Health Consultation

Groundwater Contamination Issues

NEW CARLISLE WELL SITE

NEW CARLISLE, CLARK COUNTY, OHIO

EPA FACILITY ID: OHN000509238

APRIL 3, 2006

U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES
Public Health Service
Agency for Toxic Substances and Disease Registry
Division of Health Assessment and Consultation
Atlanta, Georgia 30333

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

STATEMENT OF ISSUES

April 21, 2005, the Health Assessment Section (HAS) with the Ohio Department of Health (ODH) was asked by US Environmental Protection Agency (US EPA) Emergency Response Section staff to review and evaluate available environmental sampling data collected as part of an on-going Ohio Environmental Protection Agency (Ohio EPA) investigation of groundwater contamination associated with the former New Carlisle Landfill. Specifically, HAS was asked to determine if groundwater contamination impacting drinking water and commercial production wells at a Nursery (tree farm) and Landscaping business along State Route 235 (Dayton-Lakeview Road) just south of New Carlisle, Ohio, currently posed a health threat to people working and living at the Nursery facility. HAS was also asked to comment on the whether or not the New Carlisle Well Site (NCW) posed a potential future public health hazard to residents using private wells for their drinking water supply and living immediately adjacent to the Nursery and Landscaping business.

HAS comments and recommendations were forwarded to the US EPA On-Scene Coordinator May 16, 2005. This evaluation led to a US EPA Time-Critical Removal Action to bring City of New Carlisle public water to the Nursery and Landscaping business and several residences at the NCW site. The Removal Action was initiated September 12, 2005 and completed October 20, 2005. This health consultation documents the initial HAS evaluation of the NCW site and the results of the US EPA Removal Action.

BACKGROUND

Site History

The area under investigation is in a largely rural, mixed agricultural and low-density residential portion of Bethel Township in Clark County, 1.5 miles south-southwest of the city of New Carlisle (Figure 1). The Ohio EPA Division of Drinking and Ground Water has been reviewing periodic water quality sampling of a non-community public water supply well operated by the Nursery (tree farm) since 1993. This well formerly supplied potable water to approximately 115 workers at the main office at the Nursery (Ohio EPA, 2004). Water from the well allegedly was used primarily for non-drinking water purposes (washing, flushing toilets, etc), and most workers reportedly used bottled water for their drinking water. Sampling of the well (referred to as the “Former Public Well”) since September, 2000, has detected the volatile organic compound vinyl chloride (VC) at concentrations exceeding the US EPA Maximum Contaminant Level for this chemical (MCL = 2 ppb). Subsequent sampling indicated increasing levels of VC in this well with time. Ohio EPA issued orders in 2002 that required that the well no longer be used to provide potable water to the main office and limited future use to irrigation only.

A new potable water supply well ("New Public Well") was drilled by the nursery operators approximately 750 feet south (down-gradient) of the "Former Public Well" in 2003 (Figure 2).

As a result of concerns arising from the continued detections of increasing levels of VC in the "Former Public Well", Ohio EPA completed a Site Investigation (SI) in August, 2003 and carried out an Expanded Site Investigation (ESI) in the later half of 2003 and early in 2004 (Ohio EPA, 2004). The scope of these investigations included soil and groundwater sampling of the Nursery property and a nearby suspected source area, the former New Carlisle Landfill (NCLF). These included groundwater samples in the vicinity of the landfill, the nursery, and adjacent down-gradient residential and public drinking water wells within 3,000 feet of the Nursery facility and the NCLF (Ohio EPA, 2004). A March 11, 2005 sampling of the "New Public Well" by Ohio EPA staff detected VC at levels at 2.23 ppb, just above the federal public drinking water standard (Table 1) (Ohio EPA, pers. comm., 2005). April 18, 2005 sampling of this well by US EPA had similar results (VC = 2.11 ppb) (US EPA, pers. comm., 2005).

Other water supply wells in the area, sampled by Ohio EPA in November, 2002 and December, 2003, did not detect chlorinated solvent parent products or their degradation products, including VC (Ohio EPA, 2004). These include the public water supply well that provides potable water to the seasonal migrant camp on the Nursery property (RW10, Ohio EPA, 2004). This well is up-gradient or at least lateral to the NCLF, the likely source of the delineated contaminant plume (Figure 2). Sampling (March 11th by Ohio EPA) of two residential wells on the Nursery property detected vinyl chloride at levels just below the drinking water standard. Neither of these wells previously had detections of VC. Recent (April, 2005) sampling of these two wells, by US EPA, produced similar results (Table 2).

