Public Health Assessment for

STURGIS MUNICIPAL WELLS
STURGIS, ST. JOSEPH COUNTY, MICHIGAN
CERCLIS NO. MID980703011
NOVEMBER 1, 1993

U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES
PUBLIC HEALTH SERVICE
Agency for Toxic Substances and Disease Registry

PUBLIC HEALTH ASSESSMENT

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CERCLIS No. MID980703011

Prepared by

Michigan Department of Public Health (MDPH)
Under a Cooperative Agreement with
Agency for Toxic Substances and Disease Registry (ATSDR)

THE ATSDR PUBLIC HEALTH ASSESSMENT: A NOTE OF EXPLANATION

This Public Health Assessment was prepared by ATSDR pursuant to the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA or Superfund) section 104 (i)(6) (42 U.S.C. 9604 (i)(6), and in accordance with our implementing regulations 42 C.F.R. Part 90). In preparing this document ATSDR has collected relevant health data, environmental data, and community health concerns from the Environmental Protection Agency (EPA), state and local health and environmental agencies, the community, and potentially responsible parties, where appropriate.

In addition, this document has previously been provided to EPA and the affected states in an initial release, as required by CERCLA section 104 (i)(6)(H) for their information and review. The revised document was released for a 30 day public comment period. Subsequent to the public comment period, ATSDR addressed all public comments and revised or appended the document as appropriate. The public health assessment has now been reissued. This concludes the public health assessment 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.

Agency for Toxic Substances
and Disease Registry.................................William L. Roper, M.D., M.P.H. Administrator
Barry L. Johnson, Ph.D., Assistant Administrator

Division of Health Assessment
and Consultation..Robert C. Williams, P.E., Director
Juan J. Reyes, Deputy Director

Federal Programs Branch..Sally L. Shaver, Chief

Community Health Branch.......................................Cynthia M. Harris, Ph.D., Chief

Remedial Programs Branch.........................Sharon Williams-Fleetwood, Ph.D., Chief

Records & Information Management Branch..........................Max M. Howie, Jr., Chief

Emergency Response & Consultation Branch....................C. Harold Emmett, P.E., Chief

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(703) 487-4650

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SUMMARY

The Sturgis Municipal Wells site was listed on the U.S. Environmental Protection Agency (U.S. EPA) National Priorities List (NPL) in September 1984. In 1982, two of the four wells supplying the City of Sturgis municipal water system were found to be contaminated with trichloroethylene (TCE). Eventually, traces of TCE were found in a third municipal well and several nearby industrial wells. Traces of TCE were also found in food products prepared in a plant whose wells were contaminated. Tetrachloroethylene (also called perchloroethylene or PCE) also was found in the original contaminated municipal wells. The contaminated municipal wells have been taken out of regular service, and replaced with new wells in uncontaminated areas. Some of the contaminated industrial wells are still in use for non-consumption purposes only. The owner of the wells has drilled new wells outside the contaminated area for a potable water supply. The food product contamination was judged to not require a recall by state and federal agencies.

The contamination in the groundwater has been linked to two source areas: the site of a former woodworking and furniture manufacturing facility and a manufacturer of automotive electrical equipment. TCE, PCE, and other volatile organic compounds have been found in groundwater from monitoring wells within the city, and in soil and soil gas from the source areas. The U.S. EPA proposes to pump and treat the contaminated groundwater, to use soil vapor extraction to remove some contaminants from the source areas, and to excavate other contaminated soil from the source areas for off-site disposal. There are no reports of citizen concerns regarding the site.

The site currently poses an indeterminate public health hazard. Although there are no indications that exposure to contaminants is occurring at levels of health concern, there is no information available on air concentrations either in the open or in basements. People may be exposed to contaminants through inhalation of volatile contaminants. It is possible that exposure to TCE in the groundwater and food products occurred in the past, but remedial actions have greatly reduced the chances of long-term exposure. This assessment recommends sampling the air on and around the source areas for the chemicals of concern to evaluate the risks posed through exposure via the inhalation pathway. A program of community health education will be developed by the Agency for Toxic Substances and Disease Registry, Michigan Department of Public Health, and local health departments.

BACKGROUND

The Sturgis Municipal Wells site was listed on the U.S. Environmental Protection Agency (U.S. EPA) National Priorities List (NPL) in September 1984.

A. Site Description and History

The Sturgis Municipal Wells NPL site consists of three of the six municipal wells serving the city of Sturgis, several private industrial wells, and two contamination source areas, all within the city of Sturgis, St. Joseph County, Michigan. See Figure 1 in Appendix A for the locations of site features. The affected municipal wells are the Layne (PW-1), Jackson (PW-2), and Kirsch or Broadus Street (PW-3) wells. The Ross Laboratory wells R-1, R-2, and R-4 were also affected. Contamination source areas are the Kirsch Company Plant No. 1 and the Wade Electric Company Property. The Telemark Business Forms plant, though it is a source of localized groundwater contamination and had been investigated by the U.S. EPA in connection with the Sturgis Municipal Wells site, is no longer considered part of the site. The Michigan Department of Natural Resources (MDNR) is managing the contamination at the Telemark property under provisions of Michigan Public Act 307 of 1982, the Michigan Environmental Response Act.

Routine sampling by the Michigan Department of Public Health (MDPH) in June 1982 revealed that two of the four municipal water supply wells serving the City of Sturgis were contaminated with trichloroethylene (TCE) and tetrachloroethylene (also called perchloroethylene or PCE). These two wells (Layne well and Jackson well, PW-1 and PW-2, respectively) are located on the west side of the city and supplied approximately one-third to one-half of the total city water at the time the contamination was discovered. These wells were heavily used during the two months prior to sampling due to the reconditioning of the city's water tower. On July 27, 1982, the MDPH advised the City of Sturgis to cease use of the Layne and Jackson wells (Benzie 1982). By September, these two wells were used for peak demands only. Pumping capacity was increased on the two uncontaminated wells (Kirsch well (PW-3) and Lakeview well (PW-4)) and residents were advised to limit their potable water usage.

In 1983, sampling of two production wells at Ross Laboratories (located approximately 2,000 feet northwest of the Layne and Jackson wells) revealed TCE and PCE contamination. Ross Laboratories produces infant and special dietary formulas. Some of their products were found to be contaminated with low levels of TCE. State and federal agencies determined that the TCE contamination in Ross Laboratories products was not severe enough to warrant a product recall at that time (MDA 1983). Ross Laboratories voluntarily removed one contaminated well from all service and removed the other wells from production and are using them solely for non-contact cooling purposes. They discharge their cooling water to a spray irrigation system located west of the city, with permits from the Michigan Department of Natural Resources (MDNR). The Ross Laboratory wells were replaced with a new production well, located further north, beyond the area thought to be contaminated. The contamination of their products has not recurred since these precautions were implemented.

The city began utilizing a new well (Oaklawn well [PW-5], on the south side of the city) in April 1984. The Jackson well was abandoned in January 1985. The Layne well was still occasionally pumped to verify it was functional for emergency use. In January 1985, TCE contamination was found in the Kirsch well. This well was subsequently shut down, however, it is still used in times of peak demand (providing up to 25% of the municipal water supply) or to assure that it remains functional. In June 1989, the city brought the Thurston Woods Well (PW-6) into service. To date, sampling of the Oaklawn, Lakeview, and Thurston Woods wells has not detected contamination.

In 1986, the MDNR contracted for a remedial investigation/feasibility study of the site. The remedial investigation (RI) included groundwater monitoring, monitoring well installation, groundwater quality sampling and soil gas testing. The final RI report was issued in March 1991 (Warzyn 1991a). The feasibility study report (FS) was issued in May 1991 (Warzyn 1991b). The U.S. EPA signed a Record of Decision (ROD) of the selected remedial alternative for the site on September 30, 1991. The selected remediation included soil vapor extraction to remove volatile organic chemicals from source areas, excavation of other contaminated soils from the source areas for off-site disposal, extraction and treatment of groundwater with discharge either to surface water or to the municipal drinking water system, and at least thirty years of groundwater monitoring (EPA 1991). The source areas to be addressed were the Kirsch Co. Plant No. 1 and the Wade Electric Company property. The U.S. EPA judged that the groundwater contamination connected with the Telemark Business Forms property was localized, and only weakly connected to the general groundwater contamination in the area. The MDNR will be addressing the contamination at the Telemark Business Forms under provisions of Michigan Public Act 307 of 1982, the Michigan Environmental Response Act.

The MDPH, under a cooperative agreement with the ATSDR, issued a Preliminary Health Assessment for the Sturgis Municipal Wells site on March 10, 1989. The Preliminary Health Assessment concluded that the site was of public health concern due to past and probable continuing human exposure to TCE via contaminated groundwater, and potentially through surface water, soils, and air. The assessment recommended continued monitoring of the municipal and private wells within the city of Sturgis, surface water and air sampling, and limiting unblended use of water from the known contaminated wells. The MDPH also referred the site to the Epidemiology and Medicine Branch, Office of Health Assessment, ATSDR, for further review and consideration for appropriate follow-up public health actions or studies (MDPH 1989).

The Kirsch Company Plant No. 1 was used for woodworking and furniture manufacturing from early in this century until 1980, when the manufacturing operations were moved to their Plant No. 2 at West and Broadus Streets. Most of the manufacturing facilities at Plant No. 1 have since been demolished, except for some administrative and research and development offices. The former plant area, now vacant, east of Prospect Street was fenced during the summer of 1991.

