquifer at the current Class IV landfill site were not placed deep enough to access water; thus many dry monitoring wells are present" [5]. New wells strategically located and drilled to depths that would access water are needed to take

representative sampling. This document reviews available sampling data; however, data are available for only eight of the 13 monitoring well locations (Appendix A, Figure 2).

The review of the landfill's hydrogeologic conditions revealed that leachate from the landfill has affected the water quality in surface water, shallow, perched ground water, and water in the underlying Wilcox aquifer [5]. The off-site residential wells have not been surveyed to determine how many exist, their location, or how they are used. In corporation with the area citizens and CAMP members, the identification of private wells in the community for the purpose of sampling and analyzing water quality is recommended to better assess whether the wells have been impacted by the landfill.

In a letter to the mayor of Jonesboro dated July 12, 2002, ADEQ informed the city of the need to upgrade and recertify the groundwater monitoring system. The upgrades were to be completed by December 31, 2002. The reasons given for requiring the improvements were the age of the system and the quality of the data produced by the system. No information indicates that the improvements have been completed [6].

Site Visits

ADH conducted three site visits to the Jonesboro Municipal Landfill. On the first site visit, in September 2002, the sanitation superintendent of the landfill took ADH and ADEQ members on a tour of the site. The entire site has been fenced to prevent unauthorized entry. Locations of interest on site were the monitoring wells, the reported leachate site, and the area where the barrels containing hazardous waste had been located in June of 1983.

During the second site visit, personnel from the ADH visited the Jonesboro Municipal Landfill on October 16, 2002. A staff member of the ADH's Engineering Division collected water samples from an off-site private well located up gradient and directly across from the landfill on Strawfloor Drive. The samples were analyzed and results indicated that no substances contained in the water collected at this well exceeded the primary standards for drinking water.

Failure of a mechanical well pump, located near the south-southeast corner of the landfill, and the refusal of a property owner to grant permission to test another well prevented the sampler from collecting additional water samples off-site. ADH personnel met with the president of CAMP as part of the investigative process. The CAMP president and attorney stated that they would try to acquire permission to obtain water samples from the privately owned well. To date, ADH has not been informed whether permission has been granted.

Surface water leaves the site on the southwest corner of the property and flows into a tributary of Big Creek. Some of the water enters a small lake covering approximately 12.6 acres. The small lake is about 500 yards south-southwest of the point the water leaves the site. The lake likely is not used for fishing or swimming; however, cattle and horses drink water from the tributary.

The third site visit to the landfill took place in April 2004. This visit involved driving through the area surrounding the landfill and taking photos to assess changes that may have taken place since the first site visit in September 2002. No changes were noted that might affect possible exposure.

Demographics

The Jonesboro Municipal Landfill is in a rural, but developing area of Jonesboro. According to EPA's Enforcement & Compliance History Online Web site, 7,416 people live within a 1-mile radius of the Jonesboro Municipal Landfill. ADH estimates that 217 people live within a one-quarter mile radius of the landfill [7].

Exposure Pathway Analysis

Potential exposure pathways to contaminants at the Jonesboro Municipal Landfill site were evaluated to determine if persons could be exposed to potentially unsafe contaminants from the site. Exposure pathways consist of five elements:

1. a source of contamination,
2. transport through an environmental medium, such as soil or groundwater,
3. point of exposure,
4. a route for the contaminant to enter the body, and
5. a receptor population (persons who could be exposed).

For a person to be exposed to a contaminant, the exposure pathway must contain all the elements listed above, resulting in a completed exposure pathway. In some cases, a potential exposure pathway might exist in which at least one of the elements of the exposure pathway is missing, but could exist. Potential pathways indicate that exposure to a contaminant could have occurred in the past, could be occurring, or could occur in the future. Potential exposure pathways refer to those pathways where an environmental medium has been documented as contaminated, but whether exposures to harmful levels occurred in the past, are occurring, or may occur in the future is unknown.