The increasing levels of VC showing up in the Nursery production wells caused Ohio EPA staff to become concerned about the safety of the New Public Well and on-site residential wells as well as adjacent down-gradient residential wells and their potential to become contaminated with VC. This led to discussions between Ohio EPA and US EPA with regard to the potential for US EPA to address these drinking water quality concerns with a US EPA time-critical removal action. As an initial action, US EPA collected water samples from the "New Public Well" as well as two nearby residential wells proximal to the New Public Well. Results of the April 18, 2005 sampling indicated VC in excess of the US EPA MCL (2.11 ppb vs. 2.0 ppb). In support of this possible removal action, HAS was asked by the US EPA On-Scene Coordinator April 21, 2005, to complete a Public Health Consultation document reviewing and evaluating the public health threat posed by the contaminated water supply wells in the vicinity of the New Carlisle Landfill site.

Area Hydrogeology

The groundwater resource map for Clark County (J.J. Schmidt, 1982), groundwater studies by S.E. Norris et al. (1952), and maps of buried valley systems in Ohio by Cummins (1959), all indicate that the area under investigation is located above an extensive buried valley system consisting of a deep, pre-glacial bedrock valley backfilled with at least 165 feet of interbedded gravel, sand, and clay-rich glacial till. Water wells screened in the more permeable sand and gravel units in this buried valley aquifer system can locally produce over 1,000 gallons of water per minute (Ohio Department of Natural Resources, Division of Water, well logs). These very productive sand and gravel aquifers provide raw drinking water to the New Carlisle public water system (well field roughly two miles northeast and up-gradient of the Nursery production wells and the NCLF), process water to numerous local industrial and agricultural production wells, and drinking water to private residential wells throughout Bethel Township, south and west of New Carlisle.

These wells include all of the production wells and residential wells on the Nursery property and in the surrounding area that were sampled by Ohio EPA as part of their investigation of this groundwater contamination in 2002 and 2003 (Ohio EPA, 2004). Residential wells in the area typically obtain their water from the more productive sand and gravel units 60 to 100 feet below the ground surface. Groundwater studies carried out by Pantera (1993) as part of the City of New Carlisle's well field protection plan indicate that groundwater flow in the area is strongly to the south in the vicinity of the closed New Carlisle Landfill.

New Carlisle Landfill site

This former general refuse and solid waste landfill is approximately 1,300 feet north of the contaminated Former Public Well on the Nursery property. It has been reported that roughly 15 feet of compacted industrial, commercial, and residential refuse was disposed of in discrete cells across 21.7 acres of the landfill site over the course of a 20-year period between the1950's and 1977. Upon closure of the individual cells, wastes were reportedly covered with up to four feet of clay and vegetated (Ohio EPA, 2004). Previous sampling indicated low levels of chlorinated VOCs chloroethane (up to 690 ppb), 1,1 dichloroethane (up to 98 ppb), and toluene (up to 90 J ppb) plus traces of VC (= 0.8 J ppb) in leachate and groundwater at generally shallow depths (12-16 feet below the ground surface) on the western and southern perimeters of the landfill (Ohio EPA, 2004). Additional *Geoprobe* groundwater sampling in the former disposal area of the landfill (Ohio EPA, March 11, 2005) detected elevated levels (up to 1,010 ppb) of the chlorinated solvent trichloroethylene (TCE) at shallow depths (20-24 ft bgs) and lower levels (139 ppb) deeper (36-40 ft bgs) within the landfill (Ohio EPA, pers. comm., 2005). Vinyl chloride (17.4 ppb) and cis 1,2 dichloroethene (DCE) were also detected in this same sample.

Elevated levels of VC (up to 58 ppb) and chloroethane (up to 220 ppb) plus low levels of 1,2 dichloroethene (up to 15 ppb) were detected at depths of roughly 60 ft bgs in *Geoprobe* samples collected from the northern edge of the Nursery property during the course of the ESI. These *Geoprobe* samples were collected within a 500 foot radius of the contaminated "Former Public Well".

The contaminants of concern in the *Geoprobe* samples and the two production wells at the north edge of the Nursery property consist primarily of VC, a breakdown product of chlorinated ethenes like perchloroethylene (PCE) and TCE, and chloroethane, a breakdown product of 1,1,1 trichloroethane, both detected at greater depths, roughly 60 feet bgs. The recent detections of elevated levels of TCE in shallow groundwater at the landfill site, the distributions of groundwater contaminants at depth within the aquifer, the degraded nature of the chemical contaminants in the groundwater plume coupled with a lack of parent products in the intervening shallower intervals of the aquifer on the Nursery property, the southward direction of groundwater flow in the region (Pantera, 1993), plus an absence of evidence of other potential sources in the area, all indicate that the closed New Carlisle Landfill is the source of the groundwater contamination in the area under investigation.