The Wade Electrical Company manufactured automotive electrical equipment at the site on Jacobs Street (marked in Figure 1) from 1954 to 1963. They moved to another property in Sturgis in 1963, and ceased operations entirely in 1966. Their building burned at some time between 1963 and 1980, when Sturgis Archery bought the property. The property is unfenced, and the Sturgis Archery building occupies approximately one-tenth of the total property. Approximately two-thirds of the property is mowed, the rest is overgrown with vegetation.

The City of Sturgis lies in an extensive area of glacial outwash, consisting of interbedded layers of sand, gravel, silt, and clay, atop shale bedrock, which is part of the Coldwater Formation. Three discontinuous low permeability clay units are present beneath the city. The upper clay layer, when present, is found at 60 to 80 feet below the surface and is up to 80 feet thick. The middle clay layer is found at approximately 120 feet below the surface and ranges up to 36 feet in thickness and also appears to be discontinuous. The third layer is located at a depth of 150 feet and has an average thickness of 1.5 feet.

Groundwater appears to occur in two aquifer systems in the western portion of the city (one above the upper and middle clay layers and one below). Groundwater flow in the upper aquifer (50-60 feet thick) appears to be dominated by surface water ponds and the position of the clay deposits. Flow appears to be from high recharge areas to the edge of the clay lenses where vertical flow occurs into the lower portion of the aquifer. Groundwater flow in the lower aquifer (80-120 feet thick) appears to be dominated by the location and pumping rate of the municipal and industrial water supply wells. Regional flow in the deep aquifer is to the west-southwest.

B. Site Visit

Brendan Boyle of the MDPH visited the site on August 21, 1992, and spoke with representatives from the City of Sturgis as he viewed the municipal wells, the contamination source areas, and the general land use in the area. He observed the two downtown municipal wells (Jackson and Layne) that first showed contamination and saw the location of the Broadus Street well behind Kirsch Plant #2. It was noted that the residential density of Sturgis changes rapidly in a short distance as one travels west from the center of the city through a largely industrial area to a rural area near the airport. Boyle noted agricultural fields on the northwest side of Sturgis that are usually irrigated with water taken from wells near White School Road. The local health department has been prepared to sample water from these wells when they are in full pumpage but, due to the weather conditions in the summer of 1992, the fields have not required a significant amount of irrigation. Boyle also observed the locations of the Sturgis Municipal Wells contamination source areas and the location of a Michigan Act 307 site, the Big Hill Landfill Site, that is the source of another groundwater contamination problem east of the city of Sturgis.

Boyle spoke to three officials from the City of Sturgis regarding the municipal water system, past and current community concerns, and efforts made by the City to keep people informed about use of the Broadus Street well during periods of peak water use.

C. Demographics, Land Use, and Natural Resource Use

The population of Sturgis is 10,130 (1990 Census). The site is in the center of Sturgis in a primarily commercial and industrial section with interspersed residences.

The entire city population is served by the municipal water distribution system, using the water supply wells described above. The primary supply wells in use are the Oaklawn, Lakeview, and Thurston Woods wells, with the Broadus Street well as a reserve. The only industries in the city that had functioning private wells identified by the RI contractors were Ross Laboratories, the Kirsch Company plants, and the Sturgis Foundry. Ross Laboratories still uses one well (R-5), outside the contaminant plume, for process use. Their wells that have been found to be contaminated (R-1 and R-2) are used for non-contact cooling water only. Well R-3, which has never shown contamination, is also used for cooling water. Well R-4 has been permanently removed from service. The Ross Laboratory process well is tested weekly by the company. The Kirsch Company plants have three private wells, 2 wells at plant #1 and 1 well at plant #2. These wells are not used for production but are reserved for protection in the event of a fire. The Sturgis Foundry well (F-1) was used for non-contact cooling water, and its use was discontinued in 1988.

D. Health Outcome Data

Based on the evaluations performed for this assessment, there are indications that humans have been exposed to site-related contaminants, primarily through the household use of water from the municipal system that tapped the contaminated aquifer. There is some evidence from laboratory studies linking TCE exposure to liver and lung cancer in animals, and PCE to liver cancer in animals. U.S. EPA previously classified TCE and PCE as probable human carcinogens but has withdrawn these classifications pending further review. Michigan's death records offer one source of data from which to compare cancer death rates at the township level to county and state-wide rates. Michigan also has had a Cancer Incidence Registry in place since 1986 from which incidence of total cancers and specific cancer types can be compared at a local level to county and statewide rates. Both of these were considered as possible sources of health outcome data associated with this site.

COMMUNITY HEALTH CONCERNS

The health assessors have interviewed representatives of the state and federal environmental enforcement agencies, local and state health officials, Sturgis city employees, and others identified as having had experience with the site to determine what health concerns the community might have in regard with the site. At this time there does not appear to be unresolved citizen health concerns regarding past exposures to contaminated groundwater, or the possibility of current or future exposure. There have not been reports of health effects thought to be site-related or requests for additional information beyond that made available periodically by the local health department, the city, the U.S. EPA and the MDNR. The assessors will continue to attempt to ascertain if health concerns exist and will consider sponsoring an availability session for site-related inquiries and concerns in Sturgis as remedial actions are implemented.

The MDPH released this public health assessment for public comment on May 25, 1993. The Public Comment Period lasted until June 24, 1993. MDPH and ATSDR's response to comments received are summarized in the Responsiveness Summary attached to this public health assessment.

ENVIRONMENTAL CONTAMINANTS AND OTHER HAZARDS

To identify facilities that could contribute to the groundwater contamination at the Sturgis Municipal Wells site, MDPH searched the Toxic Chemical Release Inventory (TRI) database for 1987, 1988, 1989, and 1990. The TRI is compiled by the U.S. EPA from chemical release information provided by industries. The TRI included listings from eight facilities within the Sturgis zip code (49091), including the Ross Laboratories, Kirsch Co. Plant No. 2, and the Sturgis Foundry.

Ross Laboratories reported releases to air of phosphoric acid and sodium hydroxide solution. Kirsch Plant No. 2 reported air releases of n-butyl alcohol, xylene (mixed isomers), dichloromethane, sulfuric acid, hydrochloric acid, sodium hydroxide (solution), toluene, acetone, and methyl isobutyl ketone. Sturgis Foundry reported releases of manganese to an on-site landfill and to groundwater. One other facility reported releases of barium to the air, an on-site landfill, and to water, and air releases of toluene and methyl ethyl ketone. Air releases of toluene, acetone, methyl ethyl ketone, xylenes, naphthalene, alpha-naphthylamine, methyl methacrylate, ethyl acrylate, phosphoric acid, ethylene glycol, and 1,1,1-trichloroethane were reported from the other facilities.

None of the eight facilities reported releases of TCE or PCE, the primary contaminants in the Sturgis Municipal Wells water. The air releases of volatile organic chemicals (VOCs) probably do not significantly affect the groundwater contamination at this site. The chemicals released directly to the groundwater, manganese and barium, were not found at levels above the comparison values in the groundwater.

Contaminants of concern for this assessment, those chemicals for which potential health effects will be discussed, were selected by comparing the maximum concentrations found in environmental media with media-specific, health-based comparison values. Comparison values used included the following:

ATSDR Environmental Media Evaluation Guides (EMEGs).

Concentrations calculated from the U.S. EPA Reference Dose (Chronic) by Ingestion (RfD-C), based on a child exposure and pica behavior for soil ingestion (RMEGs).[1]

U.S. EPA Lifetime Drinking Water Health Advisories (LTHA).

Cancer Risk Evaluation Guides (CREGs) calculated from U.S. EPA Cancer Slope Factors.

U.S. EPA Safe Drinking Water Act Maximum Contaminant Levels (MCLs).

Chemicals which were detected and for which comparison values are not available are also retained as contaminants of concern. This selection process is conservative, and the identification of a chemical as a contaminant of concern does not necessarily indicate that the chemical poses any health risk at the site. The process is used to identify chemicals for further evaluation. Contaminants of concern for this site are listed in Table 1 in Appendix B.

Unless cited otherwise, environmental contamination data in this section were taken from the RI report (Warzyn 1991a).

A. On-Site Contamination

The RI report does not include a clear description and delineation of the Sturgis Municipal Wells site. The RI investigated all the Sturgis municipal wells, three potential source areas — Kirsch Co. Plant No. 1, the Wade Electric property, and Telemark Business Forms — and the contaminated groundwater beneath Sturgis. This assessment uses data from these areas as on-site data. The U.S. EPA has concluded that the contamination on the Telemark Business Forms property is separate from the major contamination in the area, and will not remediate the Telemark property when they do the other source areas.

Groundwater

In June 1982, the MDPH first analyzed Sturgis municipal water for volatile organic chemicals. TCE concentrations ranging from 11 to 74 parts per billion (ppb) were detected in water from both the Layne and Jackson wells. In August 1982, water from the Layne well contained 43 ppb TCE, and water from the Jackson well contained 4 ppb. In September 1982, water from the Jackson well contained 103 ppb TCE and 1 ppb PCE, and water from

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[1] Pica behavior is an abnormal consumption of non-food materials, such as soil, most often seen in children under 5 years of age.

the Layne well contained 28 ppb TCE. January 1983 sampling of the Layne well detected 2 ppb TCE contamination. By June 1983, 152 ppb TCE and 3 ppb PCE were detected in water from the Jackson well. Water from the Layne well did not show contamination at that time, however, Ross Laboratories found 25 ppb TCE and 10 ppb PCE in water from two of their production wells (R-1 and R-4). In 1984, 120 ppb TCE were detected in water from the Jackson well and 8 ppb in water from the Layne well. In January 1985, water from the Kirsch well was found to contain low levels of TCE (3-4 ppb). In November water from the Kirsch well contained 6 ppb TCE. Water samples taken from the Kirsch well in July 1987 contained 4 ppb TCE. The history of TCE and PCE contamination in water from the Sturgis municipal wells, from 1982 through 1989, is summarized in Table 2.

