

Health Consultation

Groundwater Contamination Issues

GEAUGA INDUSTRIES
(a/k/a CARLISLE ENGINEERED PRODUCTS)

MIDDLEFIELD, GEAUGA COUNTY, OHIO

EPA FACILITY ID: OHD061722575

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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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Prepared by:

Ohio Department of Health
Health Assessment Section
Bureau of Environmental Health
Under a Cooperative Agreement with the
Agency for Toxic Substances and Disease Registry

The Health Assessment Section (HAS) of the Ohio Department of Health completed this Public Health Consultation to address long-standing groundwater contamination concerns associated with the Carlisle Engineered Products (CEP) facility at the south edge of Middlefield, in Middlefield Township, Geauga County. The document lists agency actions at the site since the last HAS Health Consultation evaluating contamination associated with the facility (1999) and documents recent activities at the site to limit the movement of site-related contaminants off-site where these chlorinated solvents might adversely impact drinking water supplies used by area residents.

Seventy-four private and commercial wells in the general vicinity of the CEP facility have been sampled by Ohio EPA, US EPA, and Ohio Department of Health staff over the past decade. Well water has been sampled for various combinations of chemicals, including both volatile organic compounds (VOCs) and metals, VOCs only, and metals only. Four wells have been sampled twice; seven wells have been sampled three times, and three wells have been sampled five times. The most recent sampling of area wells was in July, 2003.

Chlorinated solvents have been detected in two apparently distinct groundwater plumes; one under the CEP facility and the other in the South Source Area, south of the CEP, north of Georgia Road, and west of Old State Road. Groundwater flow in the sandstone aquifer that is the source of drinking water in the area is to the northeast in the vicinity of the CEP. Sampling of local wells over the past decade led to the discovery in 2001 of two residential wells and one commercial well, all three immediately south-southeast of the CEP, that were contaminated with site-related chemicals (tetrachloroethene, trichloroethene, and 1,2 dichloroethene). The source of this groundwater contamination was the chlorinated solvent plume underlying the South Field Area. In the *past*, groundwater contamination under the South Source Area posed *No Apparent Public Health Hazard* to the two families with contaminated well water as the levels detected in these water supplies were below those levels that are likely to result in adverse health effects in humans. However, due to uncertainties with regard to the possible duration of the exposure and the range of concentrations of the contaminants of concern, it was deemed prudent to place both residences on the public water supply. The two residences were hooked up to the village water supply in May, 2001. As the full extent of the groundwater contamination associated with the two plumes has not been fully delineated, these two contaminant plumes *currently* pose an *Indeterminate Public Health Hazard*.

Historical sampling of residential wells in rural portions of Middlefield Township, south and west of the village, has indicated elevated levels of iron and manganese in the raw water in some of these wells; the result of natural geochemical conditions in the sandstone aquifer that is used as a drinking water source by these residents. There are no established health-based drinking water standards for iron and manganese. Sampling of wells in Middlefield Township by Ohio EPA and US EPA indicated that the use of water softener systems by many township residents effectively reduced or eliminated the manganese levels in the water at the tap. The agencies and the company need to more fully delineate the downgradient extent of the groundwater contamination associated with the CEP facility and the South Source Area in order

to determine the likelihood of additional residential wells in the area being impacted by site-related contaminants. CEP is encouraged to continue its efforts to contain and treat the groundwater contamination that has been detected under the facility to eliminate future threats to downgradient drinking water supplies. Similar efforts should be undertaken to address the contaminant plume under the South Source Area. Township residents using private wells as their drinking water supply are encouraged to use water treatment systems to reduce their potential to be exposed to high levels of manganese that may occur naturally in their drinking water.

STATEMENT OF THE ISSUES

The Health Assessment Section (HAS) with the Ohio Department of Health (ODH) was asked by the Agency for Toxic Substances and Disease Registry (ATSDR) to review and evaluate available environmental sampling data to determine if groundwater contamination associated with the former Geauga Industries/current Carlisle Engineered Products (CEP) facility poses a public health hazard to area residents. This request was the result of continued concerns from residents with regard to possible public health impacts resulting from the groundwater contamination associated with the CEP facility, groundwater contamination identified in a field immediately south of the CEP facility, and the occurrence of elevated manganese levels detected in well water in rural portions of Middlefield Township south and west of the CEP facility. This public health consultation reviews all of the groundwater data collected as part of various investigations of the CEP carried out since 1994 and continuing to the present to determine if area residents are being exposed to site-related chemical contaminants through the drinking water route at levels that could result in adverse health effects.

BACKGROUND

Multi-agency Environmental Investigations in Middlefield (1994-1999)

In 1994, the Ohio Environmental Protection Agency (Ohio EPA), the United States Environmental Protection Agency (US EPA), and the Agency for Toxic Substances and Disease Registry (ATSDR) were asked by a local resident to investigate the release of chemical contaminants to the environment by the Geauga Industries facility. The former Geauga Industries/current Carlisle Engineered Products facility (CEP) produces extruded and molded rubber parts and molded vinyl and plastic, primarily for the automobile industry, and is located at the south edge of the Village of Middlefield, on the west side of Old State Road in Geauga County (Figure 1). The Carlisle property includes the manufacturing facility (12 acres), a field to the west (10 acres), and a field to the south (5.5 acres). Land use to the east of Old State Road is industrial, including cabinet, rubber, and plastic manufacturers. Land to the north, south, and west of the CEP facility is primarily residential.

The resident was primarily concerned with the release of metals and other chemicals to a nearby creek in which he played as a child. He believed that his contact with pollutants discharged by the CEP facility to the creek was responsible for his current medical problems. These concerns led to a number of environmental investigations in 1994 and 1995 of the CEP facility and the surrounding area carried out by Ohio EPA, US EPA, and a consulting firm hired by the company. These included an investigation of the groundwater under the Carlisle facility (GETCO, 1994), a geologic study of manganese levels in area private wells by Ohio EPA (January, 1995), and an broader environmental investigation of the CEP facility termed an Integrated Assessment that was completed by Ohio EPA for US EPA (June, 1995).

HAS 1995 Public Health Consultation

These reports and the environmental sampling data contained within them were the basis of a

Public Health Consultation completed by the Health Assessment Section at ODH in October, 1995. The main purpose of this document was to determine if there were any completed exposure pathways linking residents with contaminants at or in the vicinity of the Carlisle Engineered Products facility and, if there were, to ascertain whether or not the levels of these contaminants were high enough to result in adverse health effects in these residents. This health consultation was carried out in response to written concerns to ATSDR from a resident. Several site-related chemicals of concern (polycyclic aromatic hydrocarbons, phthalates, and metals) were found at comparatively low concentrations in off-site soils, sediments, and surface waters (primarily the open drainage ditch, farm tile system, and portions of the unnamed tributary paralleling Newcomb Road). Anecdotal information from various sources indicated that the CEP facility had discharged process wastewaters to the ditch area and possibly a nearby farm pond in the 1950's and 1960's. As the types of chemicals and their concentrations in these discharge areas in the past are unknown, it is difficult if not impossible to determine if surface waters and sediments in these areas posed a health threat to area residents at that time. Results of the sampling carried out in the area by the various agencies in 1994 and 1995 indicated that levels of chemicals in these off-site environmental media were currently at concentrations below those that would result in adverse health effects if area residents came into contact with these substances (HAS, 1995).

The main potential threat to public health posed by the contamination at the CEP facility was determined to be from drinking the contaminated groundwater discovered under the site. Sampling of groundwater from three former production wells and five newly-installed monitoring wells on-site indicated that groundwater under the site was contaminated with high levels of the chlorinated solvents tetrachloroethene (PCE) [up to 1,200 parts per billion (ppb)], trichloroethene (TCE) [up to 4,200 ppb], 1,2 dichloroethene (DCE) [up to 870 ppb], and 1,1,1 trichloroethane (TCA) [up to 280 ppb]. Elevated levels of the metals iron [up to 19,000 ppb], magnesium [up to 20,700 ppb], manganese [up to 4,320 ppb], and sodium [up to 38,400 ppb] were also detected in groundwater under the site (Ohio EPA, 1995B).

A likely source area, the so-called "Pit" was discovered under the site. This "Pit" area was used to clean rubber molds in the 1940's and early 50's (using chromic or hydrochloric acid) and the late 1950's and early 60's (using solvents). Surface water and sediments in the "Pit" were found to have elevated levels of solvent TCE and the metals arsenic, chromium, and lead. Sediments also had high levels of the plasticizer bis(2-ethylhexyl) phthalate, lower levels of polycyclic aromatic hydrocarbons (PAHs) and polychlorinated biphenyls (PCBs), and elevated levels of magnesium, and zinc. Additional potential sources of groundwater contamination identified by Ohio EPA included former solvent drum storage areas along the west side of the CEP building. Shallow subsurface soils (4-8 feet below the ground surface) in one of these areas (Area C at the southwest corner of the facility) had levels of the solvent TCE as high as 15,000 ppb (Ohio EPA, 1995B).

A groundwater study by a consultant hired by the company (GETCO, 1994) and studies by Ohio EPA (1995A, 1995B) indicated that groundwater flow in the sandstone aquifer used by the facility and area residents as a water supply was from the southwest to the northeast in the

vicinity of the Carlisle Products facility.

Residential areas to the north of and downgradient of the Carlisle Products facility are within the village of Middlefield corporate limits. Ohio EPA staff and village administrators indicated that these residents were hooked up to the village water supply which obtains its water from a wellfield tapping a different groundwater source two miles north of the CEP (Ohio EPA, 1995B). It was highly unlikely that the village wellfield would be impacted by the groundwater contamination at the Carlisle Products facility due to its distance from the site and the local hydrogeologic conditions (Totten, 1988; Vorbau and Kriz, 1996; Cox-Colvin, 1999). The village water system was extended down Old State Road to the CEP facility sometime in the early to mid 1960's. It was presumed that most of the residents north of the CEP were also hooked up to the village water system at the same time. Information available in 1995 indicated that no one living downgradient of the site was drinking contaminated water. ODNR well logs reviewed by HAS staff did indicate the presence of at least three wells in this residential area that were used as drinking water sources sometime in the past. It was recommended that these wells be located and sampled if they were still in use as drinking water supply wells. HAS also offered to review any additional environmental data collected at the site for further evaluation (HAS, 1995).