US EPA Time-Critical Removal Action

The Ohio EPA requested assistance from the US EPA emergency response program January 4, 2005 with regard to groundwater and drinking water contamination issues associated with the New Carlisle Landfill site and the adjacent New Carlisle Well site (NCW). Vinyl chloride levels were detected in the new public water supply well on the Nursery property at levels in excess of federal drinking water standards and US EPA Removal Action Levels. Sampling of on-site wells at the Nursery property in April, 2005 reaffirmed previous contaminant concerns with regard to elevated levels of VC in on-site drinking water supplies.

A review of the history of the contaminant issues at the NCW site and a discussion of current drinking water contaminant issues and potential remedial responses occurred at an inter-agency meeting between Ohio EPA, US EPA, and the HAS April 27, 2005. The agencies participated in a site visit at the NCW site later the same day and entered into discussions with the Nursery owner and operator with regard to possible remediation options and the potential for a US EPA Time-Critical Removal Action. The US EPA On-Scene Coordinator (OSC) requested a health consultation from the HAS to review and evaluate the public health issues associated with the contamination at the NCW site. HAS submitted a draft health consultation in support of the proposed removal action to the US EPA OSC (May16, 2005).

Several options were considered for the NCW site, including installation of water treatments systems on each of the impacted wells; drilling of new water supply wells on the property, and extending the public water supply from the City of New Carlisle to the site. All of the agencies agreed that extending the public water lines to the NCW site

from the existing city mains north of the site along State Rt. 235 was the most effective long-term option from a public health perspective.

The US EPA OSC submitted an Action Memo requesting the funding for the project which was approved by US EPA 5/26/05. Public water supply lines were extended along State Rt. 235 to the Nursery property between September 12, 2005 and October 14, 2005. Existing groundwater well connections were capped. Water lines were completed to the main building at the Nursery and to the two on-site residences. October 20, 2005 US EPA's contractors collected water samples from the formerly impacted locations to confirm that city water was being delivered to the faucets. Drinking water samples collected from the main office and the two residences had no detectable levels of VC or any of the other chemicals of concern (US EPA, 2005).

DISCUSSION OF THE ISSUES

Importance of a Completed Exposure Pathway

Area residents and workers must come into physical contact with the hazardous chemicals in the groundwater under the Nursery property in order for these chemicals to cause adverse health effects in these people. In order for residents and workers to come into contact with the site-related chemicals of concern (vinyl chloride and chloroethane), there must be a **completed exposure pathway** connecting these contaminants and the "exposed" population. A "*completed exposure pathway*" consists of **five main parts** that must be present for chemical exposure to occur. These include:

- A **Source** of the hazardous chemicals (=*the NCLF*);
- A method of **Environmental Transport** which allows the chemical(s) to move from the source area and bring it into contact with people (= *area groundwater):*
- A **Point of Exposure** where people come into direct contact with the chemical of concern (= *drinking water wells at the Nursery property*);
- A **Route of Exposure** which is how people come into contact with the chemical (=*drinking it, breathing it*); and
- A **Population at Risk** which are the people who are likely to come into physical contact with the chemical(s) (=*down-gradient residents using groundwater as their potable water supply*).

Exposure pathways can also be characterized as to when the exposure occurred or might have occurred 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 exposed population's health

is also controlled by a number of other factors that include:

- 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 exposure includes the individual's:

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

Toxicology of the Chemicals of Concern

Site-related chemicals of concern associated with the contaminated groundwater and water-supply wells at the NCLF, the Nursery facility, and along St. Rt. 235, consist primarily of the degradation or break-down products of chlorinated industrial solvents, likely TCA and TCE. These chemicals include chloroethane, the break-down product of 1,1,1 TCA, and vinyl chloride, the break-down product of TCE and/or PCE. Additional site-related compounds detected in area groundwater include other degradation products, including 1,1 dichloroethane (DCA) and 1,2 dichloroethene (DCE). All of these chemicals are volatile organic compounds (VOCs). These are organic compounds that, upon exposure to the air, readily vaporize to a gas.

Both of the chemicals of concern associated with the NCW site tend to be mobile in soils and are soluble in groundwater. The parent compounds for these chemicals tend to be denser than water and so sink down through the aquifer with time and distance from the source area. With increasing distance from the ground surface and decreasing oxygen levels in the groundwater, 1,1,1 TCA and TCE undergo biodegradation by bacteria. TCE breaks down to 1,2 DCE and vinyl chloride. TCA breaks down to 1,1 DCA, 1,1 DCE, and chloroethane (Vogel, Criddle, and McCarty, 1987).

Vinyl Chloride

Vinyl chloride is a man-made chemical, typically a sweet-smelling colorless gas, used in

the manufacture of polyvinyl chloride (PVC) products. As indicated above, it also forms as the result of the biological degradation of chlorinated solvents like PCE and TCE in groundwater under anaerobic (oxygen-poor) conditions that increase with depth below the ground surface (Smith and Dragun, 1984; Vogel and McCarty, 1985).