Table 3 lists the maximum concentrations of all contaminants of concern found in water from the Sturgis municipal wells (PW-2, PW-3, PW-4, PW-5, and PW-6) collected for the RI. Only the antimony and di(2-ethylhexyl)phthalate (DEHP) concentrations exceeded available comparison values. Antimony was only detected once in groundwater samples during the RI, and the reported concentration was marked as an estimate because the analysis failed a quality control criterion. Water from the same well did not contain any detectable antimony in a subsequent sampling round. DEHP was found in samples from two municipal wells in one round but not in a subsequent round. These concentrations were also marked as estimates. DEHP is a common laboratory contaminant. None of the detected contaminants of concern for which comparison values are not available are generally considered to pose health threats at the concentrations reported in the municipal wells. The iron and aluminum concentrations do exceed established or proposed U.S. EPA Secondary Maximum Contaminant Levels, which are established based on non-health-related criteria, such as taste, color, or odor.

In the first round of sampling for the RI, twenty-eight water samples were taken from monitoring, test and production wells in Fall 1987. An industrial process well (R-4) at Ross Laboratories contained 219 ppb TCE, the Kirsch well contained 2.63 ppb TCE, and the Sturgis Foundry well (F-1) contained 95.1 ppb TCE. The RI contractors installed a total of 63 additional monitoring wells and collected three additional rounds of water samples from monitoring, test, and production wells between November 1987 and August 1989. The following contaminants of concern were found at concentrations above comparison levels (see Table 4): TCE, PCE, antimony, arsenic, benzene, beryllium, bromodichloromethane, cadmium, chloroform, cyanide, di(2-ethylhexyl)phthalate, dibromochloromethane, 1,2-dichloroethane, lead, 1,1,2,2-tetrachloroethane, thallium, 1,1,2-trichloroethane, and zinc. In addition, aluminum, calcium, chloride, cobalt, di-n-octyl phthalate, 1,1-dichloroethane, 2-hexanone, iron, magnesium, 4-methyl-2-pentanone, potassium, and sodium were detected, but no comparison values are available (see Table 4). The single detections of antimony and thallium were noted as estimates because those analyses failed a quality control criterion. The high zinc concentration listed in Table 4 (17,800 ppb) was also marked as an estimate, because quality control criteria were not met. The zinc concentration in that sample was also the only one to exceed the comparison value. Water from that well, a monitoring well, was not analyzed again for zinc in the RI. Water from a nearby well collected at the same time contained 61 ppb zinc. The next highest zinc concentration found was 2,000 ppb, which is below the Drinking Water Health Advisory (Lifetime) of 2,100 ppb. The 17,800 ppb reading is clearly anomalous.

The plume of contaminants in the groundwater has been well defined in the various investigations of the site. Figure 2 (Drawing 12686-6 from Warzyn 1991a) shows the plume as of August 1989.

Soil

The RI contractors collected "surface" soil samples from the three known or potential source areas investigated in August 1989. The sample collection technique used is not clearly described in their reports. The data tables indicate a depth of 0.5 feet, which we presume is the maximum depth of the samples. ATSDR prefers surface soil samples to be no more than 3 inches deep, though 6 inch deep samples are acceptable. Concentrations of contaminants of concern found in the RI "surface" soil samples are listed in Table 5 (from Warzyn 1990).

Sixteen samples (including duplicates) were collected, nine from the Kirsch Co. Plant No. 1, five from the Wade Electric property, and two from the Telemark Business Forms property. In general, volatile organic chemicals (VOCs) were reported at estimated levels between the instrument detection limit and the validated detection limit of the analytical method. No VOCs were detected at levels above established comparison values. However, 1,1,1-trichloroethane was detected, but no comparison value in soil is available for this chemical. Only two samples, from the Kirsch property, contained barium at levels above the comparison value. Cadmium was only detected in three samples, one from Wade (the high value cited in Table 5) and two from Kirsch. The concentrations in the Kirsch samples were marked as estimates because the levels reported were between the instrument detection limit and the validated detection limit of the analytical method. The detection limits cited (0.74 to 0.8 ppm) are above the comparison value of 0.4 ppm. Polychlorinated biphenyls (PCBs) were found in three samples from widely separated parts of the Kirsch property. The 3,800 ppm manganese cited in Table 5 was apparently an outlier, because the next highest concentration found was 964 ppm; however, every sample contained manganese concentrations above the comparison value. The lowest manganese concentration found was 274 ppm. All the manganese concentrations in these samples were marked as estimates by the laboratory performing the analysis because quality control criteria were not met. Acenaphthylene, benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(g,h,i)perylene, benzo(k)fluoranthene, chrysene, dibenzo(a,h)anthracene, indeno(1,2,3-cd)perylene, phenanthrene, and other polycyclic aromatic hydrocarbons (PAHs) were found in every sample from the Kirsch and Wade sites, though they were not detected in the Telemark samples. Many of the reported concentrations were marked as estimates. The concentrations of PAHs found in the source area surface soil were within the ranges of background concentrations found in urban areas (ATSDR 1990c). None of the samples collected could be considered background samples, but comparison with values for background soil compositions in Michigan (MDNR 1991) and the Eastern U.S. (ATSDR

1992) finds that, of the metals listed as contaminants of concern, only cadmium is present at levels substantially outside these background ranges.

The contractors also collected soil samples from borings for monitoring wells and from borings on the potential contamination source areas. The samples were collected from depths between 1.5 feet and 15 feet below the surface. Maximum concentrations found of contaminants of concern are listed in Table 6. The shallowest subsurface samples tended to have the highest concentrations of TCE and PCE, though the "surface" samples contained much lower levels (compare Table 5). Volatile organic chemicals would tend to evaporate from surface materials.

Soil Gas

Soil gas sampling, from 2.5 to 3 feet deep, in Fall 1987 and Summer 1988 revealed several hot spots of high VOC concentrations within the city, including ones at Wade Electric, the Kirsch Plant No. 1, and Telemark Business Forms. Chemicals detected are listed in Table 7.

Air

There is no record of ambient air sampling and analysis in the Sturgis Municipal Wells site area. Photoionization detector (HNu) measurements, employed during the RI to screen soil and water samples during well installation, did not detect VOCs in the ambient air (detection limit approximately 1 ppm) (Warzyn 1990).

Surface Water and Sediment

In September 1987, the RI contractors collected surface water and sediment samples from gravel pits used as seepage lagoons near the Kirsch Company Plant No. 2 and the Sturgis Foundry, and from a gravel pit near Ross Laboratories. These gravel pits collected storm runoff and effluent discharge from the facilities. Only one surface water sample contained any VOCs, 5 ppb TCE in the Sturgis Foundry seepage lagoon. Three of the four sediment samples and the laboratory blank contained methylene chloride at concentrations up to 67 ppb (estimated). The RI contractors attributed the methylene chloride to laboratory contamination. They attributed the TCE in the Foundry lagoon water to the TCE contamination in the Foundry's supply well.

B. Off-Site Contamination

Considering the site area to be as previously described under *On-Site Contamination*, the RI contractors collected no off-site contamination data.

C. Quality Assurance and Quality Control

In preparing this public health assessment, the MDPH relied on the information provided in the referenced documents and assumed that adequate quality assurance and quality control measures were followed with regards to chain-of-custody, laboratory procedures, and data reporting. The validity of the analysis and of the conclusions drawn for this public health assessment is determined by the reliability of the referenced information.

Any qualification on the cited data mentioned in the referenced sources has been cited along with the data. For example, the antimony, thallium, and zinc concentrations reported in the groundwater were reported as estimates by the laboratory doing the analyses because the analyses failed a quality control criterion.

D. Physical and Other Hazards

There are no physical hazards associated with this site. The concentrations of the contaminants in the soil gas are below the lower limits for flammability.

PATHWAYS ANALYSES

To determine whether nearby residents are exposed to contaminants migrating from the site, ATSDR evaluates the environmental and human components that may lead to human exposure. An exposure pathway contains five major elements: a source of contamination, transport through an environmental medium, a point of exposure, a route of human exposure, and an exposed population.

An exposure pathway is considered a completed pathway if there is evidence that all five of these elements are or have in the past been present. A pathway is considered a potential pathway if one or more of these elements is not known to be or have been present, but could be or have been. An exposure pathway can be eliminated from consideration if one of the elements is not present and could never be present. The following sections discuss the exposure pathways at this site.

A. Completed Exposure Pathways

Exposure pathways that include surface soil on the source areas of the site are currently complete. Pathways that include the groundwater via municipal wells and food products production were complete until the groundwater contamination was identified in 1982-1984, after which time remedial actions largely eliminated these pathways, though occasional later exposure could have occurred. This section describes these pathways.

Surface Soil

Contaminated surface soil can adhere to the skin of a person walking across an area of contaminated soil. The contaminants could then be incidentally ingested or be absorbed through the skin. Contaminated surface soil could also be picked up by the wind as dust. The dust can then settle elsewhere, spreading the contamination to other areas. Dust in the air could be inhaled, exposing people to the contaminants through their lungs. Surface soil sampling and analyses found concentrations above comparison values of arsenic, barium, cadmium, chromium, manganese, PAHs, and PCBs. There are residential properties adjacent to the Kirsch Co. Plant No. 1 property, though the property line between the plant and the residences has long been fenced. MDNR personnel report that the site was probably used as a play area by neighborhood children for several years after the Plant was demolished and before the site was more completely fenced. The Wade Electric property is not fenced, and there are reports of children playing and riding bikes on it (Franks 1992). Human exposure to surface soil on the source areas of the site has occurred.