Residents living in rural portions of Middlefield Township south and west of the CEP facility were found to obtain their drinking water supply from private wells. Most of these wells were cased into the sandstone bedrock which is the primary aquifer used to provide drinking water to these residents. These wells were determined to be hydrologically up-gradient of the CEP and unlikely to be impacted by the groundwater contamination under the facility. Sampling of 10 residential wells along Newcomb and Georgia Roads west and south of the CEP facility by Ohio EPA in July, 1994, indicated no evidence of site-related contamination (no detections of chlorinated solvents) but did result in detections of the metals manganese and iron at concentrations that exceeded US EPA Secondary Maximum Contaminant Levels (SMCLs) [= 50 and 300 ppb respectively] for these metals in 7 out of 10 wells sampled. US EPA SMCLs are based on aesthetic criteria such as odor, taste, and color rather than being based on health-related criteria. There are no health-based federal Maximum Contaminant Levels (MCL) for iron and manganese in public drinking water supplies. Fifty-six area wells were sampled for metals in the fall of 1994 by Ohio EPA and US EPA staff.

Ohio EPA carried out a geochemical study of the sandstone aquifer used by residents south and west of the CEP facility and determined that the elevated iron and manganese levels were the result of local geological conditions and not related to any operations at the facility (Ohio EPA, 1995A). Most area residential wells were discovered to have water softener systems because of the high iron content of the water. Sampling of well water pre- and post- treatment in these residences by Ohio EPA/US EPA staff in 1994 indicated that of the 35 wells, 27 had lower levels of manganese following the water softening system. Of these, in 16 the treatment systems reduced manganese levels essentially to zero (below laboratory detection limits). Five of the wells with treatment systems showed an increase in manganese levels post-treatment. The HAS health consultation (1995) pointed out the general effectiveness of these water-softening systems

in reducing manganese levels in well water at the tap in these residences.

HAS 1999 Public Health Consultation

In 1999, as a result of a letter to Ohio EPA by an area resident, Ohio EPA staff and the village of Middlefield followed up on the original HAS recommendation and did a detailed investigation of residents living within the village limits north of the CEP facility. They determined that all of the village residents had been hooked up to the village water system since the early 1960's and were not currently at risk of drinking contaminated groundwater migrating off of the site. It was also noted that the village public water supply was regularly tested and was safe to drink (Ohio EPA, 1999). HAS obtained this information from Ohio EPA and incorporated it into a follow-up health consultation that was released in December, 1999.

The conclusions made in these two health consultations were that, while groundwater under the CEP facility was contaminated with elevated levels of chlorinated solvents, this contamination currently did not pose a health hazard to area residents as there was no evidence at that time that any area residents were drinking or otherwise coming into physical contact with this contaminated groundwater.

Multi-agency Environmental Investigations in Middlefield (1999-Present)

Numerous additional sampling and investigations have been carried out with regard to the groundwater contamination associated with the Carlisle Engineered Products facility since the release of the second Public Health Consultation in 1999. Discussions here of the nature and extent of the groundwater contamination in the vicinity of the CEP facility in Middlefield and adjacent portions of Middlefield Township will be based primarily on these additional sources of information.

Interim-Action Pre-design Investigation Report (Cox-Colvin, 1999)

Consultants hired by CEP completed a more detailed investigation of the groundwater contamination under the CEP facility in October, 1999. This investigation included a review of the geology and hydrogeology of the area surrounding the facility; an evaluation of the potential sources of groundwater contamination at the site; the installation of three new monitoring wells and a new groundwater extraction well on the CEP property; sampling of all of the monitoring wells on-site; detailed determinations of the direction and nature of groundwater flow under the site; and a proposal to develop a pump and treat system to try and reduce the levels and extent of the contamination under the facility in order to prevent the contamination from moving into off-site areas to the north and northeast (Cox-Colvin, 1999).

Groundwater under the CEP facility was found to be contaminated with a variety of chlorinated solvents, including TCE (up to 5,400 ppb), PCE (up to 390 ppb), and 1,2 dichloroethene (DCE), a product of the degradation of the two solvents (up to 580 ppb) (Table 1). Contaminated wells included those wells on the north and east sides of the facility. No chemicals were detected in

monitoring wells on the west side of the facility (Figure 2). Groundwater flow, as indicated by the distribution of contaminants in the groundwater and by elevations of the groundwater measured in the sampled wells (potentiometric levels), was demonstrated to be from the southwest to the northeast under the facility. (Figure 2). The company proposed to install an additional pumping well at the site and, using the two extraction wells, pump contaminated water to an air stripper where the contaminants would be stripped from the water and either discharged to the outside air or to a secondary air treatment system. Treated groundwater would be discharged to a village storm sewer. Additional soil sampling of former drum storage areas along the west side of the CEP building indicated these areas were not important sources of groundwater contamination.

January 17, 2001 ODH Residential Well Sampling

Ohio EPA staff requested the Private Water Systems Section at the Ohio Department of Health sample a limited number of nearby private wells for the full gamut of chemical contaminants. Four wells, one situated immediately south of the CEP on Old State Road, one further south on Georgia Road, one southeast of the site on Madison Road, and one on Grant Street nearly a mile north of CEP, were sampled in January 17, 2001. Low levels of arsenic (less than 15 ppb), a naturally-occurring metal, were detected in two wells. Residents were provided with information about treatment systems to remove the arsenic from their well water. Site-related chemical contaminants, including the solvents TCE [27 ppb], PCE [9.35 ppb], 1,1,1 trichloroethane (TCA)[8.9 ppb], and 1,2 DCE, [10.2 ppb] were detected in the well water in a residence immediately south of the CEP on Old State Road. The resident was advised by ODH not to use the well for drinking water or for showering. ODH was informed by the resident that the family had been using bottled water for their drinking water for a number of years. None of the other wells sampled had detections of chlorinated solvents.

March 7, 2001 US. EPA. Residential Well Sampling

As a result of the detection of site-related solvents in the adjacent residential well sampled by ODH in January, US EPA and Ohio EPA sampled nine wells on March 7, 2001 and an additional three wells on April 18, 2001 for site-related VOCs. The impacted residential well on Old State Road was resampled and found to be contaminated with site-related chemicals as well as the next residence to the south (Table 2). Site-related VOCs were not detected in any of the other ten wells sampled (Tetra-Tech, Inc, 2001). As groundwater flow under the site is to the northeast and the two impacted residential wells were located immediately to the south of the facility, it was suspected that there was a second source area, to the south of and distinct from the contamination under the CEP building, that was responsible for these contaminated wells. Both impacted residences were hooked up to the village water supply in May, 2001 (Ohio EPA staff, personal communications, 2003).

April 16, 2001 Cox-Colvin South Source Area Investigation

As a result of the discovery of the two contaminated residential wells south of the CEP facility, on April, 16, 2001, the company's consultant installed three additional groundwater monitoring wells in the farm field south of the CEP facility, west of the two impacted residences, and north of Georgia Road. These monitoring wells, as well as those previously installed to the north on the CEP property, were sampled for VOCs (Cox-Colvin, 2001A). Three additional monitoring wells were installed in the south field in May, 2001 (Ohio EPA, 2001). Of the six new monitoring wells installed in the South Source Area, chemical contaminants showed up in three (Table 1). All three monitoring wells with detects (MW-10, MW-11, MW-12), as well as MW-05 and the two impacted residential wells immediately to the east-northeast along Old State Road, had the solvent 1,1,1 TCA as well as significant levels of tetrachloroethene (PCE) in the sampled water. 1,1,1 TCA has not been detected in recent years in the wells that surround the CEP building to the north and levels of PCE are usually less rather than more than levels of TCE detected. These results, as well as the additional groundwater potentiometric data from the six newly-installed monitoring wells, indicated a separate, second groundwater contaminant source area centered around a storage/maintenance shed in the South Source Area, north of Georgia Road and west of Old State Road (Figure 2).

May 24, 2001 ODH Residential Well Sampling

As a result of concerns from residents following the discovery of the second contaminant source area in the field south of the CEP facility, ODH resampled seven residential wells primarily west of the CEP facility and the South Source Area for VOCs. No site-related chemicals were detected.

May 29, 2001 Sampling of the new Middlefield Farm & Garden Production Well

May 29, 2001 Cox-Colvin collected a groundwater sampled from a newly-installed production well drilled by Middlefield Farm & Garden (Cox-Colvin, 2001B). The well, located near the storage/maintenance building in the south field, had detections of the same suite of solvents previously detected in monitoring wells MW-10, MW-11, and MW-12 and the two impacted residential wells (Tables 1 and 2). These include elevated levels of PCE (340 ppb) and lower levels of TCE (76 ppb), 1,1,1 TCA (51 ppb), and 1,2 DCE (31 ppb). This well further indicated the presence of a second distinct source area in the South Field in the vicinity of the storage/maintenance shed .

August 20-22, 2001 Cox-Colvin South Field Soil Investigation

Following the detections of chlorinated solvents in groundwater in the vicinity of the South Source Area described above, Cox-Colvin proposed to carry out an intensive sampling of shallow subsurface soils in the vicinity of the impacted monitoring wells to try and identify the source of the groundwater contamination impacting wells. Using *Geoprobe* technology, over 90

soil samples were collected at depths of 0-2 feet, 4-6 feet, and from the interval just above the bedrock (typically 8-10 feet) and analyzed for the VOCs TCE, PCE, and 1,1,1 TCA using field screening equipment. Ten soil samples were also collected and underwent laboratory analyses for the total spectrum of VOCs. No site-related contaminants were detected in any of the soils sampled (Cox-Colvin, 2001C).