Vinyl chloride (VC) detected in the water supply wells at the Nursery property has its source in the groundwater contamination under the New Carlisle Landfill, roughly 1,000 feet up-gradient and north of the Nursery production wells (Ohio EPA, 2004). VC has been detected at trace levels at shallow depths at the landfill (1-2 ppb) with increasing concentrations detected in deeper depths (50-70 feet bgs) in down-gradient wells and *Geoprobe* samples at the north end of Nursery property (16-58 ppb).

Vinyl chloride is currently classified as a Class A carcinogen, a "known human cancer-causing agent" by US EPA and the US Department of Health & Human Services based on evidence from both human occupational health studies and animal laboratory studies (Agency for Toxic Substances and Disease Registry, 2004). Occupational studies of workers in the vinyl chloride industry in the 1970's (Creech and Johnson, 1974; Heath et al., 1975; Fox and Collier, 1977) demonstrated a link between *chronic occupational exposure to high levels of vinyl chloride in the air in an enclosed environment* (estimated vinyl chloride concentrations of *several thousand parts per million*) and the development of *hepatic angiosarcoma*, a rare and fatal form of liver cancer. Besides liver cancer, workers exposed to very high levels of vinyl chloride in the air on a regular basis also developed "vinyl chloride disease". Symptoms included liver abnormalities; the development of "acroosteolysis", a degenerative loss of bone from the tips of the fingers; plus the formation of skin lesions and nodules on the hands and forearms. Additional studies of workers in the vinyl chloride industry indicated less conclusively an association between exposures to high levels of vinyl chloride vapor and/or PVC dust and the development of cancers of the brain, lungs, and digestive tract (Wagoner et al. 1980; Wong et al., 1991)

In contrast to occupational studies of human exposures to vinyl chloride via the inhalation route, *no similar human epidemiological studies have indicated associations between drinking vinyl chloride-contaminated water and the development of cancers.* Similarly, no studies could be found linking oral exposure to vinyl chloride in humans with the development of neurological, developmental, reproductive, genotoxic, or dermal health effects (ATSDR, 2004). However, studies of laboratory rats fed large doses of vinyl chloride as PVC powder or via gavage led to statistically-significant increases in the incidence of hepatic angiosarcomas in these animals (Feron et al., 1981; Maltoni et al., 1981; Til et al., 1983).

Based on the evidence of carcinogenicity in animals after oral exposure, both the Department of Health & Human Services (2002) and the US EPA (1994), have considered it to be prudent public health practice to consider the potential for carcinogenic effects in humans by this route as well as via inhalation. US EPA's current weight-of-evidence characterization for vinyl chloride concludes that vinyl chloride is a *known human carcinogen by the inhalation route of exposure* based on human epidemiological studies and, by analogy, considered to be *carcinogenic by the oral route* based on positive animal bioassay data.

On this basis, US EPA established a public drinking water Maximum Contaminant Level Goal of zero for vinyl chloride in drinking water supplies. The actual Maximum Contaminant Level (MCL) for vinyl chloride has been established to be 2.0 parts vinyl chloride per billion parts of water (MCL = 2 ppb). This concentration has also been adopted as the numeric Removal Action Level (RAL) for vinyl chloride at federal Superfund sites with contaminated drinking water by US EPA (1997). The US EPA Drinking Water Equivalent Level (DWEL) for non-cancer health effects resulting from a lifetime of drinking water contaminated with vinyl chloride is 100 ppb. The US EPA One-Day and Ten-Day Health Advisories for children drinking water contaminated with vinyl chloride (=acute exposure scenario) are both at 3,000 ppb. The Agency for Toxic Substances and Disease Registry (ATSDR) has also developed Cancer Risk Evaluation Guide (CREG) numbers for specific carcinogens that calculate at what levels exposure to the chemical could result in additional cancer cases per million people (1×10^{-6} risk). The CREG value for vinyl chloride is 0.03 ppb in drinking water.

Chloroethane

Like VC, chloroethane (CA) is a man-made, colorless gas at room temperature. It has a sharp odor that can be detected in water at levels above 20 ppb. Under pressure, it can be a liquid that will readily vaporize upon exposure to the atmosphere. In the past it was used in the production of tetraethyl lead additives in gasoline and as a surgical anesthetic (ATSDR, 1998). Currently, it is used as a solvent and refrigerant as well as an intermediary in the production of dyes, drugs, and as a component of commercial household products, including paints, solvents, air fresheners, and deodorant sprays. It is also used as "numbing agent" in minor surgery. As indicated above, CA also occurs in groundwater as one of the end products of the anaerobic biodegradation of more complex chlorinated ethanes like the common solvent 1,1,1 trichloroethane (Vogel, Criddle, and McCarty, 1987).