Discussion

CAMP members contacted Southern Ecological Services (SES) on March 10, 2002, to conduct an environmental screening of the area where leachate had escaped the landfill site. On March 14, 2002, SES collected 21 grab surface water samples and 2 composite surface soil samples off site of the landfill. SES collected the grab water samples from the area where leachate was observed flowing into the tributary of Big Creek running adjacent to Casey Springs Road [1]. Arsenic and lead in the grab surface water samples were at or above the MCL. Appendix B, Table 2 reflects the information from the Environmental Screen Report prepared by SES.

In April 1986, monitoring wells that were installed by EnviroMed and Hall, Blake and Associates were sampled for the first time. Appendix B, Table 1 summarizes the monitoring well data. The three elements that exceeded EPA's maximum contaminant level (MCL), action level, or national secondary drinking water regulations (NSDWRs or secondary standards) were arsenic, lead, and manganese. Arsenic was detected in monitoring well MW-3-1 at twice the MCL of 0.01 mg/L. The action level for lead is 0.015 mg/L and the initial sample results ranged from a "No Detect" to 0.06 mg/L, with an average of 0.027 mg/L. The secondary standard for

manganese is 0.05 mg/L. Sample results for manganese ranged from 0.11 mg/L to 5.93 mg/L, with an average of 1.13 mg/L (Appendix B, Table 1).

Exposure Pathways

Information is not available at this time as to whether the residents in the area of the landfill are using their private wells for a drinking source. However, because public water is available to the area, area residents likely are not using the wells as a potable source of water. In corporation with the area citizens and CAMP members, the identification of private wells in the community for the purpose of sampling and analyzing water quality is recommended to better assess whether the wells have been impacted by the landfill.

Groundwater Exposure Pathway

Groundwater was sampled from only one residential well that was located up gradient of the landfill. No contaminants were detected. Additional analytical data from sampling of the monitoring wells (on-site) and residential wells in the area of the site are needed to determine the potential for human exposure through these pathways. According to an engineer for Jonesboro City Water and Light Company, water distribution lines were laid in 1968 for the area immediately surrounding the landfill site. The Valley View Rural Water Association, which became part of Jonesboro City Water and Light Company in the late 1980s, laid the lines.

Soil Exposure Pathway

A documented history of leachate off-site, as well as the barrels of hazardous waste that were uncovered in 1983, suggests that dermal exposure may have occurred. Potential contact with the soil would likely be infrequent, and involve small areas of the body (i.e., hands primarily). However, without adequate off-site sampling to characterize the soil, ADH is unable to determine whether this pathway is of a public health concern.

Surface Water, Sediment, and Leachate Exposure Pathway

Human exposure to leachate and surface water is possible given that contamination has been documented both on- and off-site. Available information is insufficient to determine the extent of human contact with contaminants. Potential human exposure pathways include dermal contact with leachate and inhalation of vapors released from the leachate surface water and sediment.

The estimated daily exposure dose for the ingestion of arsenic in the leachate was calculated. This pathway calculation represents the worst-case scenario for exposure to the known contaminant of concern (arsenic) in the leachate. On the basis of the review of the limited data available, arsenic in the leachate is not expected to cause adverse health effects in children or adults.

Neither surface water nor sediments from the tributary or the lake located south-southwest of the site have been analyzed for contaminants. Sampling and analysis for volatile organic compounds (VOCs), semi-volatile organic compounds (SVOCs), and inorganic chemicals are needed. The

sampling and analysis would confirm that human exposures through dermal contact with surface water, and inhalation of chemicals volatilized from surface water are not occurring.

Air Exposure Pathway

Ambient air monitoring in the human breathing zone has not been conducted at the site. The potential for human exposure via inhalation of volatilized contaminants, therefore, cannot be assessed. Airborne chemical contamination through the off-site migration of gases, and particles and chemicals adhered to dust especially during the period of active operation of the site, may have occurred.

Arsenic

A potential pathway for human exposure to arsenic from the Jonesboro Municipal Landfill is through the ingestion of groundwater. Arsenic toxicity varies depending upon its form. The soluble inorganic forms are easily absorbed from the digestive tract and distributed throughout the body. Arsenic is cleared rapidly from the blood and does not strongly accumulate in the body during exposure to low levels. Arsenic remaining in the body accumulates in the liver, kidney, lung, spleen, aorta, skin, hair, and upper gastrointestinal tract. Nevertheless, arsenic rapidly clears from these tissues, with the exception of skin and hair [8].