Following up on a request from Ohio EPA, additional soil sampling in the vicinity of monitoring wells MW-13 and MW14 on the South Field property, just north of Georgia Road (Figure 3), was carried out in January, 2002. Fifteen additional soil borings were made and sampled for site-related contaminants using field screening equipment and laboratory analysis. In addition, monitoring wells MW-13 and MW-14 were resampled for VOCs. No VOCs were detected in any of the Phase II soil samples collected nor in the groundwater samples from wells MW-13 and MW-14 (Cox-Colvin, 2002A).

April 23, 2002 ODH Residential Well Sampling

Meetings between Ohio EPA staff and concerned citizens in the fall of 2001 led to a request from Ohio EPA to ODH to sample a number of residential wells located in the vicinity of the former Village of Middlefield "Dump". The Dump, used as an unregulated landfill for the disposal of solid waste prior to the 1970's, is located near the intersections of Old State Road (St. Rt. 608) and Madison Road (St. Rt. 528). As the landfill is located nearly two miles to the southeast of the South Source Area and is in a different drainage basin from the CEP facility and the South Source Area, it was unlikely that this site could have anything to do with the groundwater contamination in the South Source Area. Nonetheless, ODH sampled six wells in the vicinity of the Dump as well as a residential well on Kinsman Road and a commercial well on Old State Road, both east of the South Source Area. The Kinsman Road well provided drinking water to a number of homes in the general vicinity of the Johnson Rubber plant, another potential source of groundwater contamination in the area. Wells were sampled for VOCs and metals. No VOCs were detected in any of the wells. Manganese and arsenic (up to 806 ppb and 11 ppb, respectively) were detected in three of the wells sampled. Both metals are commonly detected at similar levels in water samples from the sandstone aquifer used by residents as a drinking water source throughout Middlefield Township (Ohio EPA, 1995A).

Discovery and Sampling of the Idled Lewis Press Room Well

In December, 2001, while moving equipment at the CEP building, a previously unidentified production well was discovered in the Lewis Press Room in the southcentral part of the CEP building. An investigation of the integrity of the idled "Lewis Press Room Well" in April, 2002, indicated that the well was eight inches in diameter and 91 feet in depth, cased into the sandstone bedrock, with the surface of the water in the well at 37 feet below the level of the floor. Use of a

down-hole camera indicated that the well casing had deteriorated but no visible holes or cracks in the casing were observed. The stagnant water in the well had a floating layer of oil (Light Non-Aqueous Phase Liquid [LNAPL]) that was roughly one foot thick. The oil appeared to be entering the well from outside the casing. Oil appeared to continue to flow into the well following removal of several gallons of the initial LNAPL layer.

The oil and groundwater collected directly from the well were sampled April 26, 2002 (Cox-Colvin, 2002B). The oil and the associated groundwater had highly-elevated levels of the same chlorinated solvents previously detected in groundwater in on-site monitoring wells and production wells (Table 3). Based on the high concentrations of these chemicals detected in the oil and water in the well and its location directly up-gradient of those on-site monitoring wells that historically have had the highest levels of chlorinated solvents, it is likely that the idled Lewis Press Room Well is the major source of the groundwater contamination under the CEP facility.

Installation of the On-site Groundwater Treatment System

August 22, 2002, CEP installed and started up operation of the on-site water treatment system. The system consists of two extraction wells at the northeast corner of the CEP property (PW01 and PW02) that pump contaminated groundwater to an on-site “air stripper”. The Air Stripper exposes the VOC-contaminated groundwater to the air which then causes the chlorinated solvents to volatilize out of the water and be discharged to the ambient air. The treated water leaves the stripper system and is discharged via an Ohio EPA- permitted outfall to the village storm sewer system which discharges to Tare Creek north of the village. The company samples the influent and effluent on either side of the system on a monthly basis to insure that the air stripper is working (Ohio EPA staff, pers. comm., 2003). The intent of the water treatment system is to reduce the levels of chlorinated solvents in the groundwater on-site in order to limit the potential for the groundwater contamination to move off-site to the northeast of the CEP facility.

October 22, 2002 ODH Residential Well Sampling

Due to continuing uncertainty about the source and nature of the groundwater contamination in the vicinity of the South Source Area, Ohio EPA approached ODH to resample a limited number of residential wells on Georgia and Old State Roads. Four residential wells and one commercial well were sampled for VOCs. No site-related chemicals were detected.

May and June, 2003 On-site Water Treatment System Sampling Events

As part of the operation of the on-site water treatment system at the CEP facility, influent and

effluent water coming into and being discharged by the system is sampled monthly with the results reported to Ohio EPA. The influent water from pumping wells PW01 and PW02 is tested once a month and the treated water being discharged by the system is sampled twice a month. The results for May and June, 2003 (Cox-Colvin, 2003A & B) were provided to HAS by Ohio EPA staff (July, 2003). No site-related VOCs were detected in treated water discharged to the storm sewer from the treatment system in either May or June, 2003 (Table 4).

July, 2002 and March, 2003 Cox-Colvin Monitoring Well Sampling

June 16, 2003, HAS received the results of the July 29, 2002 sampling of all of the on-site monitoring wells and a later March 29, 2003 sampling of monitoring wells, including three new monitoring wells (MW-15, MW-16, MW-17) installed off-site northeast of the CEP facility (Figure 3). MW-15 is roughly 300 feet north of the site, east of Old State Road. MW-16 is 800 feet northeast of the site, east of Old State Road. MW-17 is 1,100 feet north of the CEP facility on the east side of Old State Road. Six out of eight on-site monitoring wells sampled in July, 2002 and in March, 2003 had detections of chlorinated solvents (Table 1). Wells MW-01 and MW-02 along the west side of the CEP facility had no detects. The highest levels of contaminants in both rounds were in MW-07 at the northeast corner of the CES property (Table 1). Low levels of TCE (7.6 ppb) were detected in off-site well MW-15 just north of the site. No site-related chemicals were detected in either of the other off-site monitoring wells.

July 16, 2003 Ohio EPA Residential Well Sampling

Due to continuing concerns about the safety of the residential wells along Georgia Road and Old State Road, in the vicinity of the South Source Area, Ohio EPA resampled four residential wells and one commercial well in the area for VOCs July 16, 2003. None of the wells had detections of site-related VOCs (Ohio EPA, 2003).

Geology and Hydrogeology in Middlefield and Middlefield Township

Surface Water Flow and Topography

The Village of Middlefield and adjacent portions of Middlefield Township in Geauga County are situated in an area of rolling, glaciated bedrock hills near the drainage divide between the Cuyahoga River basin to the west and the Grand River basin to the east. Streams west of Madison Road (State Rt. 528) typically flow west and northwest towards the Cuyahoga River. Streams east of Madison Road flow to the southeast (Swine Creek) and northeast (Phelps Creek), eventually discharging to the Grand River in adjacent portions of Trumbull and Ashtabula Counties. Middlefield and portions of Middlefield Township south and west of the Carlisle Engineered Products facility are within the capture zone of the Cuyahoga River basin.

An unnamed north-south trending tributary of Tare Creek, located west of the CEP facility and

running roughly parallel to Newcomb Road, drains the immediate area of concern, flowing north from the bedrock hills to the south towards Middlefield and the Tare Creek valley north of the village. The CEP facility lies in a slight sag (elevation of 1,190 feet) between two bedrock hills; one immediately to the northwest of the plant and the other about ½ mile to the southeast along Old State Road (both at elevations in excess of 1,200 feet). Surface water flow at the CEP facility follows a circuitous path, flowing south in a north-south trending ditch located along the western edge of the CEP property to Georgia Road, then west and southwest to a farm tile system that discharges to the north-flowing unnamed tributary, southeast of the junction of Georgia and Newcomb Roads (Figure 4).

Bedrock Geology and Hydrogeology

Middlefield Township and the southern edge of the village, south of Kinsman Road and west of Old State Road, is underlain by bedrock consisting of the Massillon Sandstone and the Sharon Conglomerate. The bulk of the village and areas east-northeast of Old State Road overlie the interbedded shales, siltstones, and thin sandstones of the Cuyahoga Formation (Ohio EPA, 1995A; Slusher and Larson, 1996). In general, the bedrock surface in the area slopes downward from the southwest to the northeast. There is a small north-south trending bedrock valley that parallels the current course of the unnamed tributary along Newcomb Road (Ohio EPA, 1995A; Slusher and Larson, 1996; Vorbau and Kriz, 1996). Glacial soils are generally thin (less than 25 feet thick) in the immediate vicinity of the CEP, thickening towards the north end of the village along Tare Creek. Sandstone bedrock is encountered at a depth of only 10 feet below the ground surface under the CEP facility (Cox-Colvin, 1999).

Most residents in Middlefield Township, south and west of the village, obtain their drinking water from private wells drilled into the underlying sandstone bedrock, primarily the Sharon Conglomerate. A majority of wells are drilled to depths 70 to 100 feet deep, are cased several feet into the bedrock, and typically yield 10 to 20 gallons per minute (Ohio Department of Natural Resources, well logs; Walker, 1990; Ohio EPA, 1995A). Production and monitoring wells at the CEP facility obtain their water from the same sandstone unit with water detected at depths of from 50 to 80 feet below the ground surface (GETCO, 1994; Cox-Colvin, 1999).

Groundwater flow in the sandstone aquifer under the CEP facility is from the southwest to the northeast, following the trend of the bedrock surface (GETCO, 1994; Ohio EPA, 1995B; Cox-Colvin, 1999). Groundwater flow maps for the sandstone aquifer in Middlefield Township south and west of the CEP facility (Ohio EPA, 1995A) indicate a similar regional flow pattern, generally from the southwest to the northeast. This places residents using private wells in rural areas south and west of the village up-gradient (uphill hydrologically) from the CEP facility and unlikely to be impacted by groundwater contamination that is under the facility or that is associated with the second contaminant source detected in the South Source Area in 2001.

