ATSDR
AGENCY FOR TOXIC SUBSTANCES AND DISEASE REGISTRY

Public Health Assessment for

W. R. GRACE SUPERFUND SITE
ACTON, MIDDLESEX COUNTY, MASSACHUSETTS
CERCLIS NO: MAD001002252
APRIL 5, 2011

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

THE ATSDR PUBLIC HEALTH ASSESSMENT: A NOTE OF EXPLANATION

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

In addition, this document has previously been provided to EPA and the affected states in an initial release, as required by CERCLA section 104 (i)(6)(H) for their information and review. The revised document was released for a 30-day public comment period. Subsequent to the public comment period, ATSDR addressed all public comments and revised or appended the document as appropriate. The public health assessment has now been reissued. This concludes the public health assessment process for this site, unless additional information is obtained by ATSDR which, in the agency's opinion, indicates a need to revise or append the conclusions previously issued.

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PUBLIC HEALTH ASSESSMENT

W. R. GRACE SUPERFUND SITE

ACTON, MIDDLESEX COUNTY, MASSACHUSETTS

CERCLIS NO: MAD001002252

Prepared by:

Agency for Toxic Substances and Disease Registry
Division of Regional Operations

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List of Acronyms

ATSDR	Agency for Toxic Substances and Disease Registry
AWD	Acton Water District
CAEPA	California Environmental Protection Agency
CAP	Community Assessment Program
CEL	Cancer Effect Level
COC	contaminant of concern
CNS	central nervous system
CREG	cancer risk evaluation guide
CSF	cancer slope factor
CVs	comparison values
DHHS	Department of Health and Human Services
EMEG	environmental media evaluation guide
HOD	Health Outcome Data
IARC	International Agency of Research on Cancer
IRIS	integrated risk information system
LOAEL	lowest observed adverse effect level
MCL	maximum contaminant level
MDPH	Massachusetts Department of Public Health
MIBK	methyl isobutyl ketone (also known as 4-methyl-2-pentanone)
mg/kg/day	milligrams per kilogram per day
mg/L	milligrams per liter
mg/m^3	micrograms per cubic meter
MRL	minimal risk level
NAS	National Academy of Sciences
NOAEL	no observed adverse effect level
NPL	National Priority List
PAH	polycyclic aromatic hydrocarbon
PCB	polychlorinated biphenyl
PHA	public health assessment
ppb	parts per billion

RBC	risk-based concentration
RfD	reference dose
RI	Remedial Investigation
RMEG	reference dose media evaluation guide
SDWA	Safe Drinking Water Act
SVOC	semi-volatile organic compound
TEF	toxicity equivalent factor
μg/L	micrograms per liter
USEPA	United States Environmental Protection Agency
VOC	volatile organic compound
WHO	World Health Organization

Summary

The Massachusetts Department of Public Health (MDPH), Bureau of Environmental Health Assessment under cooperative agreement with the Agency for Toxic Substances and Disease Registry (ATSDR) previously evaluated the public health significance of environmental contamination at the W.R. Grace and Company, Inc., Acton, Massachusetts site in an initial release public health assessment dated November 4, 1992. Subsequent to that evaluation, the U.S. Environmental Protection Agency (USEPA) and the W.R. Grace and Company remediated portions of the site and conducted additional sampling. Because of the changing site conditions and the availability of additional environmental data, the USEPA contacted ATSDR in 2003 and requested that the new environmental data (defined as data available through August 5, 2004*) be reviewed and evaluated. Recent communications with USEPA indicate that data collected since August 5, 2004 shows no changes in site conditions or contaminant levels.

In 1978 the Acton Water District (AWD) detected Volatile Organic Compounds (VOCs) in two of its municipal wells (Assabet One and Two), and as a result the AWD closed the two wells. According to the AWD, Assabet One was brought back online with carbon filtration for a few months in 1982. When testing indicated low levels of trichloroacetic acid† (TCA) were "breaking through" the carbon filters, they took this well offline again. In 1983 Assabet One was brought back online with both air stripping and carbon filtration technology in place. By March 1984, Assabet Two had also been brought back online with this same treatment. At some later date the AWD stopped using carbon filtration at these wells, but it continues to use an air stripper to remove VOCs from the water. In September 1983 the W.R. Grace site was added to the National Priorities List (NPL). Since that time the affected municipal supply wells, associated groundwater plume, and other portions of the site have become the subject of ongoing investigations by the USEPA and the W.R. Grace and Company, Inc.