Animal studies suggest that low levels of oral intake of arsenic may be beneficial or even essential, but higher exposure levels may result in adverse health effects. Some people can ingest up to 150 grams per kilogram per day (g/kg/day) without noticeable symptoms. However, in more sensitive individuals, doses as low as 20 to 60 micrograms per kilogram per day (µg/kg/day), or approximately 1 to 4 milligrams per day (mg/day), may result in signs of arsenic toxicity. These signs include disturbances of the blood and nervous systems, digestive tract irritation, skin and blood vessel injuries, and liver or kidney damage. In most cases of chronic exposure, many or all of the signs of arsenic toxicity are found together, indicating that the sensitivity for these various symptoms are fairly similar. The most sensitive effects are the appearance of skin calluses and pigmentation. The lowest level at which these effects appear is above 10 µg/kg/day, or approximately 0.7 mg/day [8].

The estimation of the daily exposure dose involves determining contaminant concentrations at points of potential human exposure and developing assumptions regarding the extent of human exposure in the completed exposure pathways. For this evaluation, the maximum concentration detected for the contaminant of concern (arsenic) in leachate is considered as a concentration at the point of potential exposure. People are assumed to have access to the source of leachate a maximum of 42 years, the length of time the landfill has been in existence. Children are assumed to have a body weight of 16 kilograms (kg) or 35 pounds, and to ingest 1.5 liters of water per day; and adults are assumed to have a body weight of 70 kg or 154 pounds, and to ingest 2 liters of water per day.

The estimated daily exposure dose of arsenic for children was calculated at 0.0045 milligrams per kilogram per day (mg/kg/day) or 0.072 mg per day for a child weighing 16 kg. This is 9.72 times lower than the lowest level at which the most sensitive effects of arsenic toxicity are expected to occur. For adults weighing 70 kg the estimated daily exposure dose was calculated at

0.098, which is 7.14 times lower than the lowest level at which the most sensitive effects of arsenic toxicity is expected to occur. No people are being exposed or have been exposed to levels of arsenic in the leachate impacted surface water that would be expected to cause adverse health effects, on the basis of review of the limited data available for this Health Consultation.

Lead

The route of exposure to humans from lead at the Jonesboro Municipal Landfill would be through ingestion of groundwater. Lead, most dangerous in young children and the unborn, also may exert its effects even before conception. Pregnant women who have been exposed can pass lead to their unborn children. The effects of lead exposure during pregnancy may include premature birth, low birth weight, or abortion. Young children absorb lead more readily through the digestive tract than do adults and are more sensitive to its effects. In young children, lead exposure can decrease intelligence (IQ) scores, slow growth, and cause hearing problems [9]. As children grow older, these effects may continue and interfere with their school performance.

Numerous chemicals interact with lead and some nutritional deficiencies may increase the risk of lead effects. Iron deficiency increases lead absorption. Increased uptake of dietary fiber, iron, and thiamine results in lower blood lead levels in occupationally exposed people. A higher calcium intake decreases the amount of lead in the body. Phosphorus and calcium inhibit the body's lead absorption. Children having elevated blood lead levels show lower concentrations of a vitamin D metabolite in their blood. Consumption of maximally contaminated groundwater from the on-site deep aquifer could lead to an increase in blood lead levels. If blood lead levels were to increase to 10 micrograms per deciliter (µg/dL) or more in children, the more subtle neurological effects of lead exposure are possible [9].

Manganese

Manganese is found everywhere and is essential for normal physiologic functioning in all animal species. Individual requirements for, as well as adverse reactions to, manganese may be highly variable. The oral reference dose for manganese is 0.14 milligrams per kilogram per day (mg/kg/day). An oral reference dose is an estimate of the daily exposure to a substance for people who are assumed to be without appreciable risk; the dose is calculated using the no-observed-adverse-effect level (NOAEL). For a 70 kg (154 pound)-adult, this would equate to an intake of 9.8 milligrams per day and, for a child weighing 10 kg (22 pounds), 1.4 milligrams per day [10]. The levels of manganese detected in the monitoring wells exceed the primary standards for drinking water.