Glacial Geology and Hydrogeology

Glacial soils, primarily tills (mixtures of clay and silt with minor sand and gravel), blanket most of Middlefield Township to varying depths. Groundwater, if present at all in these clay-rich soils, tends to flow downhill following local surface relief. As indicated above, glacial soils are comparatively thin (9-12 feet thick) under the CEP facility. The glacial cover thickens going north towards the north end of the village, reaching a maximum thickness of 150 feet thick in the vicinity of Tare Creek, an east-west flowing stream roughly two miles north of the CEP (Totten, 1988; Vorbau and Kriz, 1996). The creek flows in a buried bedrock valley that has been backfilled with a variety of glacial deposits, including clay, sand, and gravel. Groundwater flow in the the glacial soils filling the buried valley parallels the flow of Tare Creek, flowing from the east-northeast to the west-southwest. Sand and gravel portions of these unconsolidated glacial soils make excellent aquifers and have the potential to generate wells yielding up to 300 gallons of water per minute (Walker, 1990).

The Village of Middlefield well field, consisting of three production wells that, on the average, produce 610,000 gallons of water per day, is located 1.8 miles north of the village on the west side of Old State Road (Ohio EPA, 1995B). The municipal water system provides drinking water to roughly 2,220 customers, including residents of the Village, the CEP facility, and other industrial and commercial facilities to the east of the CEP. The village water system is sampled on a regular basis and currently is in compliance with all public drinking water supply standards and the water is safe to drink (Ohio EPA-Northeast District Office, Division of Drinking and Ground Water, personal communications, October, 2003).

DISCUSSION OF THE ISSUES

Importance of a Completed Exposure Pathway

Area residents have to come into physical contact or *be exposed* to the contaminated groundwater at the Carlisle Engineered Products facility in order for these toxic chemicals to cause the development of adverse health effects in these residents. In order for the residents to come into contact with these chemicals, there must be a *completed exposure pathway* . A completed exposure pathway consists of *five main parts* that must be present for exposure to occur. These include:

- A Source of the toxic chemicals of concern;
- A method of Environmental Transport which allows the chemical to move from the source and bring it into contact with the residents (surface water, groundwater, soils, entrained dust, vapors, soil gas);
- A Point of Exposure which is the place where a resident comes into direct contact with the chemical (on-site versus off-site);

- A Route of Exposure which is how the resident comes into contact with the chemical (drinking it, eating it, breathing it, touching it); and
- A Population at Risk which are the people living near the site who could possibly come into physical contact with site-related chemicals.

Exposure pathways can also be characterized by when the exposure occurred or might occur in the *past, present, or future*.

Physical contact with a chemical contaminant in and by itself *does not* necessarily result in adverse health effects. A chemical's ability to affect the resident's health is also controlled by a number of other factors including:

- How much of the chemical a person is exposed to (the *dose*).
- How long a person is exposed to the chemical (duration of exposure).
- How often a person is exposed to the chemical (acute versus chronic).
- The chemical's toxicity and how it impacts the body.

Other factors affecting a chemical's likelihood of causing adverse health effects upon contact includes the resident's:

- History of past exposure to chemicals.
- Smoking, drinking alcohol, or taking certain medicines or drugs.
- Current health status.
- Age and sex.
- Family medical history.

Toxicology of the Chemicals of Concern in the Groundwater

Site-related chemicals of concern associated with contaminant plumes under the Carlisle Engineered Products facility and under the South Field Source area consist primarily of chlorinated solvents. These include the solvents trichloroethene (TCE), tetrachloroethene or perchloroethene (PCE), and 1,1,1 trichloroethane (TCA). Additional chemicals detected include 1,1 dichloroethane (DCA) and 1,2 dichloroethene (DCE), both of which are products of the environmental breakdown of one or all of these parent solvents (Vogel and McCarty, 1985). All three parent solvents and the two breakdown products are volatile organic compounds (VOCs), liquid-phase organic compounds that upon exposure to the air, readily vaporize to a gas.

All of these chemicals tend to be mobile in soils, are partially soluble in groundwater, and are denser than water. Significant rainfall events can readily flush these chemicals down through the soils to the groundwater. Upon coming into contact with groundwater, due to their density, they tend to sink down through the aquifer as time and distance from the source area increases. With increasing distance from the ground surface and decreasing oxygen levels in the groundwater, TCE, PCE, and TCA undergo biodegradation by bacteria. TCE and PCE break down to 1,2 DCE and vinyl chloride. TCA breaks down to 1,1 DCA, 1,1 DCE, and chloroethane. To date, no vinyl chloride has been detected in groundwater plumes associated with the CEP facility or the South Source area.

Trichloroethene

This chemical is a man-made solvent, used primarily to degrease metal parts. It was widely-used in the metal fabricating industry and also in a variety of cleaning products, paint removers, and glues in the 1950s and up to the 1970's. It appears to have been used to clean rubber and plastic molds at Carlisle Engineered Products facility. In the past, TCE was classified by US EPA as a B2 carcinogen -- a probable human cancer-causing agent. Its carcinogenicity is currently being reviewed by US EPA. The US EPA drinking water standard for TCE in public water supplies is 5 ppb and the US EPA Removal Action Level (RAL) for TCE in groundwater at Superfund sites is 300 ppb.

The health effects from drinking or inhaling low levels of TCE over long periods of time remain poorly-documented and controversial. A study of residents in Woburn, Massachusetts associated excessive cases of acute lymphocytic leukemia in children with their mothers' exposure to elevated levels of TCE (183-267 ppb) in a public drinking water well over the course of 5-10 years (Lagako et al., 1984). The impacted well also contained low levels (< 50 ppb) of PCE, 1,2 DCE, and chloroform. Statistically significant excess leukemia cases in females were associated with residents exposed to TCE and other chemicals, both in their drinking water supply and from factory air emissions in Toms River, New Jersey (Fagliano et al., 1990). A health study conducted by ATSDR (2003) of birth defects and childhood leukemia in children born to parents stationed at Camp Lejeune Marine base between 1975 and 1988 linked an increased incidence of these adverse health effects to the parents' exposure to high levels of TCE (up to 1,400 ppb), PCE (up to 407 ppb), and 1,2 DCE (up to 215 ppb) in the base public drinking water supply (ATSDR, 2003). Further investigations of the Camp Lejeune exposures are being carried out by ATSDR.

In contrast, consecutive surveys of self-reported health effects from over 4,000 residents at 15 sites in five states exposed to TCE through their drinking water supplies (levels of 3-24,000 ppb) for varying periods of time (7-20 years) failed to link these exposures with the development of excess cancer cases. Non-cancer health effects tentatively linked to these exposures included an increased incidence of strokes, increased incidence of diabetes, some increased incidence in liver and kidney disease, and urinary tract disorders (ATSDR, 1999).

The Middlefield investigations indicate that two families along Old State Road were exposed to well water contaminated with TCE at levels of 30 and 10 ppb for an unknown period of time. These levels were likely variable over time and the range of concentrations of TCE in these wells is unknown. The levels detected in January and March, 2001 exceeded the US EPA drinking water standard for TCE in public water supplies (MCL = 5 ppb) but were below the non-cancer drinking water equivalent level (DWEL = 300 ppb) and the US EPA Superfund drinking water removal action level (RAL = 300 ppb). It is unlikely that the levels of TCE detected in the well water in the two residences would pose a health hazard to these residents as they are below those levels that are likely to result in adverse health effects in humans (=DWEL) and the duration of the time of exposure was probably limited to less than 30 years.

Tetrachloroethene

This chemical, also known as Perchloroethene or PCE, is another man-made chlorinated solvent. It is used primarily by dry-cleaning establishments but also has been used as a metal degreaser in metal fabricating industries. Its chemical properties are similar to that of TCE except that PCE is somewhat more fat soluble than TCE and is retained in the body for longer periods of time. PCE also has been classified in the past as a B2 -- probable human cancer-causing agent by US EPA. Its carcinogenicity is also currently under review by US EPA.

Data with regard to adverse health effects associated with environmental exposures to tetrachloroethene comes primarily from occupational studies of dry-cleaner workers breathing elevated levels of PCE (greater than 50 parts per million) in an enclosed air environment for long periods of time. These studies suggest associations between these exposures and the increased incidence of lymphomas, kidney, bladder, esophageal, intestinal, and cervical cancers in these workers (IRAC, 1995; ATSDR, 1997). These studies were confounded, however, by the presence of numerous other dry-cleaning chemicals in the indoor air besides the PCE. Health studies involving ingestion of PCE in drinking water supplies are limited. As indicated above, PCE was a chemical of concern in contaminated drinking water along with TCE in the Woburn, Tom's River, and Camp Lejeune health studies although in all three cases the concentrations of PCE were below those of TCE. Adverse health effects associated with ingestion of low levels (parts per billion) of PCE in drinking water remain largely unknown.

The Middlefield investigations have indicated that two families along Old State Road immediately south of the CEP have been exposed to PCE in their drinking water supply at concentrations of 7.4 and 72.4 ppb. It is not known with any certainty how long these residents might have been exposed to the PCE in their drinking water. Levels of PCE in their drinking water supplies likely varied over time. The full range of PCE concentrations is not known. The detected levels exceeded US EPA Maximum Contaminant Level for PCE in public water supplies (MCL = 5 ppb). The higher of the two detections also exceeded the US EPA Removal Action Level for PCE in groundwater (RAL = 70 ppb). Both detections, however, were below the non-cancer drinking water equivalent level for PCE (DWEL = 500 ppb). As levels of PCE detected in the well water are below the level that would result in adverse health effects in

humans (=DWEL) and the duration of this exposure was likely less than 30 years, it is unlikely that these exposures to PCE in the well water would result in adverse health effects in these residents.