Elevated levels of CA (up to 630 ppb) were detected in a number of shallow groundwater samples (12-16 feet deep) collected from the immediate vicinity of the New Carlisle Landfill and from *Geoprobe* samples (GW-12D) collected from groundwater at depths of 54-58 feet bgs at the northern edge of the Nursery property (up to 220 ppb) (Ohio EPA, 2004). Chloroethane was detected only at trace levels (0.9 ppb) in the former water supply "Former Public Well" on the Nursery property.
In contrast to VC, chloroethane is not very toxic, either acutely or chronically, to humans

or lab animals. There are limited epidemiological studies investigating the health effects from exposure to the compound. Adverse health effects associated with exposure to chloroethane are central nervous system effects (loss of consciousness, loss of muscular control, seizures) identified in people who intentionally abused (inhaled) high levels of CA or were exposed to it as an anesthetic during surgery (likely in the 1,000's of parts per million range in air). Similar CNS effects were observed in workers accidentally exposed to elevated levels of chloroethane in the workplace (ATSDR, 1998). Chloroethane is currently classified by the International Agency for Research on Cancer (IARC) as a Group 3 carcinogen – indicating there is no data available that exposure to CA causes cancer in humans or animals.

The Occupational Safety and Hygiene Agency (OSHA) has established an occupational exposure standard of no more than 1,000 parts per million CA in air in the work environment over an 8-hour period. There are no Maximum Contaminant Levels or other drinking water standards for CA in drinking water supplies.

Health Threat Posed by Drinking Water Contamination at Nursery Property

Non-Community Public Water Supply Wells

As indicated above, the main chemical contaminant of concern detected in groundwater and drinking water supply wells in the vicinity of the New Carlisle Landfill is the vinyl chloride in the Former Public Well and the New Public Well on the Nursery property. These wells functioned as non-community public water supply wells prior to 2002 (Former Public Well) and since 2003 (New Public Well). These wells provided potable water to the main office building at the site, servicing approximately 115 full-time and seasonal employees and, in the past, customers in the retail area and possibly an on-site residence as well (Ohio EPA, pers. comm., January, 2005). Vinyl chloride has been detected in the Former Public Well in excess of safe drinking water standards (MCL = 2 ppb VC) since 1997. VC levels in this well demonstrate an erratic but constant creep upward with time culminating in levels as high as 16 ppb in November, 2002 and 24 ppb in March, 2005 (Figure 2). Ohio EPA's Division of Drinking and Ground Water issued orders to the owners of the Nursery to cease the use of this well as a public water supply August 8, 2002. Since this time, use of this well has been limited to irrigation purposes.

A new public water supply well, located 750 feet to the south of the contaminated Former Public Well, was drilled deeper into the underlying sand and gravel aquifer (120 feet deep compared to 70 feet deep for the Former Public Well) and went into service August 29, 2003. Like the previous well, this well was designated as a non-community public water supply well by Ohio EPA and was subject to Ohio EPA regulations. Just like the former public supply well, this new well provided potable water to on-site workers and was not blended or mixed. The new well did not service retail traffic at the nursery nor the on-site residence. The nursery owners have indicated that the well water was used primarily for kitchen and restroom uses and not as a drinking water supply. Most employees are currently using bottled water for their drinking water.

Sampling of this well August 31, 2004, November 18, 2004, and March 11, 2005, resulted in VC levels of 1.9 ppb, 1.8 ppb, and 2.23 ppb, respectively (Ohio EPA, pers. comm., 2005).

These data indicate the presence of a *completed exposure pathway* in association with the contamination of the two non-community public water supply wells at the Nursery property. The likely source of the groundwater contamination is the New Carlisle Landfill to the north. Chlorinated solvents disposed of in the landfill have been biodegraded to vinyl chloride and chloroethane that has migrated down-gradient to the south as groundwater contaminants to production wells on the Nursery property. Residents, workers, and retail customers using the Former Public water supply well at the nursery as their drinking water supply during the period between 2000 and 2002 were likely exposed to levels of vinyl chloride at levels that exceeded federal drinking water standards for public water supplies (MCL = 2 ppb vinyl chloride). Exposure to VC could have come from both the ingestion and inhalation routes.

Retail customers at the nursery were only incidentally exposed to the VC in drinking water at the nursery and would likely not suffer any adverse health effects. Employees and residents using the well water as drinking water on a more regular basis during this time period would also not likely develop any adverse health effects from these exposures due to the low levels of VC in the water and the limited duration of the exposure. The VC levels in the well would not pose an acute, short-term health hazard to individuals drinking the well water.

As the levels of VC in the well water exceeded the US EPA MCL (MCL=2 ppb) and the ATSDR Cancer Risk Evaluation Guide (CREG = 0.03 ppb), exposure to VC in drinking water at the levels detected in the Former Public water supply well, over the course of a lifetime, could result in an increased potential for the development of liver cancers in these individuals. Uncertainties affecting this potential include whether or not these individuals drank the well water on a regular basis, what the levels of VC were in the water that they drank, how long they had been drinking the water from the impacted well, and the lack of scientifically-acceptable data with regard to human health effects from drinking low levels of VC (less than 20 ppb) associated with limited chronic exposures (likely less than five years duration).