Community Health Concerns

The local community group, CAMP, raised general concerns that the Jonesboro Municipal Landfill may have affected the health of the people living near the landfill site. Data are not sufficient to fully answer the questions posed by the community. However, on the basis of the review of the limited data available for this Health Consultation, arsenic in the leachate is not expected to cause adverse health effects.

Past soil samples indicated that hazardous wastes were present, but the nature and extent of contamination is unknown because of limited sampling. A review of the limited data does not indicate that people are being exposed or have been exposed to levels of contamination that would be expected to cause adverse health effects. However, data or information are not available for all environmental media to which humans may be exposed. Community-specific health outcome data to indicate that the site has had an adverse impact on human health are insufficient or nonexistent.

Child Health Considerations

Both ADH and ATSDR recognize that the unique vulnerabilities of infants and children demand special emphasis in communities faced with air, water, soil, or food contamination. Children could be at greater risk than are adults from certain kinds of exposure to hazardous substances. Children play outdoors and sometimes engage in hand-to-mouth behaviors that increase their exposure potential. Children are shorter than are adults, meaning they breathe dust, soil, and vapors close to the ground. A child's lower body weight and higher intake rate result in a greater dose of a hazardous substance per unit of body weight. If toxic exposure levels are high enough during critical growth stages, the developing body systems of children can sustain permanent damage. Finally, children are dependent on adults for access to housing, for access to medical care, and for risk identification. Thus, adults need as much information as possible to make informed decisions regarding their children's health.

Because the site is entirely fenced to prevent unauthorized entry, only potential off-site exposures (i.e., groundwater and surface soil) should be considered, but additional sampling data are needed. However, on the basis of the review of the limited data available for this Health Consultation, arsenic in the leachate is not expected to cause adverse health effects in children.

Conclusions

Data or information are not available for all environmental media to which humans may be exposed; and no community-specific health outcome data exist to indicate that the site has had an adverse impact on human health. Human exposure to contaminants may be occurring, but additional sampling data are needed to better assess the possible exposures. On the basis of the review of the limited data available, however, arsenic in the leachate is not expected to cause adverse health effects in children or adults.

On the basis of the review of information, ADH has concluded that the Jonesboro Municipal Landfill site poses an *indeterminate public health hazard*, the category used in ATSDR's documents when a professional judgment about the level of health hazard cannot be made because information critical to such a decision is lacking.

The information necessary to determine if exposure to groundwater, soil, surface water, sediment, and air is of a public health concern has not been provided to ADH for review.

Recommendations

- ADH recommends that the City of Jonesboro—under the guidance of ADEQ—should consider the benefits and plausibility of installing a new groundwater monitoring system that is strategically located and drilled to depths that would access water for representative sampling. The city should then periodically monitor these on-site monitoring wells (using Appendix 1 Parameters, contained in the Arkansas Pollution Control and Ecology Commission's Regulation 22, as per ADEQ's original request in July 2002 [6]).

- ADH recommends that this office (ADH), in conjunction with the area citizens and CAMP members, identify private wells in the community for the purpose of sampling and analyzing water quality.

- ADH recommends that on- and off-site surface/subsurface soil sampling be conducted by the city of Jonesboro, an independent third party, or ADEQ, to more accurately characterize concentration of contaminants for the soil exposure pathway.

- ADH recommends that bore samples be collected on-site by the city of Jonesboro, an independent third party, or ADEQ, to better characterize the contents of the site, on the basis of past acceptance of hazardous waste found in 1983 and leachate in 2002.

- ADH recommends if on- and off-site soil sampling indicates contaminants at levels of a health concern, that surface water and sediment samples from the off-site tributary/lake be collected and analyzed for VOCs, SVOCs, and inorganics to determine that dermal or inhalation exposures are not occurring.

- ADH recommends if on- and off-site soil sampling indicates contaminants at levels of a health concern, that the possibility of contamination of the air should be pursued to determine if this is a potential exposure pathway. If contamination of air is a potential exposure pathway, ADH recommends collecting air sampling data for the purpose of assessing exposure of the residents.

Public Health Action Plan

The purpose of the Public Health Action Plan is to ensure that this document not only identifies any current or potential exposure pathways or related health hazards, but also provides a plan of action to mitigate and prevent adverse human health effects resulting from exposures to hazardous substances in the environment. The first section of the Public Health Action Plan contains a description of completed actions to mitigate exposures to environmental contamination. The second section lists public health actions that will be implemented in the future.