1,1,1 Trichloroethane

This is another man-made chlorinated solvent that is used primarily to degrease metal parts but also has many other uses as a component of household spot removers, glues, paints, and aerosol sprays. It is more likely to vaporize upon exposure to the air than the previous solvents and is not as toxic. Currently US EPA classifies TCA as a Class D Carcinogen; there being no significant human or animal data that indicate that this chemical is a cancer-causing agent.

No studies document harmful effects in humans resulting from drinking water contaminated with 1,1,1 TCA. Occupational studies of workers breathing high levels of TCA (1,000s of ppm) in an indoor air environment indicated the onset of central nervous system dysfunction, including dizziness, loss of coordination, and loss of consciousness. Animal studies indicate central nervous system dysfunction and some liver damage in rodents exposed to very high levels of 1,1,1 TCA via ingestion (ATSDR, 1995).

Low levels of 1,1,1 TCA (7 and 13.5 ppb) were detected in residential water supplies in two homes along Old State Road immediately south of the CEF. These levels were far below established drinking water standards for 1,1,1 TCA (US EPA MCL = 200 ppb; Lifetime Health Advisory/ LTHA = 200 ppb; US EPA RAL = 1,000 ppb). As such, exposure to this chemical at these levels in drinking water is highly unlikely to result in adverse health effects.

1,2 Dichloroethene

This chemical is a chlorinated solvent in its own right but also is a by-product of the anaerobic biodegradation of PCE and TCE. It easily vaporizes upon exposure to the air and readily leaches through sandy soils to underlying groundwater. Its toxicity is similar to that of 1,1,1 TCA, being a Class D carcinogen with there being no data to indicate that this chemical promotes tumor formation in the body (ATSDR, 1996).

The toxicology of 1,2 DCE is similar to that of 1,1,1 TCA in that there is no significant research documenting adverse health effects in humans from drinking 1,2 DCE -contaminated water.

Occupational studies indicate similar central nervous system dysfunction in workers breathing very high levels of 1,2 DCE in the air (1,000 - 2,000 ppm).

Low levels of 1,2 DCE (13.5 and 3.8 ppb) were detected in two residential water supplies used by two homes on Old State Road south of the CEP facility. These levels were far below established standards for 1,2 DCE in drinking water (US EPA MCL = 70/100 ppb; LTHA = 70/100 ppb; US EPA RAL = 400/600 ppb) and exposure to these levels of DCE would not likely result in adverse health effects.

Manganese

Manganese is a naturally-occurring metal in soils and rocks. In nature, manganese occurs as a solid forming mixtures with oxygen, carbon, and silica. These manganese compounds are mined and refined to yield manganese metal primarily for use in the steel industry, but also as dietary supplements and as ingredients in ceramics, fertilizers, and pesticides. Some manganese compounds dissolve in water and manganese is a common trace element in surface and underground waters. Manganese levels in groundwater in Ohio typically are less than 100 ppb. However, certain sandstone aquifers in eastern Ohio can have levels of naturally-occurring manganese up to 2,000 ppb and sand and gravel aquifers along the Ohio River can have manganese levels in excess of 5,000 ppb (Ohio EPA, 2000).

There are no federal health-based standards established for manganese in drinking water. US EPA has established a Secondary Maximum Contaminant Level (SMCL) for manganese in public water supplies of 50 ppb. This is not a health-based drinking water standard, but is based on aesthetic qualities; odor, taste, color and clarity. Elevated manganese levels can result in a disagreeable odor and a black coloration to the water. The U.S. Food and Drug Administration uses the same 50 ppb standard for manganese in bottled drinking water. Various states have established their own water quality standards for manganese in drinking water, ranging from 50 to 840 ppb (ATSDR, 2000).

Manganese at low levels is essential for good health. It plays a role in bone mineralization, protein formation, metabolic regulation, and provides cells with protection from free radical species. Diets deficient in manganese can result in serious illness, leading to problems with blood clotting, skin disorders, and metabolic disorders, plus interfering with normal growth, bone formation, and reproduction (ATSDR, 2000). Central nervous system effects (tremors, loss of muscle control) have been associated with ingestion of drinking water with highly elevated levels of manganese (at or in excess of 14,000 ppb) in a study of a human population in Japan and in a second study of elderly individuals in Greece who were drinking water with manganese levels of 1,800 to 2,300 ppb. Other studies in Canada and Israel, however, indicated no correlation between increased incidence of CNS disorders and ingestion of drinking water with similarly high levels of manganese (ATSDR, 2000).

Manganese levels in the raw water obtained from the sandstone aquifer that is the source of drinking water for 50 rural residents in Middlefield Township ranged from below the detection limit to 4,060 ppb, with a mean manganese concentration of 498 ppb (Ohio EPA, 1995A).

However, manganese levels at the tap in these homes were typically much lower due to the use of water softener systems by many of these residents.

Summary of the Identified Groundwater Concerns

Contaminant Plume underlying the Carlisle Engineered Products facility

The sources of this groundwater contaminant plume are likely the former Lewis Press Room production well and the “Pit” area under the CEP facility. The chemicals of concern are the chlorinated solvents trichloroethene (TCE) and tetrachloro- or perchloroethene (PCE), plus 1,2 dichloroethene (DCE), a chemical breakdown product of these two solvents. These contaminants have impacted the sandstone aquifer under the facility. The extent of this groundwater plume as it has been determined to date includes the northern and eastern portions of the CEP property (monitoring wells MW-3, MW-4, MW-6, MW-7, and MW-8 plus “production well” PW-01) and off-site monitoring well MW-15, 300 feet north of the CEP facility on the east side of Old State Road (Figure 3). To date, there is no evidence that any residents have come into contact with this plume through their drinking water supply. This information is presented in summary fashion in Table 5.

Contaminant Plume associated with the South Source Area

The source of this second, apparently separate, contaminant plume is currently unknown. The contamination appears to center around a storage/maintenance shed situated in the southeast corner of the South Source Area, between Georgia Road and Old State Road (Figure 2). The chemicals of concern are the solvents TCE, PCE, and 1,1,1 trichloroethane (TCA), as well as their breakdown products, including 1,1 dichloroethane (DCA) and 1,1 and 1,2 dichloroethene (DCE). The contamination has impacted the sandstone aquifer directly under the South Source Area and some distance to the northeast (monitoring wells MW-5, MW-10, MW-11, and MW-12; a nearby commercial production well; plus two residential wells on Old State Road). The full extent of this plume is unknown.

Site-related contaminants were detected in 2001 in the well water of two residential wells immediately south of the CEP on the west side of Old State Road. A completed exposure pathway existed for the residents using these two wells as their drinking water supply. The likely *source* of the contamination is the plume in the South Source Area; the *route of transport* is through the groundwater; the *point of exposure* is at the tap; the *route of exposure* is through drinking the water and possibly inhalation of these volatile chemicals during use of the water; and the *population at risk* would be the two families using these two wells. The chemicals detected and their concentrations are presented in Table 2. It is unknown how long these wells were contaminated with chlorinated solvents. One of the affected families informed ODH that they had not been using their well water as their drinking water supply for a number of years. Both residences were hooked up to the Middlefield public water supply in May, 2001.

Manganese and other Metals in Middlefield Township Well Water

All private wells sampled, including wells located in more rural portions of Middlefield Township, south, west, and southeast of the CEP facility and the South Source Area, had detectable levels of the metals aluminum, arsenic, barium, cadmium, calcium, chromium, copper, iron, lead, magnesium, manganese, and zinc in the raw well water. These trace metals are common constituents of naturally-occurring groundwater all across Ohio (Ohio EPA, 2000). Sources of these metals are the enclosing soils and rock types that store the groundwater and serve as aquifers providing water to the wells. Groundwater-bearing sandstone layers in northeastern Ohio, such as the Massillon Sandstone and the Sharon Conglomerate, often have naturally high concentrations of the metals iron and manganese with Ohio EPA recording iron levels of up to 17,200 ppb and manganese levels up to 1,810 ppb from ambient wells drawing their water from these aquifers in eastern Ohio (Ohio EPA, 2000).

As indicated above, sampling of 56 private wells in Middlefield Township primarily south and west of the village of Middlefield was carried out by Ohio EPA and US EPA staff in 1994. Review of well logs for these sampled wells by Ohio EPA staff indicated that a majority of these wells obtained their water from the Sharon Conglomerate (Ohio EPA, 1995A). Iron levels in well water ranged from below detection limits up to 22,900 ppb with a mean iron concentration of 5,441 ppb. Manganese levels in the same wells ranged from below detection limits to 4,060 ppb with a mean manganese concentration of 498 ppb.

Wells with the highest manganese levels (greater than 1,000 ppb Mn) followed a roughly linear, south to north trend, slightly west of and largely parallel to Newcomb Road (Ohio EPA, 1995A, Figure 5). Bedrock surface topography maps (Ohio EPA, 1995A, Figure 8; Vorbau and Kritz, 1996) indicate that this area is both up-gradient (uphill) from the CEP facility and separated from it by a south-to-north trending bedrock valley. It is hydrogeologically impossible for the groundwater under the CEP facility to be the source of the iron and manganese levels observed in these wells. As indicated by Ohio EPA in their January, 1995 report, the high iron and manganese levels observed in groundwater south and west of the village of Middlefield coincides with the geographic distribution of the water-bearing Sharon Conglomerate aquifer. The high levels of these metals detected in area wells are likely natural in their origin, resulting from local geological and geochemical conditions (Ohio EPA, 1995A).

Due to the adverse effects of these high iron levels on the water quality of wells in portions of Middlefield Township south and west of Middlefield, many residents have cation-exchange water softener systems which, besides softening the water, also effectively remove the iron from the water (Ohio EPA, 1995A). As manganese chemically is very similar to iron, these same cation-ion exchange water softener systems also will greatly reduce or remove manganese concentrations as high as 5,000 ppb from the water as well (McGowan, 1997). Sampling of well water pre- and post-treatment in these residences by Ohio EPA and US EPA in 1994 indicated that of the 35 wells sampled, 27 (77%) had lower levels of manganese following the

water softener system. Of these, in 16, the treatment system reduced manganese levels to essentially zero (below detection limits). Five of the wells showed an increase in manganese levels post-treatment. McGowan (1997) has emphasized the importance of regularly regenerating the salt levels in softener systems to maintain their effectiveness in removing these metals from the raw well water. It is likely that these five residences had treatment systems that were not properly functioning at the time they were sampled.