Groundwater

Municipal Wells. The groundwater beneath the city of Sturgis is contaminated with trichloroethylene and tetrachloroethylene. Surface and subsurface soil at three known or suspected source areas also contains the chemicals, though it is not known exactly how the contamination occurred. Rainwater percolating through contaminated soil can wash contaminants into the groundwater. The contamination in the groundwater has reached several municipal and industrial wells in the city. People who used water from the contaminated municipal wells for domestic purposes were exposed to the contaminants by ingestion, dermal contact, and inhalation secondary to household use.

The municipal water system serves approximately 10,000 people. For approximately 5 years before the contamination was first identified, the Layne and Jackson wells had generally supplied less than 10 percent of the total water supply of the city; the Kirsch and Lakeview wells provided most of the city water. In mid-1982, however, the Layne and Jackson wells provided approximately 30 percent of the city water because of the reconditioning of the city water tower located near the wells (Warzyn 1991a, Przybysz 1982). At the time the Kirsch municipal well was found to be contaminated with TCE, it was supplying approximately 50% of the city's water supply, with the Lakeview and Oaklawn wells providing the remainder. Each well was connected directly to the distribution system, with no prior mixing or dilution. By June 1986, pumpage of the Kirsch well had been reduced to 23% of the total water supply.

As soon as the contamination was detected in any of the municipal wells, the municipal water supply authority took steps to reduce or eliminate human exposure to the contaminants.

They reduced the use of the contaminated wells, blended water from them with uncontaminated water, and instituted frequent monitoring of the system when the contaminated wells were in use. When the anticipated water demand indicated that the contaminated wells might have to be used, the City announced the fact through the local newspaper, advising city residents to restrict water use to minimize the need to use the reserve wells. The city has since brought two new municipal wells into service, and restricted use of the contaminated wells to high-demand periods. The municipal system is regularly monitored to detect contamination. For example, should the plume be drawn to one of the primary wells, the monitoring would alert the water authority to reduce or eliminate pumping of the affected well.

Food Products Production. Several of the contaminated industrial wells supplied the Ross Laboratories facility in Sturgis. Ross Laboratories produces powdered and liquid infant formulas, special dietary formulas and tin and tin-free plated cans for their products. At the time the contaminated wells were discovered, infant formulas manufactured by Ross Laboratories were tested and found to contain approximately 5 ppb of TCE. Adult nutritional supplements sold under Ross Laboratory brand names contained similar levels of TCE (MDA 1983). Any person consuming these products was exposed to small amounts of TCE. The company acted promptly to prevent future contamination of their products. The contaminated wells have been restricted to non-contact cooling water use, and a new well, outside the contaminant plume, has been drilled to supply water for the food manufacturing process. A carbon adsorption system is also used to treat water intended for consumption and production of products. The company privately monitors the water on a weekly basis.

B. Potential Exposure Pathways

Groundwater — Private Residential Wells

A potential exposure pathway would include any private residential well that taps the contaminated aquifer. Domestic use of contaminated water can result in exposure to the contaminants via ingestion, dermal contact, and inhalation of volatilized chemicals secondary to household use. Inquiries to state and local health departments did not locate any records of private residential wells within the affected area. There are private wells along the periphery of Sturgis, but no records of any within the city were found. To date, there have been no reports of contaminated private residential wells within the city of Sturgis. However, the exact number of private wells in the city is not known, nor is the number of wells that have been sampled.

Air

The volatile contaminants in the soil or groundwater may vaporize and migrate through the gas in the pores between the soil particles to the surface. A person in the area may inhale the vapors. Dilution and dispersion in the open air would probably reduce the concentrations in the air to levels which are not likely to cause adverse health effects, but the vapors might collect and concentrate in an enclosed structure, such as a basement. There is no data on air sampling and analysis from the site, though screening with a photoionization (HNu) detector during the RI did not detect any VOCs in the ambient air (detection level 1 ppm) (Warzyn 1990). There is no information available on basements in the area. There are residential properties adjacent to the Kirsch Co. Plant No. 1 property, though the property line between the plant and the residences has long been fenced. MDNR personnel report that the site was probably used as a play area by neighborhood children for several years after the Plant was demolished and before the site was more completely fenced. The Wade Electric property is not fenced, and there are reports of children playing and riding bikes on it (Franks 1992). Human exposure to air from the source areas of the site has occurred, however, it is not known whether any contaminants were present in the air. Because of the lack of contaminant data, exposure pathways that include air are considered potential exposure pathways.

PUBLIC HEALTH IMPLICATIONS

A. Toxicological Evaluation

Exposure to surface soil on the source areas of the site is currently a completed exposure pathway. Two other exposure pathways have been complete in the past, but these exposures have been terminated: domestic use of water from contaminated municipal wells and use of water from contaminated industrial wells to process foodstuffs. There is inadequate information available to determine if anyone is significantly exposed to airborne volatile chemicals from the site. This section evaluates the current exposure to surface soil, past exposures to contaminated municipal water and processed foodstuff, and the potential airborne exposure to volatile chemicals.

The primary benchmarks against which exposures are evaluated for their potential for causing non-cancer adverse health effects are the Minimal Risk Levels (MRLs), developed by ATSDR, and Reference Doses (RfDs) and Reference Concentrations (RfCs), developed by the U.S. EPA. It is generally accepted that a person exposed to a dose of a chemical less than an MRL, RfD, or RfC is not likely to experience non-cancer adverse health effects. The derivation of MRLs, RfDs, and RfCs from the observed threshold exposures includes safety factors to allow for different responses between species and between individuals. These values may not be protective for individuals who are hypersensitive to chemical exposures, including the very young, the very old, individuals whose bodies are under stress from illness, and individuals who have an allergic response to the chemical.

For chemicals which may cause cancer, the risk associated with an exposure is evaluated independently using published potency factors, which relate the chance of contracting cancer to the dose of the chemical. For this assessment, the risk of cancer is considered significant if 1 extra case of cancer is likely to develop among 1,000,000 people subject to the exposure over their lifetimes.

For the surface soil pathway, exposure doses are calculated based on a young person, weighing 30 kilograms and incidentally ingesting an average of 100 milligrams of soil per day. The youngster is assumed to spend an average of 3 hours per day in the source areas of the site, and to visit the site regularly over 10 years.

For the drinking water pathway, there is no information to indicate when the contaminants first reached the municipal wells. Contaminants of concern were found in the first analysis of the city water capable of detecting them. The city reduced use of the contaminated wells as soon as the contamination was identified. However, the contaminated wells were still used occasionally during high-demand periods as back-up supplies. Water from the contaminated wells, when they were so used, was blended with uncontaminated water. For this evaluation, we assume lifetime use of water containing the maximum concentrations of contaminants reported in the municipal wells. The general exposure doses are computed assuming an adult weighing 70 kilograms and consuming 2 liters of water per day, and a more sensitive subject is modelled as a child weighing 10 kilograms and consuming 1 liter of water per day. The air concentration in a shower is derived from the normalized concentration for a 10-minute "reference" shower modeled in Little 1992, Figure 5, curve "A". A person is assumed to spend a total of 15 minutes per day in the shower area.

The contaminant source areas are in a commercial and industrial area of Sturgis, and the people most likely to be exposed to airborne vapors will be working adults, in the area for 8 hours a day, 5 days a week. This evaluation assumes exposure to the maximum concentrations found in the soil gas at the source areas.

Surface Soil Contaminants

Based on the available data, the modelled child is not likely to ingest enough of any of the contaminants present in the soil on the source areas of the site to incur any non-cancer health effects. The MRLs and RfDs are not likely to be exceeded, nor are the exposure doses likely to approach the doses at which adverse health effects have been observed. Under the modelled exposure to the site, exposure to the carcinogens present is not likely to result in a significantly increased risk of cancer. Many of the contaminants of concern were found at the site at levels comparable to those found in background samples, particularly from urban areas. Health effects from exposure to the site areas are likely to be indistinguishable from the background incidence rates.

Trichloroethylene (TCE)

No one of any age whose primary drinking water supply contains the maximum concentration of TCE found in the Sturgis municipal wells would have been likely to ingest enough of the chemical to exceed the MRL for intermediate-term exposure. There is no established MRL for chronic ingestion exposure of TCE. The amount of TCE ingested through drinking water would not be likely to exceed the doses at which adverse non-cancer health effects have been observed at any exposure duration. There is some evidence from studies on laboratory animals to link exposure to TCE with liver and lung cancer. The U.S. EPA had classified trichloroethylene as a probable human carcinogen (U.S. EPA Class B2), but has withdrawn the classification pending review. The potency factor for the chemical is also under review (ATSDR 1991a). Calculating the risk using the previously published potency factor value that is under review (ATSDR 1989a), a person whose primary water supply contains the maximum amount of TCE found in the Sturgis municipal wells for his or her lifetime might ingest enough of the chemical to incur a significant increased risk of contracting cancer.

The estimated concentration of TCE in the air in a shower using water containing the maximum TCE concentration found in the Sturgis municipal wells is not likely to cause adverse non-cancer health effects. There is some evidence from studies on laboratory animals to link inhalation of TCE with lung and other cancers. As mentioned above, the U.S. EPA has withdrawn its cancer classification and potency factors for TCE pending further review. Calculating the risk using the potency factor cited in ATSDR 1989a, a person showering in this water for his or her lifetime could incur a significantly increased risk of contracting cancer.