Completed Actions

- ADH evaluated soil samples in June 2002 at the request of ADEQ.
- ADH completed a community needs assessment in July 2002.
- ADH mailed arsenic and lead fact sheets and information about ATSDR to the president of CAMP in October 2002.
- ADH updated the community needs assessment in December 2003.
- ADH conducted three site visits: September 2002, October 2002, and April 2004.

Future Activities

- ADH will provide the concerned residents (CAMP members) with a copy of this completed Health Consultation.
- ADH will continue health education activities in the vicinity of the Jonesboro Municipal Landfill as needed or requested.
- If future sampling data more fully delineate the nature and extent of site contamination, ADH and ATSDR will review these data to determine if a potential health hazard exists and issue a follow-up to this Health Consultation.

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Certification

This Health Consultation for Jonesboro Municipal Landfill was prepared by the Arkansas Department of Health under a cooperative agreement with the Agency for Toxic Substances and Disease Registry (ATSDR). It is in accordance with approved methodology and procedure existing at the time the Health Consultation was initiated.

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The Division of Health Assessment and Consultation (DHAC), ATSDR, has reviewed this Health Consultation and concurs with its findings.

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Appendices

Appendix A - Figures

Figure 1. Jonesboro Municipal Landfill Aerial Photo

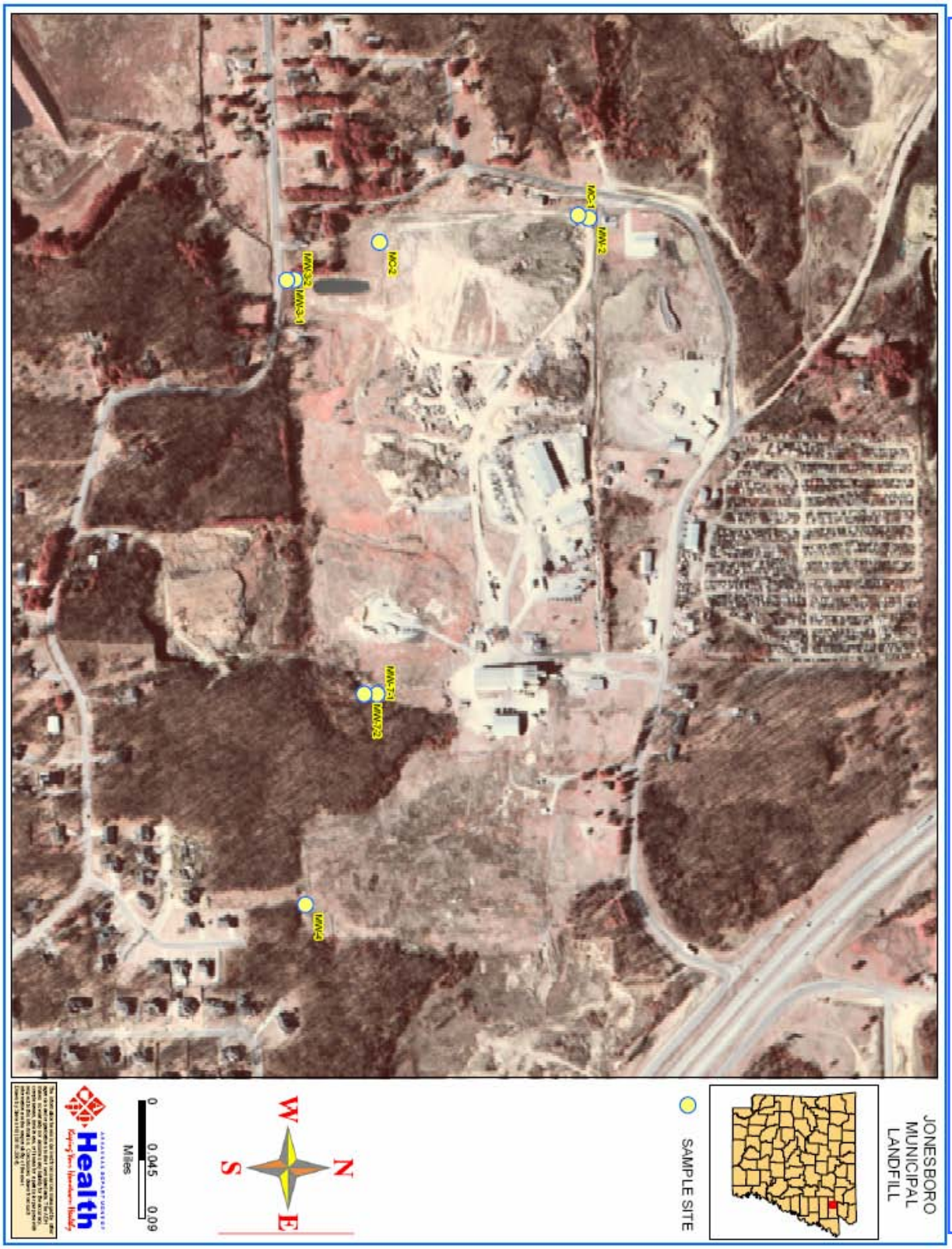

Figure 2. Aerial Photo of Jonesboro Municipal Landfill Monitoring Well Sample Sites

Appendix B - Table

Table 1. Lab Results of Initial Sampling of Monitoring Wells

Analyte	MW-2	MW-3-1	MW-3-2	MW-3-2	MW-4	MW-7-1	MW-7-2	MW MC-2	MW MC-1	†EPA MCL