CHILDRENS HEALTH CONSIDERATIONS

ATSDR and HAS recognize the unique vulnerabilities of children exposed to environmental contamination and hazards. HAS considered the greater sensitivity of children in Middlefield Township when drawing conclusions and making recommendations in this health consultation.

CONCLUSIONS

In the *past*, groundwater contamination associated with the South Source Area posed *No Apparent Public Health Hazard* to two families along Old State Road who used private wells as their water supply and whose wells had detectable levels of chlorinated solvents. Levels of contaminants detected in these water supplies were below those concentrations that are likely to result in adverse health effects in humans. Current and future exposure of these residents to these chemicals has been eliminated by hooking these two homes up to the village public water system; therefore, no public health hazard exists currently at these two homes. Contaminant plumes associated with the CEP and the South Source Area currently pose *Indeterminate Public Health Hazards* pending further delineation of the full extent of these plumes and identification and remediation of the source area in the South Source Area.

High concentrations of naturally-occurring manganese (some in excess of 1,000 ppb) have been detected in well water in portions of Middlefield Township south and west of the village. Whether or not these manganese levels are a health hazard to residents is dependent on: 1) the concentrations of manganese in the raw water; 2) how long the resident has been consuming well water with elevated manganese levels; and 3) whether or not an effective treatment system is being used to reduce or remove the manganese from the raw water prior to the tap.

RECOMMENDATIONS

1. The agencies and/or the Potential Responsible Parties need to more fully delineate the downgradient extent of the CEP and South Source Area contaminant plumes in order to determine the likelihood of additional residential wells in the area being impacted by these contaminants.

2. The agencies and/or the Potential Responsible Parties are encouraged to continue their efforts to contain and treat the groundwater contamination that has been detected under the CEP to eliminate future threats to drinking water supplies used by off-site residents living down-gradient of this plume. Similar efforts should be undertaken to address the contaminant plume under the South Source Area.
3. Residents using private wells as their drinking water source in Middlefield Township south and west of the Village of Middlefield are advised to treat their raw well water using cation-exchange water softener units or other effective treatment systems in order to reduce or eliminate their exposure to the high manganese levels that occur naturally in the sandstone aquifer used by most of these residents as the source of their drinking water.

PUBLIC HEALTH ACTION PLAN

1. The Health Assessment Section, working with the Water Systems group at ODH and the Geauga County Health Department, will provide information to residents with regard to treatment systems that will remove the metals manganese and iron from well water supplies in Middlefield Township.
2. The Health Assessment Section will continue to review and evaluate additional environmental sampling data as it becomes available to insure that area residents have a safe drinking water supply.

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TABLE 1

**Sampling Results (Parts per Billion) for Carlisle Engineered Products
Monitoring Wells (1994 - 2003)**

Monitor Well	GETCO 1994	Cox-Colvin 1998	Cox-Colvin 1999*	Cox-Colvin 2001	Cox-Colvin 2002	Cox-Colvin 2003
#1	MCL=34	ND	ND	ND	ND	ND
#2	MCL=41	ND	ND	ND	ND	ND
#3	MCL=15 TCE=23	TCE=7.9	TCE=13 DCE=8.3	TCE=24 DCE=11	TCE=23 DCE=9.8	TCE=29 DCE=9
#4	MCL=7 TCE=150	TCE=340	TCE=170 DCE=42	TCE=150 DCE=45	TCE=140 DCE=41	TCE=97 DCE=18
#5	TCE=7.3 CHL=12	NA	TCE=62 DCE=8.4 DCA=6.3	TCE=24 DCE=4.5 DCA=1.5	TCE=58 PCE=2.8 DCE=8.9 DCA=4.4	TCE=37 PCE=1.2 DCE=7 DCA=2.6
#6			TCE=710 DCE=340	TCE=480 DCE=31	TCE=300 DCE=170	TCE=130 DCE=80
#7			TCE=5400 PCE=390 DCE=590	TCE=3200 PCE=130 DCE=480	TCE=3200 PCE=160 DCE=480	TCE=2100 PCE=1500 DCE=200
#8			TCE=48 PCE=15 DCE=1.3	TCE=29 PCE=10 DCE=0.7	TCE=36 PCE=15 DCE=1.1	TCE=36 PCE=13 DCE=1.1
#9				ND		
#10				TCE=75 PCE=410 DCE=38 TCA=69		
#11				TCE=1.4		
#12				TCE=28 PCE=9.7 DCE=4.1 TCA=2.6		

#13				ND		
#14				ND		
#15						TCE=7.6
#16						ND
#17						ND

* = 2 sample events; January + March (higher of two results listed)

MCL = Methylene chloride (common laboratory contaminant)

TCE = Trichloroethene

PCE = Tetrachloroethene/perchloroethene

DCE = 1,2 Dichloroethene

DCA = 1,1 Dichloroethane

TCA = 1,1,1 Trichloroethane

NA = Chemical sample results not available

ND = Chemical not detected in sample

TABLE 2

**Chemicals detected (Parts per billion) in two adjacent residential wells
along Old State Road, Middlefield Township (March, 2001)**

Chemical	Residential well 01	Residential Well 02	US EPA MCL	US EPA RAL	US EPA Cancer Class	DWEL
TCE	31.6	10.3	5	300	B2	300
PCE	7.4	72.4	5	70	B2	500
1,1 DCE	6.3	ND	7	70	C	400
1,2 DCE	13.5	3.8	70/100	400	D	400
1,1 DCA	9.4	1.2	NA	NA	C	NA
1,1,1 TCA	7.1	13.5	200	1,000	D	1,000

TCE = Trichloroethene

PCE = Tetrachloroethene/perchloroethene

DCE = Dichloroethene

DCA = Dichloroethane

TCA = Trichloroethane

MCL = US EPA Maximum Contaminant Level for public water supplies

RAL = US EPA Removal Action Level for groundwater

DWEL = Drinking Water Equivalent Level (Lifetime exposure protective of non-cancer effects)

NA = Maximum Contaminant Level not available for this chemical

B2 = Probable Human Cancer-causing agent based on animal studies

C = Possible Human Cancer-causing agent based on animal studies

D = Not Classifiable: No evidence that chemical causes cancer in animals or humans or studies to date inadequate to make a determination

TABLE 3

**Chemical contaminants detected in Floating Oil Layer and underlying Well Water,
Idled Lewis Press Room Well, Carlisle Engineered Products facility,
Middlefield, Ohio (April 26, 2002)**

Chemical	Oil Fraction (ppb)	Water Fraction (ppb)	US EPA MCL	US EPA RAL
Trichloroethene	110,000	1,400	5	300
Tetrachloroethene	240,000	230	5	70
1,2 Dichloroethene	37,000	240	70	400

ppb = Parts per billion

MCL = US EPA Maximum Contaminant Level for public drinking water supplies

RAL = US EPA Removal Action Level for contaminated groundwater

TABLE 4
Chemical contaminants (Parts per billion) detected in raw water influent and treated effluent water; Carlisle Engineered Products water treatment system (May-June, 2003)

Chemical	May 03 raw water	June 16 raw water	June 30 raw water	May 03 treated water	June 16 treated water	June 30 treated water
TCE	280	250	280	ND	ND	ND
PCE	BDL	BDL	BDL	ND	ND	ND
1,2 DCE	150	130	150	ND	ND	ND
1,1 DCA	BDL	BDL	BDL	ND	ND	ND

TCE = Trichloroethene

PCE = Tetrachloroethene/Perchloroethene

DCE = Dichloroethene

DCA = Dichloroethane

ND = Chemical not detected in sample

BDL = Chemical present at levels below detection limit of laboratory process

TABLE 5

**Summary of Groundwater concerns associated with the Carlisle
Engineered Products facility, Middlefield, Ohio**

Groundwater Issue	Source(s)	Chemicals of Concern	Extent of Chemical Plume	Impacted Population	Response
Contaminant Plume under CEP facility	Lewis Press Well; the Pit; former drum storage areas SW corner of facility	TCE 1,2 DCE PCE	Wells MW-3 MW-4,MW-6 MW-7,MW-8 MW-15, PW-01	None documented to date	Installation of on-site groundwater treatment system w/h monthly monitoring; Installation of off-site monitoring wells
Contaminant Plume under the South Source Area	unknown source in vicinity of shed/ maintenance building	PCE TCE 1,1,1 TCA 1,2 DCE	Wells MW-5, MW-10, MW-11, MW-12 + 2 Residential wells & one commercial well on Old State Road	2 families using well water from two impacted wells on Old State Road	2 residences hooked up to village of Middlefield water supply, May, 2001; 2001 soil & groundwater investigation
High Manganese levels in township wells	naturally-occurring in Sharon Conglomerate Bedrock aquifer	high levels of Manganese and Iron	many private wells in the township south and west of CEP	residents using these private wells as their drinking water source	residents are advised to use water softeners or other treatment systems to reduce metals levels