There is no information available to determine the duration of the contamination in Ross Laboratory products. There are no records of analysis of the plant's water supply or of their products before the contamination was discovered in 1983. The plant's operators took steps immediately upon the discovery of the contamination to forestall further contamination of their products. State and federal agencies determined that the TCE contamination in Ross Laboratories products was not severe enough to warrant a recall of the products at that time (MDA 1983). Our evaluation supports this decision, that an infant who consumed 1 liter per day of the contaminated formula would not be likely to have ingested enough TCE to exceed the MRL for intermediate-term exposure, or to reach the levels at which adverse health effects (liver damage in mice in laboratory studies) have been observed, though hypersensitive individuals may have experienced some health effects. Adults using other contaminated Ross Laboratory products as supplements to their diet would also not be likely to have ingested enough TCE from the products to exceed the intermediate-exposure MRL. The total TCE consumption over a lifetime use of Ross Laboratory products, including formula consumption as an infant and use of the other dietary supplements as an adult, would not be likely to result in a significantly increased risk of contracting cancer.

The maximum concentration of TCE in the soil gas exceeds the levels at which people have reported drowsiness, decreased reaction time, and eye irritation on short-term exposure.

Lifetime exposure to air containing this concentration of TCE could result in some increased risk of contracting cancer, as calculated using the potency factor cited in ATSDR 1989a (currently under review by the U.S. EPA).

Tetrachloroethylene (Perchloroethylene or PCE)

No one of any age whose primary drinking water supply contained the concentrations of PCE found in the Sturgis municipal wells would have been likely to ingest enough of the chemical to exceed the RfD (chronic) by ingestion or the MRL for intermediate-term exposure for non-cancer adverse health effects. There is evidence from studies of laboratory animals linking ingestion of PCE with liver cancer. The U.S. EPA has classified tetrachloroethylene as a probable human carcinogen (U.S. EPA Class B2), though this classification is under review. The potency factor is also under review; however, by using a published value cited in ATSDR 1991b, it can be estimated that lifetime consumption of this water may result in a significant increased risk of contracting cancer.

It is estimated that the air in a shower using water containing the maximum concentration of PCE found in the Sturgis municipal wells might contain a concentration of the chemical in excess of the MRL for intermediate-term exposure by inhalation for non-cancer health effects. The estimated air concentration is far below any level at which adverse health effects have been observed. There is evidence from studies of laboratory animals linking inhalation of PCE with liver cancer. The potency factor via inhalation is also under review; however, by using a published value cited in ATSDR 1991b, it can be estimated that lifetime showering with this water is not likely to result in a significant increased risk of contracting cancer due to the PCE level.

The PCE concentration in the soil gas in the contaminant source areas is higher than the acute and intermediate-term MRLs for non-cancer adverse health effects, though it is below the concentrations at which health effects have been observed on short-term exposure. From cases reported in the literature, long-term exposure in the workplace to air containing concentrations of PCE equivalent to those found in the soil gas has resulted in minor neurological impairment and minor changes in the kidneys (increased levels of certain enzymes in the urine, suggesting minor damage). The calculated risk of contracting cancer using the published potency factor value and considering a lifetime exposure to air containing this concentration of PCE is estimated to be significantly increased.

1,1-Dichloroethylene

The concentration of 1,1-dichloroethylene in the soil gas from the potential source areas exceeds the MRL for chronic exposure via inhalation for non-cancer adverse health effects but is lower than the concentrations at which adverse health effects have been observed in studies of laboratory animals. Workers exposed to low levels of the chemical for long periods of time have developed liver and kidney damage; however, the concentrations they were exposed to were not reported in ATSDR 1989b. There is evidence from studies of laboratory animals that inhalation of 1,1-dichloroethylene can cause cancer of the lungs and breasts. The U.S. EPA has classified 1,1-dichloroethylene as a possible human carcinogen (U.S. EPA Class C). Lifetime exposure to air containing the concentration of the chemical found in the soil gas may result in a significantly increased risk of contracting cancer.

1,2-Dichloroethylene

There are no MRLs or RfCs available for inhalation exposure to either cis-1,2-dichloroethylene or trans-1,2-dichloroethylene. The total 1,2-dichloroethylene concentrations in the soil gas from the contaminant source areas are below the lowest levels at which adverse health effects have been observed in studies of laboratory animals. There is no evidence that either isomer of 1,2-dichloroethylene causes cancer. There is little likelihood that adverse health effects would result from exposure to the 1,2-dichloroethylene in the soil gas (ATSDR 1990a).

1,1,1-Trichloroethane

The maximum concentration of 1,1,1-trichloroethane in the soil gas from the contaminant source areas on the site exceeds the MRL for acute inhalation exposure for non-cancer adverse health effects, though it is less than the levels at which any adverse health effects have been observed in humans or laboratory animals. There is no evidence that 1,1,1-trichloroethane causes cancer. There is little likelihood that adverse health effects would result from exposure to the 1,1,1-trichloroethane in the soil gas (ATSDR 1990b).

Toluene

The concentration of toluene in the soil gas from the contaminant source areas is approximately equal to the MRL for intermediate-term exposure by inhalation for non-cancer adverse health effects, though it is below any level at which adverse health effects have been observed in humans or laboratory animals. There is no evidence available that toluene can cause cancer. The toluene in the soil gas is not likely to cause any adverse health effects (ATSDR 1989c).

Other Contaminants of Concern

Other contaminants of concern were found in very few samples and at low levels in the groundwater or were only listed because there are no comparison values available. The high zinc and antimony levels reported were qualified and anomalous. Exposure to significant levels of these contaminants is unlikely, and they will not be discussed further.

B. Health Outcome Data Evaluation

Even though there is evidence of past human exposure to TCE and PCE through contamination of the municipal water supply, exposure was at relatively low levels. No acute health effects would have been anticipated and no health complaints were reported in association with the contaminated water supply. No other data sources for acute effects were available for evaluation. The duration of exposure is unknown; however, because only 2 wells were found to be contaminated in 1982 and contamination did not reach a third well until 1985, it is likely that contamination of the municipal supply was relatively short-term. While lifetime exposure to maximum levels of contaminants observed in some of the municipal wells could result in an increased risk of cancer, one would not expect a significant increase of cancer from short-term exposure to concentrations observed. At the time contamination was discovered in 1982, the two municipal wells with contamination showed 11 and 74 ppb TCE. From that time forward, the city of Sturgis has been able to eliminate or minimize contaminant levels in the distribution system. For the 5 year period prior to discovery of contamination, the two contaminated wells supplied generally less than 10 percent of the total water supply for the city. Based upon these factors, no review of cancer mortality or cancer incidence records was conducted for this assessment.

C. Community Health Concerns Evaluation

There were no current community health concerns identified for the Sturgis Municipal Wells site during the development of this assessment. Comments received during the public comment period are addressed in the Responsiveness Summary appendix of the document.

CONCLUSIONS

1. The Sturgis Municipal Wells site currently poses an indeterminate public health hazard. Although there are no indications that exposure to contaminants is occurring at levels of health concern, there is no information available on air concentrations either in the open or in basements. People may be exposed to contaminants through inhalation of volatile contaminants.

2. The surface soil in the source areas of the site contains contaminants at concentrations potentially of human health concern. One source area, the Wade Electric Property, is freely accessible, though the more contaminated source area, the Kirsch Plant No. 1 site, has been recently fenced.

3. In the past, the site posed a public health hazard due to human exposure to contaminants at levels of public health concern. Users of the municipal water system were exposed to trichloroethylene and tetrachloroethylene in their domestic water. These exposures have been greatly reduced by remedial actions on the part of the municipal water authority, though low-level exposures are still possible when contaminated wells are used as reserve wells during high-demand periods. Industrial wells supplying a food-processing plant in the city were also contaminated with TCE. The plant operators have implemented remedial actions to prevent future contamination of their products. At the time the contamination was identified, state and federal agencies did not judge the hazard to be sufficient to order a recall of the contaminated products.

RECOMMENDATIONS

1. Ambient air sampling in outdoor and indoor environments in the vicinity of the potential source areas is recommended to determine the potential for inhalation of volatile contaminants.

2. Access to the source areas, particularly the Wade Electric Property, should be restricted, at least until the hazards associated with the source areas can be fully evaluated.

HEALTH ACTIVITIES RECOMMENDATION PANEL STATEMENT

The Health Activities Recommendation Panel has evaluated the data and information developed for the Sturgis Municipal Wells public health assessment for appropriate follow-up health actions. The panel determined that, inasmuch as there are indications that human exposure to contaminants has occurred and may still be occurring, a program of public health education is appropriate for this site. The community health education should include information from the ATSDR Trichloroethylene (TCE) Subregistry Report.

PUBLIC HEALTH ACTIONS

The Public Health Action Plan (PHAP) for the Sturgis Municipal Wells site contains a description of actions to be taken by ATSDR and/or the Michigan Department of Public Health (MDPH) at and in the vicinity of the site subsequent to the completion of this Public Health Assessment. The purpose of the PHAP is to ensure that this Public Health Assessment not only identifies public health hazards, but also provides a plan of action designed to mitigate and prevent adverse human health effects resulting from exposure to hazardous substances in the environment. Included is a commitment on the part of ATSDR and MDPH to follow up on this plan to ensure that it is implemented. The public health actions to be implemented by ATSDR and/or MDPH are as follows:

Health Actions Planned

ATSDR, MDPH, and the local health department will develop a program of community health education for the residents of Sturgis.

ATSDR and MDPH will coordinate with federal and state environmental agencies to carry out the recommendations made in this assessment.

ATSDR will reevaluate and expand the Public Health Action Plan when needed. New environmental, toxicological, or health outcome data, or the results of implementing the above proposed actions and recommendations may determine the need for additional actions at this site.