Individuals previously obtaining their drinking water from the New Public water supply well at the Nursery also could have been exposed to low levels of VC via this drinking water supply. However, levels of VC in this well likely would have been too low and the duration of the exposure too short to result in adverse health effects. Continued use of this well as a drinking water supply, coupled with the likely increase in the concentrations of VC in the well water, could however, eventually pose a future public health hazard to on-site workers and residents living down-gradient to the nursery facility and using local groundwater as their drinking water supply.

On-Site Private Residential Wells

Private wells installed by the property owner provided potable water to individuals living in two on-site residences. These include a single elderly individual in the large residence on-site (RW 19) and a couple and their three children in the rental house across the driveway to the north (RW 18). As indicated in Table 2, RW 19 had previously been found to contain no VC in the well water and only trace levels (< 1 ppb) of 1,2 DCE and TCE in December, 2004. March 11, 2005 samples had VC at similar levels. RW 18 was sampled for VOCs in March, 2005 and April, 2005. Levels of VC ranged from just below the federal drinking water standard in March (1.94 ppb) to about half that number in April (1.09 ppb).

On-site residents could be exposed to the contaminants of concern through both the drinking water and inhalation routes. Inhalation of VC could occur during showering or turning on the spigots in the kitchen or bathroom sinks. However, neither the very low levels of VC detected in the water in these wells nor the short duration of potential exposure to this chemical suggest that drinking water from these two wells posed a significant health threat to individuals living in these homes in past. HAS is concerned that if the current contaminant plume continues to migrate southward towards several off-site residential wells, that the opportunities for additional area residents to be exposed to increased levels of vinyl chloride in these drinking water wells would likely increase. This could potentially lead to adverse health effects in these residents depending on the concentrations of VC and the duration of these exposures (years to decades).

Effects of the US EPA Time-Critical Removal Action

Extension of the public water lines to the Nursery property and hooking up the main office building and the two on-site residences to the city water supply as part of the US EPA Removal Action effectively eliminated exposure of on-site workers and residents to vinyl chloride in their drinking water supply. Provision of city water to the Nursery property insures that these residents will not be exposed to vinyl chloride through their drinking water supply in the future as well. Concerns still exist with regard to the potential for down-gradient off-site residents obtaining their drinking water from private wells to be exposed to vinyl chloride through contamination of their well water in the future.

CHILDRENS HEALTH CONCERNS

ATSDR and HAS consider children in the assessment of all sites that pose a potential or real public health hazard. ATSDR and HAS use public health guidelines that are specifically developed to be protective of children. As indicated above, children are at a greater risk of developing adverse health effects from exposures to elevated lead levels in their environment than are adults. As such, the potential threat to the health of area children has been considered in this health consultation.

CONCLUSIONS

In the past, employees, on-site residents, and retail customers were likely exposed to low levels of vinyl chloride in drinking water supplied by the "Former Public Well" at the Nursery complex just south of New Carlisle, in Clark County, Ohio. These levels of vinyl chloride in drinking water likely did not pose an acute health threat to these individuals, but for the last several years have exceeded US EPA Maximum Contaminant Levels for vinyl chloride in public water supplies.

Due to uncertainties as to (1) the levels of VC in drinking water that these people were exposed to, (2) how long they may have been drinking contaminated water, (3) questions as to whether or not the well water was used as drinking water by the bulk of the employees at the facility, and (4) the toxicity of low levels of vinyl chloride in the course of short term exposures (several years) through the drinking water route, this contamination is deemed to have posed an *Indeterminate Public Health Hazard* to site employees and residents in the past.

With the connection of the main office area and the two on-site residences to the City of New Carlisle public water supply as part of the US EPA Removal Action, exposure to vinyl chloride from on-site drinking water supplies ceased. The NCW site *currently* poses *No Public Health Hazard* to workers and residents at the Nursery property. The groundwater contamination at the NCW site will likely pose *No Public Health Hazard* to on-site workers and residents *in the future* as well.

Investigations by Ohio EPA (2004 and in progress) have detected increasing levels of vinyl chloride in the vicinity of the NCW site and identified the New Carlisle Landfill as the source of this groundwater contamination. Barring any interventions to reduce, contain, or eliminate the on-going groundwater contamination in the area, this groundwater contamination could potentially impact additional down-gradient residents using groundwater as their primary drinking water supply, posing a *Public Health Hazard* to these off-site residents *in the future* depending on the extent and duration their exposure to this contaminant plume .