FIGURES

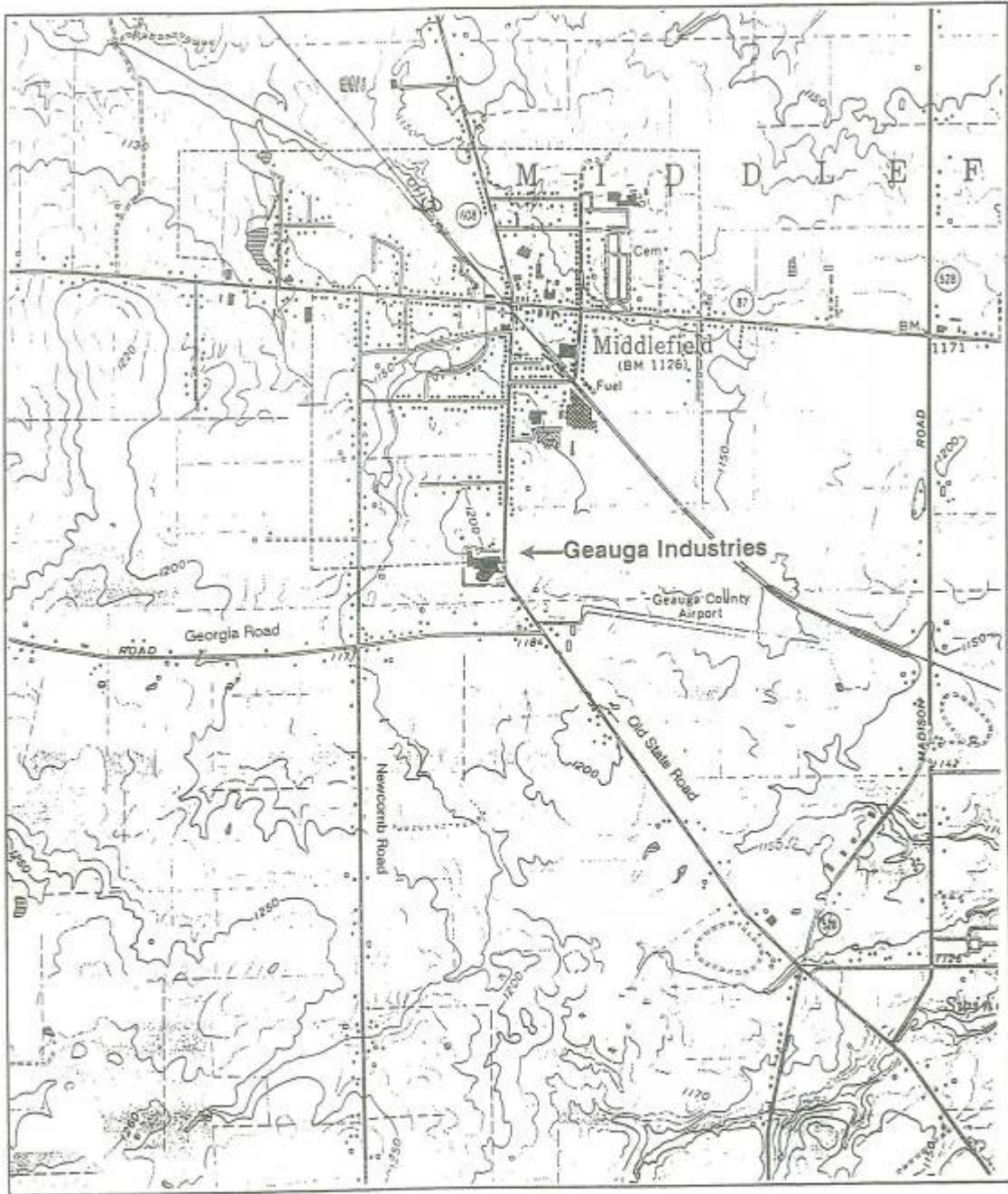


Figure 1:
Gauga Industries Site Location Map



MIDDLEFIELD, OHIO
NE/4 Garrettsville 15' Quadrangle
N 4122-W8100 (7.5
1959
Photorevised 1970

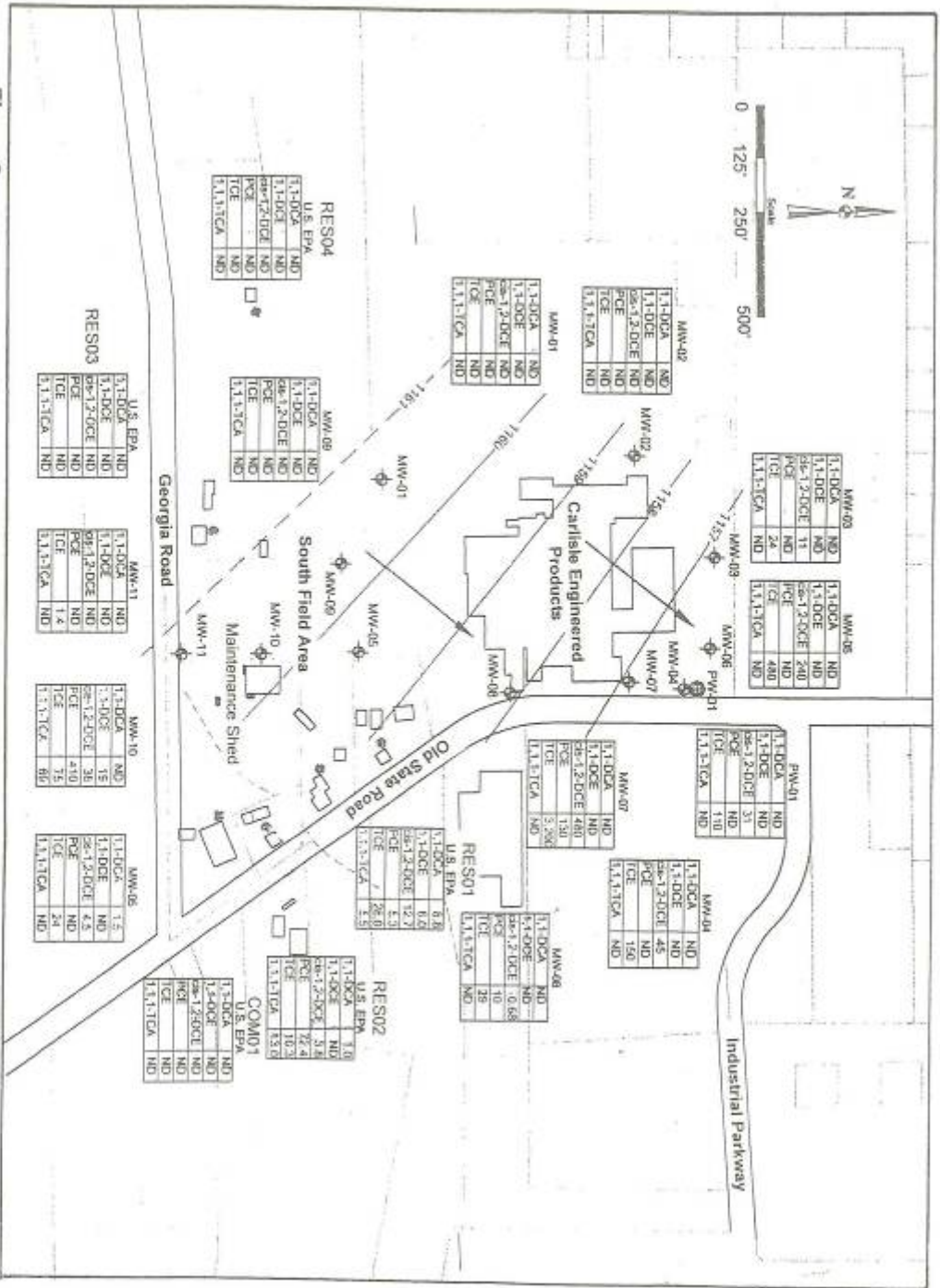
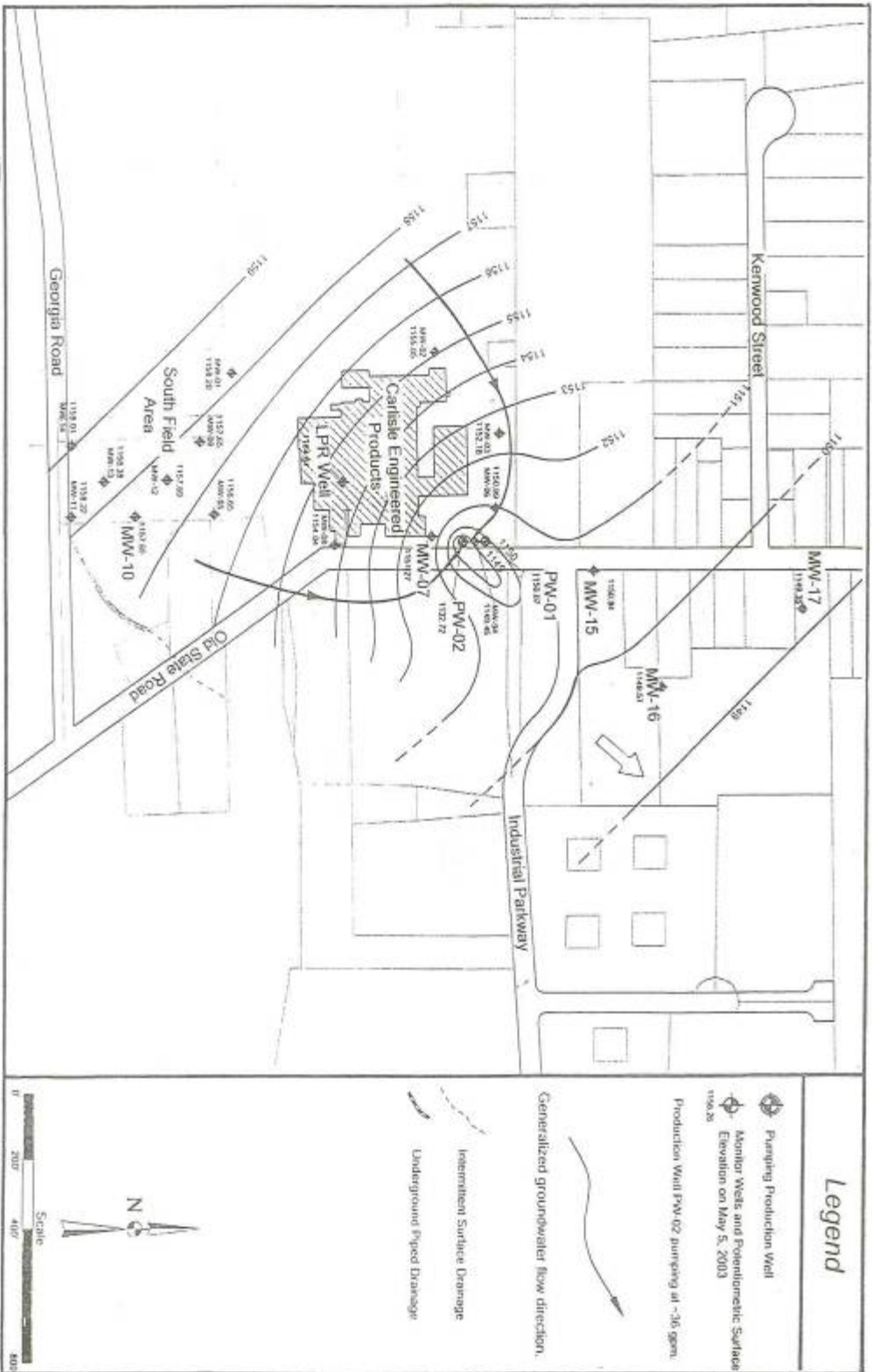