PREPARERS OF REPORT

Michigan Department of Public Health

John W. Filpus, Environmental Engineer

Brendan Boyle, Health Assessment Coordinator

John L. Hesse, Principal Investigator

James Bedford, Environmental Toxicologist

ATSDR Regional Representative

Louise Fabinski
Regional Services, Region V
Office of the Assistant Administrator

ATSDR Technical Project Officer

William Greim
Division of Health Assessment and Consultation
Remedial Programs Branch

CERTIFICATION

The Sturgis Municipal Wells public health assessment was prepared by the Michigan Department of Public Health under a cooperative agreement with the Agency for Toxic Substances and Disease Registry (ATSDR). It is in accordance with approved methodology and procedures existing at the time the health assessment was initiated.

Technical Project Officer, SPS, RPB, DHAC

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

Director, DHAC, ATSDR

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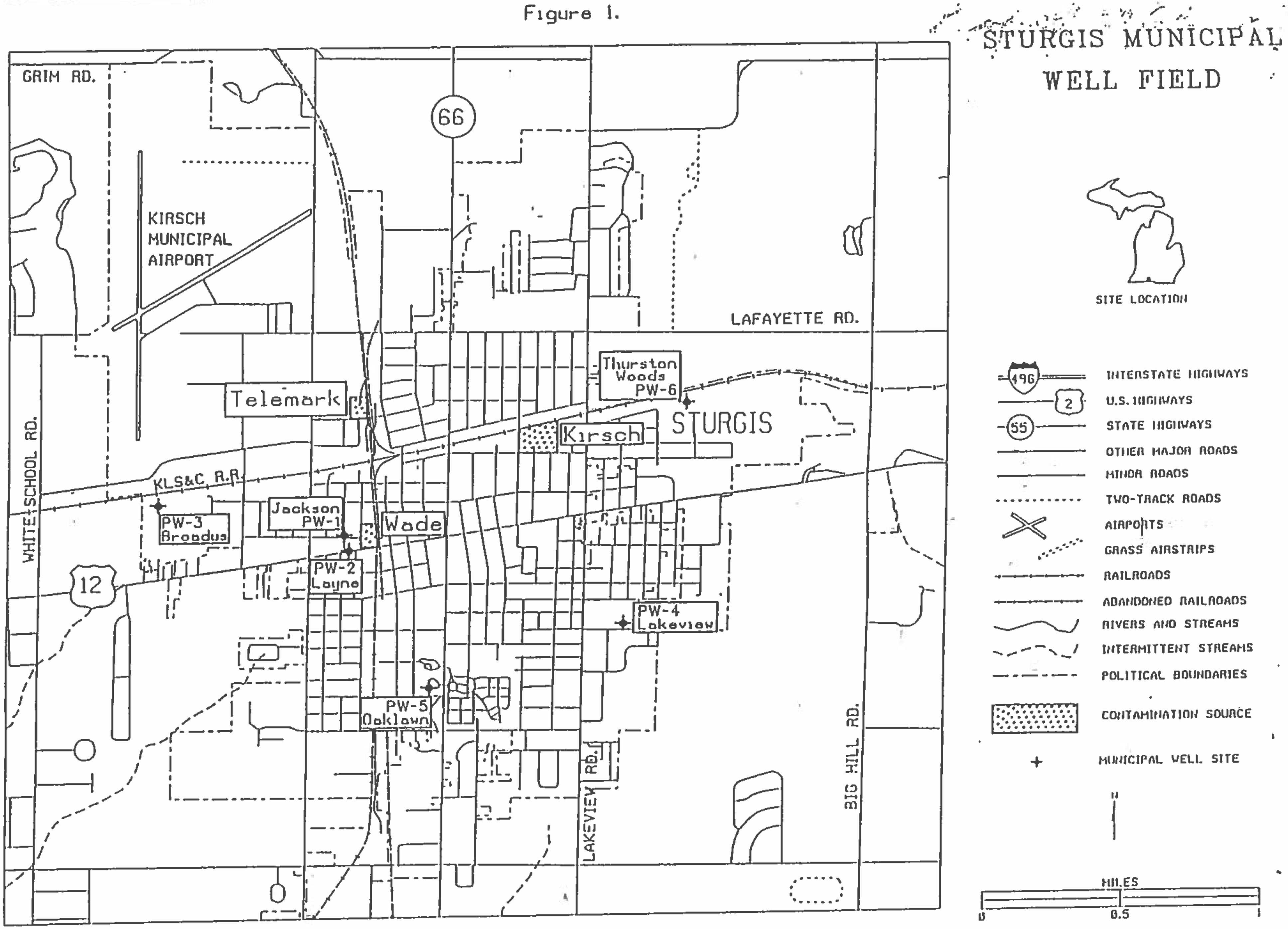
APPENDIX A.

FIGURES

LIST OF FIGURES

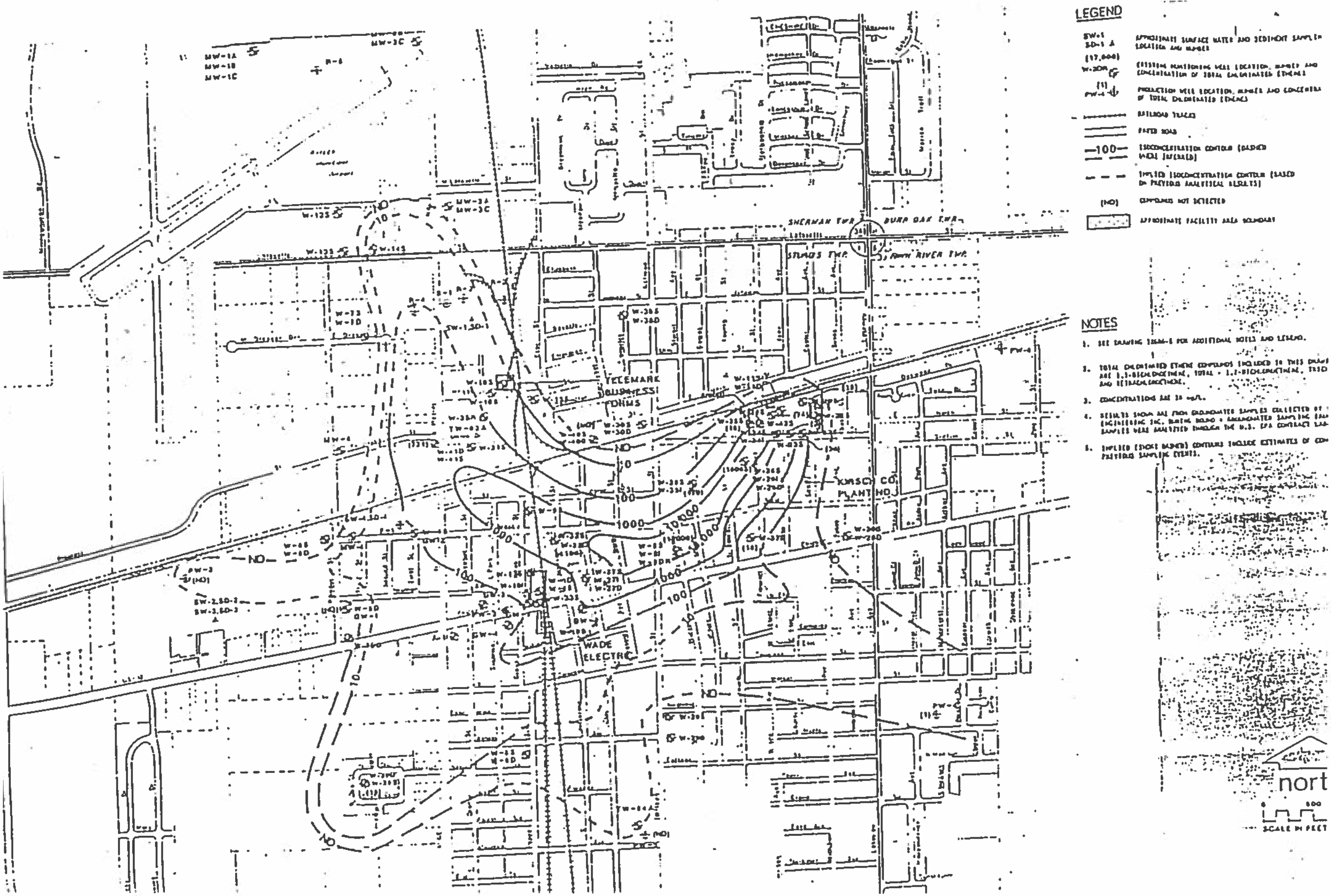
Figure 1.



Michigan Department of Public Health
Base map information provided by Michigan Department of Natural Resources, MIRIS Program

8/28/92

Figure 2. Contaminant Plume (August 1989): Total Chlorinated Ethylene Concentrations, in ppb. (From Warzyn 1991a, Drawing 12686-6)



APPENDIX B.