RECOMMENDATIONS (Made prior to the US EPA Removal Action)

- Provide an alternative, safe drinking water supply to on-site employees and residents and/or water treatment systems on impacted public drinking water wells to mitigate or eliminate exposure to vinyl chloride through the drinking water pathway.

- Sample down-gradient residential drinking water supply wells in the immediate vicinity of the New Carlisle Landfill site and the Nursery facility along US Rt 235, south-southwest of New Carlisle, to insure that these wells do not become contaminated with vinyl chloride at levels that might pose a public health hazard to these residents.

- Continue additional investigations of the groundwater contamination in the area in order to determine the source of and full extent of the groundwater contamination in the area.

- Develop and implement remedial actions to contain, reduce, or eliminate groundwater contamination in the impacted area, based on site-specific information.

PUBLIC HEALTH ACTION PLAN

The following actions have been taken or are on-going to reduce or eliminate the public health threat posed by the vinyl chloride contamination of area drinking water supplies:

1) Following successive quarters where vinyl chloride levels exceeded the federal MCL for public drinking water supplies, Ohio EPA's Division of Drinking and Groundwater in 2002 issued orders that the "Former Public Well" at the Nursery no longer be used as a potable water supply and limited future use to irrigation only. A new potable water supply drilled by the nursery owners went into service in 2003.

2) Continued sampling of the "New Public Well" by Ohio EPA resulted in detections of vinyl chloride in this new water supply well starting in August, 2004. Recent sampling (March and April, 2005) resulted in detection of VC at levels exceeding federal drinking water standards. This well no longer is used to provide drinking water to on-site workers or residents.

3) As part of a larger, on-going investigation of groundwater contamination in the general vicinity of the former New Carlisle Landfill site (NCLF) by Ohio EPA, additional public water supply and residential wells have been sampled on the Nursery property and along State Rt. 235 (Dayton- Lakeview Road) immediately east and south of the site (Ohio EPA, 2002-2005). This investigation has indicated that the groundwater contaminant plume generating from the NCLF site is currently affecting only wells on the

Nursery property**.**

4) Two newly-installed residential wells on the Nursery property were recently sampled by Ohio EPA and US EPA (March-April, 2005) and found to be contaminated with levels of vinyl chloride below the federal drinking water standard. Use of these wells as drinking water supplies was discontinued.

5) January 4, 2005, Ohio EPA officially requested that US EPA consider the Nursery property for a "Time-Critical Removal Action" to mitigate the exposure of workers and residents to vinyl chloride in their drinking water supply.

6) US EPA proposed (April 27, 2005) two possible Removal Action alternatives to the owner of the Nursery property. These included the provision of individual water treatment systems for the affected public water supply well and two on-site residential wells or connecting the Nursery property to the City of New Carlisle public water supply. The owner, with the support of the agencies, selected the extension of the public water supply to the Nursery property and the provision of hook-ups to the main office building and the two residences.

7) As part of the US EPA Time-Critical Removal Action, US EPA contractors, working with the City of New Carlisle and the Division of Drinking and Ground Water at Ohio EPA, extended the City of New Carlisle water main along State Rt. 235 south to the Nursery property and connected the main office and on-site residences to the public water supply September 12-October 20, 2005.

8) Ohio EPA is continuing to investigate the New Carlisle Landfill site, the likely source of the groundwater pollution.

9) HAS will continue to review and evaluate additional environmental sampling data to insure that workers and residents in the area are not being exposed to toxic chemicals at levels of public health concern.

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CERTIFICATION

This Health Consultation for the New Carlisle Well Site was prepared by the Ohio Department of Health under cooperative agreement with the Agency for Toxic Substances and Disease Registry. It is in accordance with approved methodology and procedures existing at the time the exposure investigation report was begun. Editorial Service was completed by Cooperative Agreement Partner.

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

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TABLE 1.
Historical sample results for the "New Public Well",
New Carlisle Well Site, New Carlisle, Ohio

Date of Sample	Sampled by	Vinyl chloride (ppb)	US EPA MCL/RAL Vinyl chloride (ppb)
October 8, 2003	Ohio EPA	<0.5	2
November 19, 2003	Ohio EPA	<0.5	2
August 31, 2004	Ohio EPA	1.9	2
November 18, 2004	Ohio EPA	1.8	2
January 3, 2005	US EPA	0.9	2
March 11, 2005	Ohio EPA	2.23	2
April 18, 2005	US EPA	2.11	2

ppb = Parts per billion
MCL = Maximum Contaminant Level (Drinking Water Standard) for Public Water supplies (in ppb)
RAL = US EPA Removal Action Level for groundwater at Superfund sites (ppb)

TABLE 2.
Sampling results (ppb) for on-site production wells and nearby residential wells, New Carlisle Well Site, New Carlisle, Ohio