	4/20/86	4/17/86	4/17/86	4/24/86	4/17/86	4/17/86	4/24/86	4/17/86	4/17/86	
	Water	Water	Water	Water	Water	Water	Water	Water	Water	
Arsenic	N/D	**0.02**	N/D	N/D	N/D	N/D	N/D	N/D	N/D	0.05/0.01‡
Barium	0.032	2.0	0.684	0.013	0.333	0.567	0.060	0.863	0.683	2
Cadmium	0.001	N/D	N/D	0.001	N/D	N/D	0.002	N/D	0.001	0.005
Chromium	0.030	0.052	0.058	0.040	0.026	0.040	0.092	0.012	0.011	0.1
Lead	0.01	**0.04**	**0.06**	0.01	**0.02**	**0.05**	**0.04**	0.01	N/D	0.015§
Manganese	**0.11**	**5.93**	**0.53**	**0.17**	**1.43**	**0.94**	**0.85**	**0.17**	**0.06**	0.05¶
Mercury	N/D	N/D	N/D	N/D	N/D	N/D	N/D	N/D	N/D	0.002
Selenium	N/D	N/D	N/D	N/D	N/D	N/D	N/D	N/D	N/D	0.05
Silver	N/D	N/D	N/D	N/D	N/D	N/D	N/D	N/D	N/D	0.10¶
Nitrate	0.57	0.10	0.70	-	0.30	8.00	-	0.20	0.24	10

*Unless otherwise stated, all data are reported in units of milligram per liter or parts per million. Each metal is tested for its total concentration.
†US Environmental Protection Agency's (EPA's) maximum contaminant level.
‡0.05 milligrams per liter (the current MCL) and 0.01 milligrams per liter (the federal MCL, effective 2006)
§EPA's action level
¶ National Secondary Drinking Water Regulations (NSDWRs or secondary standards) are non-enforceable guidelines regulating contaminants that may cause cosmetic effects (such as skin or tooth discoloration) or aesthetic effects (such as taste, odor, or color) in drinking water [11]. N/D = No Detect
Concentrations in bold face indicate that it is above EPA's MCL/Action Level.

Table 2. Analytes at or above EPA MCL*			
Test	Matrix	Concentration	EPA MCL
Arsenic	Water	0.0506 mg/L	0.05 / 0.01† mg/L
Lead	Water	0.037 mg/L	0.015 mg/L

mg/L = milligrams per liter or parts per million (ppm)
EPA MCL = U.S. Environmental Protection Agency's maximum contaminant level
*Samples collected March 10, 2002, by Southern Ecological Services
†0.05 mg/L (the current MCL) and 0.01 mg/L (the federal MCL, effective 2006)