TABLES

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Table 1. Contaminants of concern at the Sturgis Municipal Wells site

acenaphthylene	1,1-dichloroethane
aluminum	1,2-dichloroethane
antimony	1,1-dichloroethylene
arsenic	1,2-dichloroethylene (total)
barium	2-hexanone
benzene	indeno(1,2,3-cd)pyrene
benzo(a)anthracene	iron
benzo(a)pyrene	lead
benzo(b)fluoranthene	magnesium
benzo(g,h,i)perylene	manganese
benzo(k)fluoranthene	mercury
beryllium	4-methyl-2-pentanone
bromodichloromethane	2-methylnaphthalene
2-butanone	naphthalene
cadmium	nickel
calcium	phenanthrene
chloride	polychlorinated biphenyls
chloroform	potassium
chloromethane	sodium
chromium	1,1,2,2-tetrachloroethane
chrysene	tetrachloroethylene
cobalt	thallium
copper	toluene
cyanide	1,1,1-trichloroethane
di(2-ethylhexyl)phthalate	1,1,2-trichloroethane
di-n-octyl phthalate	trichloroethylene
dibenzo(a,h)anthracene	vanadium
dibenzofuran	vinyl chloride
dibromochloromethane	zinc

Table 2. Concentrations of trichloroethylene (TCE) and tetrachloroethylene (PCE) in water from Sturgis municipal wells, 1982-1989 (Warzyn 1988, 1991a)

Date	Well(s)	TCE (ppb)	PCE (ppb)
6/82	PW-1, PW-2	11-74	ND
8/82	PW-1	43	ND
	PW-2	4	ND
9/82	PW-1	28	ND
	PW-2	103	1
1/83	PW-1	2	ND
6/83	PW-1	ND	ND
	PW-2	152	3
1984	PW-1	8	ND
	PW-2	120	ND
1/85	PW-3	3-4	ND
11/85	PW-3	6	ND
6/87	PW-3	4	ND
9/87	PW-2	ND	ND
	PW-3	2.63	ND
	PW-4	ND	ND
	PW-5	ND	ND
11/87	PW-3	3.J	ND
	PW-4	ND	ND
	PW-5	ND	ND
11/88	PW-3	ND	ND
	PW-4	ND	ND
	PW-5	ND	ND
8/89	PW-5	ND	ND
	PW-6	ND	ND

ND — Not Detected
J — Estimated Value

Comparison Values:

TCE — U.S. EPA Safe Drinking Water Act Maximum Contaminant Level 5 ppb, ATSDR Cancer Risk Evaluation Guide (CREG) 3.2 ppb.

PCE — 100 ppb calculated from U.S. EPA Reference Dose (Chronic) by Ingestion for child consumption, CREG 0.7 ppb.

PW-1 — Layne Well
PW-2 — Jackson Well
PW-3 — Kirsch Well
PW-4 — Lakeview Well
PW-5 — Oaklawn Well
PW-6 — Thurston Woods Well

Table 3. Maximum concentrations of contaminants of concern found in the groundwater from municipal wells during the Sturgis' Municipal Wells RI — September 1987 through August 1989 (Warzyn 1991a)

Chemical	Maximum Concentration (ppb)	Comparison Value (ppb)
aluminum	51	NA
antimony	197.J	3^{A}
arsenic	1.66	3^{R}
barium	51.7	700^{R}
calcium	112,000	NA
chloride	28	NA
di(2-ethylhexyl)phthalate	6.J	200^{R}, 2.5^{C}
iron	331	NA
lead	1.7	15^{PL}
magnesium	32,100	NA
manganese	82	$1{,}000^{R}$
nickel	40.1	100^{A}
potassium	1,200	NA
sodium	7,680	NA
trichloroethylene	3.J	5^{M}, 3.2^{C}
zinc	219	$2{,}100^{A}$

Contaminants of concern that were not detected in this medium are not listed.

NA — None Available
J — Estimated Value

Bases for Comparison Values

E — ATSDR Environmental Media Evaluation Guides (EMEGs)
C — ATSDR Cancer Risk Evaluation Guides (CREGs)
R — Concentration calculated from U.S. EPA Reference Dose (Chronic) by ingestion, assuming child exposure (RMEGs)
A — U.S. EPA Drinking Water Health Advisory (Lifetime)
M — U.S. EPA Safe Drinking Water Act Maximum Contaminant Limit
PM — U.S. EPA Safe Drinking Water Act Maximum Contaminant Limit (proposed)
PL — U.S. EPA Proposed Action Level for Lead in Drinking Water

Table 4. Maximum concentrations of contaminants of concern found in the groundwater from monitoring, industrial, and municipal wells during the Sturgis Municipal Wells RI — September 1987 through August 1989 (Warzyn 1991a)

Chemical	No. of Detections	Det. Limit (ppb)	Maximum Concentration (ppb)	Comparison Value (ppb)
aluminum	18	20-82	106	NA
antimony	1	1.6-57	197	3^{A}
arsenic	5	1-2	3.6	3^{R}
barium	44	NR	176	700^{R}
benzene	3	NR	2	5^{M}, 1.2^{C}
beryllium	2	0.5-0.83	0.6	50^{R}, 0.0081^{C}
bromodichloromethane	3	NR	2	200^{R}, 0.27^{C}
cadmium	3	3.6-5	5.7	2^{B}
calcium	212	NR	190,000	NA
chloride	165	NR	972	NA
chloroform	7	0.3-2	16	100^{R}, 0.57^{C}
chromium	3	5.1-7.8	19	10,000^{R} (III) 50^{R} (VI)
cobalt	1	4-31	6.9	NA
copper	2	3-31	9.6	1,300^{PM}
cyanide	8	10	247	200^{R}
di(2-ethylhexyl)phthalate	10	10-17	51	200^{R}, 2.5^{C}
di-n-octyl phthalate	4	NR	8	NA
dibromochloromethane	2	NR	1	300^{R}, 0.42^{C}
1,1-dichloroethane	1	1	2	NA^{C}
1,2-dichloroethane	2	NR	1	5^{M}, 0.38^{C}
1,2-dichloroethylene (total) (trans)	 13 1	 NR NR	 17 4	70^{A} (cis) 100^{A} (trans)
2-hexanone	1	NR	0.6	NA
iron	32	15-160	1,970	NA
lead	10	0.6-4.1	15.3	15^{PL}
magnesium	212	NR	117,000	NA
manganese	29	2.6-7.8	462	1,000^{R}
mercury	2	0.2	0.3	2^{A}
4-methyl-2-pentanone	1	NR	0.7	NA
nickel	6	5.8-8.7	40.1	100^{A}
potassium	178	685-1,750	25,000	NA
sodium	206	NR	543,000	NA
1,1,2,2-tetrachloroethane	1	NR	0.3	0.18^{C}
tetrachloroethylene	25	NR	150	100^{R}, 0.7^{C}
thallium	1	1.3-6	1.1	0.4^{A}
1,1,1-trichloroethane	11	NR	9	200^{A}
1,1,2-trichloroethane	6	NR	8	3^{A}, 0.61^{C}
trichloroethylene	80	NR	17,000	5^{M}, 3.2^{C}
zinc	39	14-39	17,800	2,100^{A}

Contaminants of concern that were not detected in this medium are not listed.

Detection limits varied from one sampling round to another.

NR — Not Reported

NA — None Available
NA[c] — Carcinogen (possible, probable, or known) but no CREG available
(III) — Chromium(III)
(VI) — Chromium(VI)
(cis) — cis- isomer
(trans) — trans- isomer

Bases for Comparison Values

E — ATSDR Environmental Media Evaluation Guides (EMEGs)
C — ATSDR Cancer Risk Evaluation Guides (CREGs)
R — Concentration calculated from U.S. EPA Reference Dose (Chronic) by ingestion, assuming child exposure (RMEGs)
A — U.S. EPA Drinking Water Health Advisory (Lifetime)
M — U.S. EPA Safe Drinking Water Act Maximum Contaminant Limit
PM — U.S. EPA Safe Drinking Water Act Maximum Contaminant Limit (proposed)
PL — U.S. EPA Proposed Action Level for Lead in Drinking Water

Table 5. Maximum concentrations of contaminants of concern found in surface soil samples collected during the Sturgis Municipal Wells RI — August 1989 (Warzyn 1990)

Chemical	Maximum Concentration (ppm)	Comparison Value (ppm)
acenaphthylene	0.044J	NA
aluminum	8,390	NA
arsenic	6.9	0.6^{R}
barium	181	140^{R}
benzo(a)anthracene	4.5	NA^{C}
benzo(a)pyrene	3.6	0.12^{C}
benzo(b)fluoranthene	5.9	NA^{C}
benzo(g,h,i)perylene	1.2J	NA
benzo(k)fluoranthene	5.9J	NA^{C}
beryllium	1.1	10^{R}, 0.16^{C}
cadmium	2.8	0.4^{E}
calcium	67,800	NA
chloroform	0.010JB	20^{E}, 110^{C}
chromium	47	$2{,}000^{R}$ (III) 10^{R} (VI)
chrysene	4.1	NA^{C}
cobalt	6.2	NA
copper	86	NA
cyanide	1.5J	40^{R}
di(2-ethylhexyl)phthalate	0.4J	40^{R}, 50^{C}
dibenzo(a,h)anthracene	0.38J	NA^{C}
dibenzofuran	0.87J	NA
indeno(1,2,3-cd)pyrene	1.3J	NA^{C}
iron	26,900	NA
lead	95.7	NA
magnesium	10,900	NA
manganese	3,800.J	200^{R}
2-methylnaphthalene	0.4	NA
naphthalene	1.4	NA
nickel	15.1	40^{R} (sol.)
phenanthrene	8.7	NA
polychlorinated biphenyls	1.5	0.01^{E}, 0.091^{C}
potassium	886	NA
tetrachloroethylene	0.014	20^{R}, 14^{C}
toluene	0.01J	400^{R}
1,1,1-trichloroethane	0.004J	NA
trichloroethylene	0.002J	64^{C}
vanadium	21.9	NA
zinc	136.J	NA

Concentrations in parts per million (ppm)

Contaminants of concern that were not detected in this medium are not listed.