Figure 2. Monitoring well locations, contaminant levels, and groundwater flow directions in the vicinity of the Carlisle Engineered Products facility and the South Field Area, Middlefield (modified from Cox-Colvin & Associates, 2001)



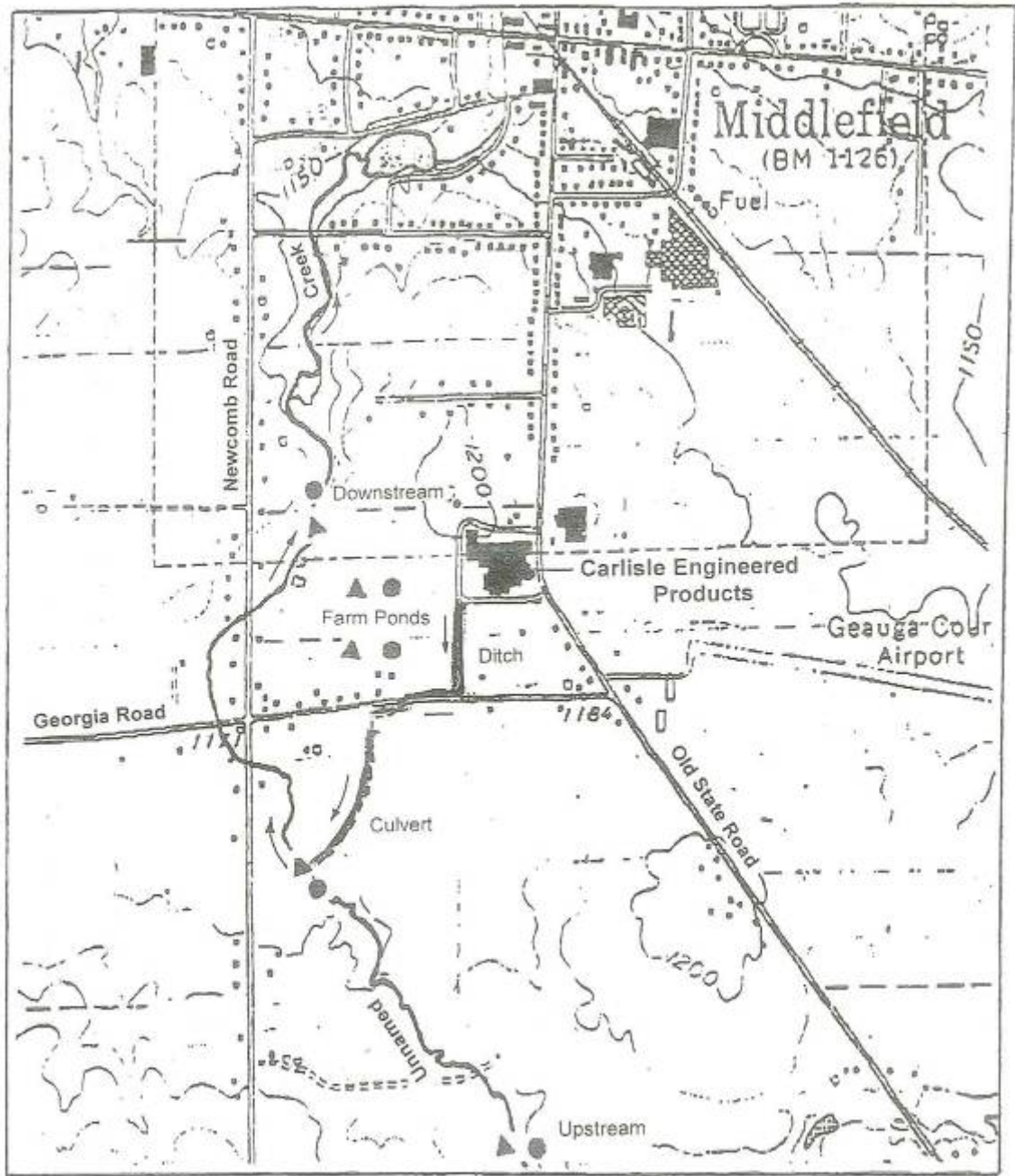


Figure 4.
 Surface water flow and Ohio EPA 1994 sampling localities in the vicinity of the
 Carlisle Engineered Products facility, Middlefield Township, Geauga County

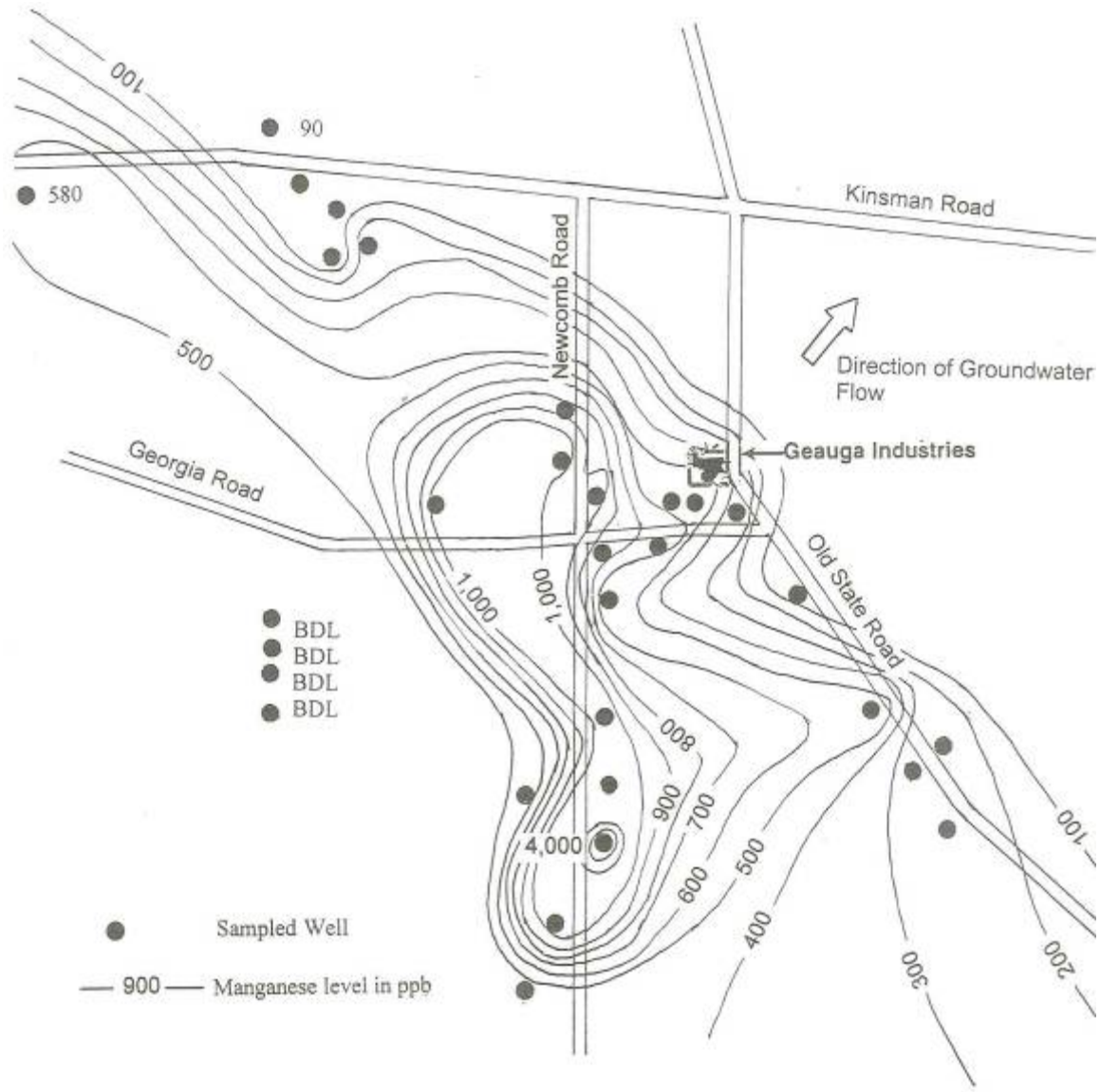


Figure 5.
 Manganese concentrations in groundwater in the vicinity of the
 Carlisle Engineered Products facility, Middlefield Township (Ohio
 EPA, 1995A, Figure 10)

CERTIFICATION

This Geauga Industries Groundwater Contamination Issues Health Consultation was prepared by the Ohio 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 procedures existing at the time the health consultation was begun.

Technical Project Officer, SPS, SSAB, DHAC, ATSDR

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

Chief, State Program Section, SSAB, DHAC, ATSDR