Date of Sample	Former Public Well	Migrant Camp Well (RW-10)	RW-14 (off-site)	RW-18 (on-site rental)	RW-19 (on-site residence)
Nov 2002	VC = 16; CA = 0.9	ND	NS	NS	NS
Feb 2004	VC = 16	NS	NS	NS	NS
Dec 2004	NS	NS	DCE= 0.16 TCE = 0.17	NS	DCE = 0.16 TCE = 0.17
Mar 2005	VC=24.3	NS	ND	VC = 1.94	VC = 0.45
Apr 2005	NS	NS	NS	VC = 1.09	VC < 0.5

ppb = Parts per billion
NS = Well not sampled
ND = No chemicals of concern detected
VC = Vinyl chloride
CA = Chloroethane
DCE = cis 1,2 Dichloroethene
TCE = Trichloroethylene

FIGURES

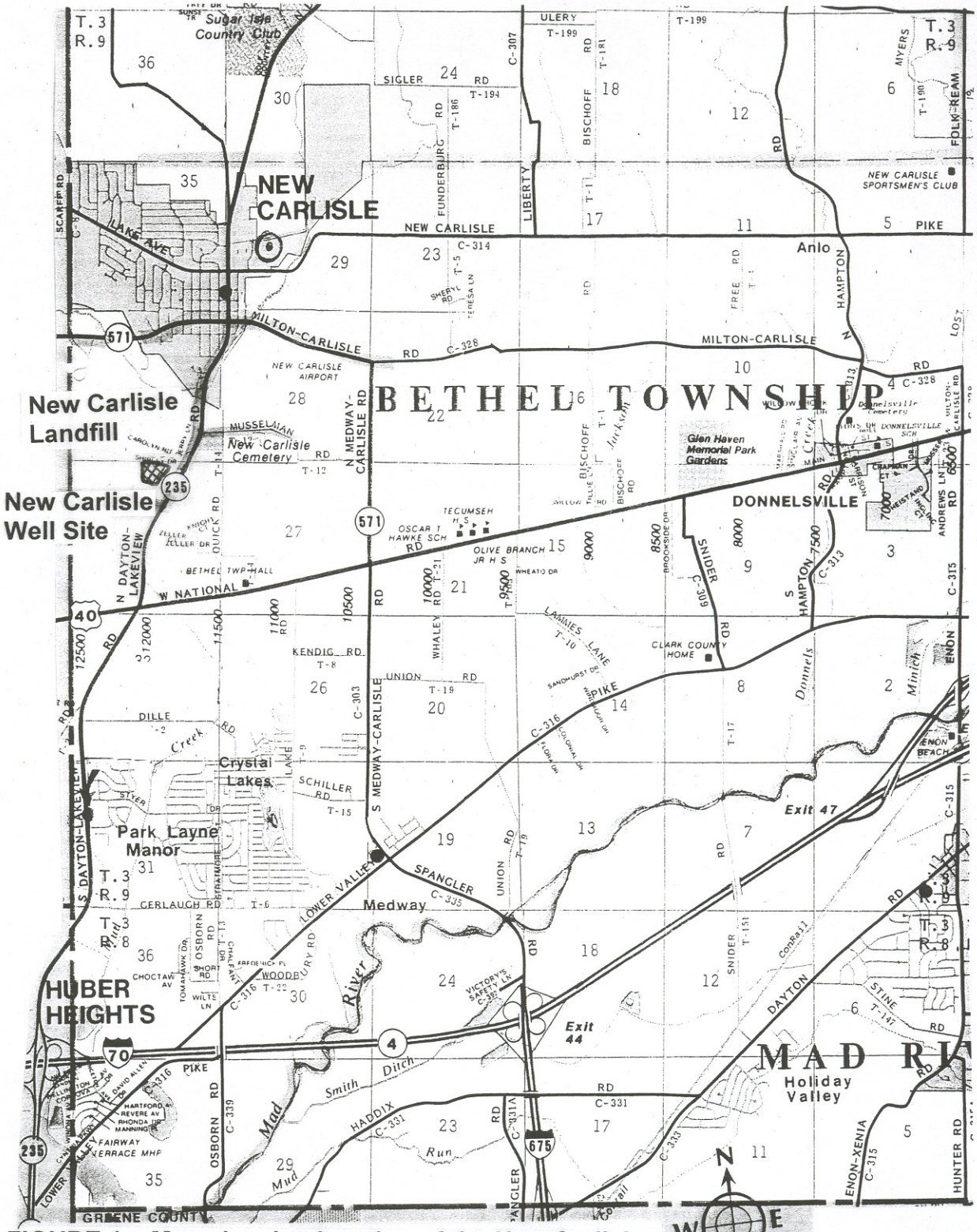

FIGURE 1. Map showing location of the New Carlisle Landfill and the New Carlisle Well Site Bethel Township, Clark County, Ohio

Scale: One inch equals approximately one mile.