J —	Quantity Estimated
NA —	None Available
NA[c] —	Carcinogen (possible, probable, or known) but no CREG available
(III) —	Chromium(III)
(VI) —	Chromium(VI)
(cis) —	cis- isomer
(trans) —	trans- isomer
(sol.) —	Comparison Value for soluble salts of nickel

Bases for Comparison Values

E —	ATSDR Environmental Media Evaluation Guides (EMEGs)
C —	ATSDR Cancer Risk Evaluation Guides (CREGs)
R —	Concentration calculated from U.S. EPA Reference Dose (Chronic) by ingestion, assuming child exposure, pica behavior (RMEGs)

Table 6. Maximum concentrations of contaminants of concern found in subsurface soil samples collected during the Sturgis Municipal Wells RI — June 1988 — May 1989 (Warzyn 1991a)

Chemical	Maximum Concentration (ppm)	Comparison Value (ppm)
acenaphthylene	0.36	NA
aluminum	15,600	NA
antimony	70	0.8^{R}
arsenic	16	0.6^{R}
barium	249	140^{R}
benzene	0.004	24^{C}
benzo(a)anthracene	5	NA^{C}
benzo(a)pyrene	5.1	0.12^{C}
benzo(b)fluoranthene	5.1	NA^{C}
benzo(g,h,i)perylene	1.6	NA
benzo(k)fluoranthene	3.5	NA^{C}
beryllium	1.6	10^{R}, 0.16^{C}
2-butanone	45	NA
cadmium	5.2	0.4^{E}
calcium	101,000	NA
chloroform	0.042	20^{R}, 110^{F}
chloromethane	0.008	NA
chromium	62.8	$2,000^{R}$ (III) 10^{R} (VI)
chrysene	4	NA^{C}
cobalt	13.2	NA
copper	2,030	NA
cyanide	188	40^{R}
di(2-ethylhexyl)phthalate	0.7	40^{R}, 50^{C}
di-n-octyl phthalate	0.15	NA
dibenzo(a,h)anthracene	1.1	NA^{C}
dibenzofuran	0.18	NA
1,2-dichloroethylene (total)	1.2	NA (cis) 40^{R} (trans)
indeno(1,2,3-cd)pyrene	3	NA^{C}
iron	108,000	NA
lead	167	NA
magnesium	21,800	NA
manganese	3,800	200^{R}
mercury	0.3	NA
2-methylnaphthalene	0.42	NA
naphthalene	0.29	NA
nickel	69.4	40^{R} (sol.)
phenanthrene	3.6	NA
polychlorinated biphenyls	0.29	0.01^{E}, 0.091^{C}

Chemical	Maximum Concentration (ppm)	Comparison Value (ppm)
potassium	1,280	NA
sodium	11,800	NA
tetrachloroethylene	260	20[R], 14[C]
thallium	0.5	NA
toluene	0.25	400[R]
1,1,1-trichloroethane	0.01	NA
trichloroethylene	99	64[C]
vanadium	40.5	NA
vinyl chloride	6	0.04[E]
zinc	2,010	NA

Concentrations in parts per million (ppm)

Contaminants of concern that were not detected in this medium are not listed.

NA — None Available
NA[C] — Carcinogen (possible, probable, or known) but no CREG available
(III) — Chromium(III)
(VI) — Chromium(VI)
(cis) — cis- isomer
(trans) — trans- isomer
(sol.) — Comparison Value for soluble salts of nickel

Bases for Comparison Values

E — ATSDR Environmental Media Evaluation Guides (EMEGs)
C — ATSDR Cancer Risk Evaluation Guides (CREGs)
R — Concentration calculated from U.S. EPA Reference Dose (Chronic) by ingestion, assuming child exposure, pica behavior (RMEGs)

Table 7. Chemicals detected in soil gas samples from the Sturgis Municipal Wells RI (Warzyn 1991a).

Chemical	Maximum Concentration (mg/m^3)	Comparison Value (mg/m^3)
trichloroethylene	1,195.	0.0006^{C}
tetrachloroethylene	290.	0.0017^{C}
1,1-dichloroethylene	2.04	0.12^{E}, 0.00002^{C}
1,2-dichloroethylene (total)	1.092	NA
1,1,1-trichloroethane	23.6	NA
toluene	3.68	NA

NA — None Available

Bases for Comparison Values

E — ATSDR Environmental Media Evaluation Guides (EMEGs)
C — ATSDR Cancer Risk Evaluation Guides (CREGs)

RESPONSIVENESS SUMMARY

The MDPH released this public health assessment for public comment on May 25, 1993. The Public Comment Period lasted until June 24, 1993. During this period, the MDPH received the following comments:

1. A manager at Ross Laboratories offered information to clarify certain factual statements within the assessment. The suggestions made have been implemented in this draft of the assessment.

2. Gradient Corporation, under contract to Cooper Industries, the parent corporation of the Kirsch Company, performed an extensive critique of this assessment. This critique concluded:

   "Although Gradient is in general agreement with these conclusions [of the public health assessment], the MDPH document is written in a manner which implies that the site poses a greater health risk than may actually exist. The following are suggestions which we believe will provide a more balanced perspective on the contamination in question."

Gradient's suggestions are listed below, with MDPH and ATSDR responses to them. The page numbers cited in the comments are those in the draft reviewed, and may not agree with the current revision.

1. <u>Selection of Chemicals-of-Concern</u>. Chemicals-of-concern (COCs) were selected by comparing site maximum concentrations observed in environmental media with media-specific, health-based comparison values. If the maximum concentration of a chemical exceeded its comparison value, it was retained as a COC. The document should indicate that this process is conservative and probably results in an overestimate of the number of COCs because the health-based comparison value is not generally applicable to the maximum concentration to be encountered. For example, the comparison value derived from a Reference Dose (RfD) represents the *average* contaminant concentration which poses an acceptable risk. Thus, it is expected that media posing an acceptable health risk will have contaminant concentrations both below and above this *average* concentration. All comparison values derived from noncancer or cancer risk factors imply an average concentration.

<u>Response</u>: A statement that the method of choosing contaminants of concern represents conservative assumptions has been added to the text.

2. <u>Derivation of Comparison Values</u>. It would be more helpful if more background were provided on the conservative assumptions used to derive comparison values. For example, what exposure assumptions were used to calculate a soil comparison

value based on an RfD and a child exhibiting pica behavior? How different are these assumptions from those typically used by the U.S. Environmental Protection Agency (USEPA) to assess the risks posed by the incidental ingestion of soil by children? A cursory review indicates that the latter assumptions would result in RfD-based comparison values at least 10-fold higher than those listed in the document.

Response: The assumptions used in deriving the comparison values were taken from ATSDR 1992, Appendix D (citing the U.S. EPA Exposure Factors Handbook), as follows:

Non-Cancer (EMEGs and RMEGs):

Child
Weight: 10 kg
Water consumption: 1 L/day
Soil ingestion: 5,000 mg/day (pica behavior)

Cancer (CREGs):

Adult
Weight: 70 kg
Water consumption: 2 L/day
Soil ingestion: 100 mg/day (incidental)
Exposure duration: 70 years
Target cancer risk: 1 in 1,000,000

3. More background information on the basis of the comparison values plus a discussion of the distribution of chemicals concentrations in environmental media, as noted above, would help the reader understand why contaminants present in soil do not pose an unacceptable health risk (pg. 15) even though they are present at concentrations that exceed their comparison values (pg. 12).

Response: A brief explanation that a chemical that exceeds a comparison value does not necessarily pose a health hazard has been included in the discussion of the selection of contaminants of concern.

4. USEPA Cancer Classifications. The report does not discuss the scheme used by the USEPA to classify carcinogens. A one-in-a-million cancer risk posed by a site contaminant such as 1,1-DCE (Class C) does not imply the same degree of concern as a one-in-a-million cancer risk posed by a Class A carcinogen such as benzene. Readers of this document should be apprised of this distinction.

Response: The MDPH and ATSDR do not accept this interpretation of the carcinogen classes. U.S. EPA's classification does not reflect the relative potency of the chemical as a carcinogen. The slope factors used to calculate the risk do reflect the relative toxicity of the chemicals, and the derivation of the slope factors may take into account the source of the data indicating that the chemicals may be carcinogens. The classification merely reflects the weight of the available evidence indicating that the chemical is a carcinogen, and may change with a new series of studies.

5. Risks Posed by Soil Gas. The document states that TCE, PCE, and 1,1-DCE pose a significant increased cancer risk if individuals are exposed for a lifetime to the maximum soil gas concentrations detected. Apparently this risk served as the basis for the recommendation that air sampling be performed. What cancer risk do the authors consider significant, greater than one-in-a-million? Ignoring the issue of data quality, it is unlikely that individuals will be exposed to undiluted soil gas. Soil gas concentrations (as well as the resultant health risk) are reduced at least 100-fold in traveling from soil to the breathing zone. USEPA considers an excess cancer risk of one-in-one hundred million to be acceptable. This recommendation needs better justification.

Response: As mentioned on page 15, a "significant" cancer risk for this assessment was considered to be 1 in 1,000,000. CREGs are calculated based on that risk level. A comparison of the concentrations in Table 7 with the CREGs indicates that the risks may still be substantially greater than 1 in 1,000,000, even after a 100-fold dilution.

6. Data Quality. The MDPH states that the validity of their conclusions is based on the reliability of information provided, in part, by the USEPA and their contractor, Warzyn. However, this qualification statement should include a short discussion of the fact that site data are suspect due to inadequate quality assurance/quality control measures used in their procurement as well as data inconsistencies. As you are aware, these concerns have been documented and placed in the public domain.

Response: Quality assurance/quality control qualifications on the data cited in this document were discussed with the data.

7. Soil Excavation. The authors state that USEPA proposes to "... excavate other contaminated soil from source areas for off-site disposal" (pg. 1). Is this the opinion of the authors as well? Gradient agrees with the authors' conclusion that site soil poses no significant noncancer or cancer health risk (pgs. 15-16). Why then must it be excavated? This point must be clarified.

Response: The reference to the proposed excavation is merely a statement of the U.S. EPA's publicly announced intentions for the remediation of the site. The authors' expression of opinions on proposed remedial actions, as expressed in health assessments, should be properly restricted to whether public health and safety are protected.