ATSDR reviewed the available data and information for the W.R. Grace site through August 5, 2004, and identified one completed exposure pathway and four potential exposure pathways. The completed pathway is exposure to contaminants from the municipal drinking water supply and the potential pathways of exposure are private well water, surface water, sediment, and vapor intrusion. In addition, ATSDR evaluated the potential for exposure to site related contaminants through fish consumption and considers this pathway to be incomplete.

Persons who were supplied water by the AWD's Assabet One and Two wells between 1970 and 1978‡ may have previously drank, bathed, and showered with groundwater contaminated with VOCs. There is very limited data for this time period and there is no information regarding quality control and quality assurance (QA/QC) practices for the available data set. However, in an effort to address community concern regarding past exposure to drinking water contaminants in these wells, ATSDR did evaluate the available historical data. *ATSDR concludes that past levels of VOCs in the Assabet wells pose an indeterminate public health hazard because of the*

* This PHA evaluates data provided to ATSDR through August 5, 2004. Requests for evaluation of new data should be directed to ATSDR's Division of Health Assessment and Consultation. ATSDR and the MDPH Cooperative Agreement Program will determine the best course of action for evaluation of additional data sets.

† Trichloroacetic acid (TCA) is considered a breakdown product of trichloroethylene (TCE)

‡The time period from when the wells were opened until the time contamination was discovered and the wells were closed.

data limitations and gaps. Levels of trichloroethylene (TCE) may have exceeded current health guidelines, but because of the short duration of exposure (about 9 years) and the relatively low levels compared to those associated with potential effects in health studies, it is unlikely that adverse health effects have occurred.

Presently the municipal drinking water wells affected by VOC contamination are treated through an air stripping process to remove the VOCs. Recent sampling has indicated no VOC contamination (due to the treatment process); however, it has indicated the presence of arsenic and manganese. Based on the concentrations reported for the wells and toxicological evaluations, adverse health effects are not expected to occur. *Therefore, ATSDR considers current exposure to VOCs, arsenic, and manganese in the municipal drinking water supply to be a no apparent public health hazard.*

Seven non-municipal wells have been identified in the vicinity of the W.R. Grace site: four private irrigation wells; two private production wells for contact cooling water and one non-community public water supply at a sports arena. Of the six non-municipal wells used for non-drinking water purposes: one well contained elevated levels of vinyl chloride and was converted to a monitoring well; four wells indicated no VOC contamination present; and one well was not sampled because it was sealed and properly closed at the request of the property owner. The non-community public water supply well at the sports arena is classified as a transient non-community (TNC) public water system by the MDPH. This well was sampled in May 2002 and again in July 2006. No VOCs were detected. ATSDR conducted toxicological evaluations of the VOC concentrations from the non-municipal well, now used for monitoring, and determined adverse health effects are not expected to occur. *Therefore, ATSDR concludes that exposure to groundwater from private wells for non-drinking water uses poses no apparent public health hazard and that the TNC water supply well poses no public health hazard.*

Trespassers who access the W.R. Grace site may have been exposed in the past, may be presently exposed, or may be exposed in the future to contaminants in surface water. However, based on the concentrations reported in surface water and toxicological evaluations, adverse health effects are not expected to occur. *Therefore, ATSDR concludes that occasional exposure to surface water poses no apparent public health hazard.*

Trespassers who access the W.R. Grace site may also have been exposed in the past, may be presently exposed, or may be exposed in the future to contaminants in soil and sediment. Based on the concentrations reported in sediment and toxicological evaluations, exposure to arsenic indicates elevated risk for trespassers. ATSDR's evaluation of potential health effects from exposure to contaminants in sediment incorporated conservative assumptions for health effects, which may have resulted in an over estimation of potential exposure to individuals. ATSDR considered adolescents to be the most likely age group to access the site and based its assumptions on this age group. *ATSDR concludes that exposure to the highest levels of arsenic in sediment at the W.R. Grace site may pose a public health hazard to adolescents via dermal contact and ingestion. However, adolescents should not be trespassing on the site or accessing the areas with elevated levels of arsenic as often as estimated by ATSDR§. There is a moderate elevated theoretical excess lifetime cancer risk for adults, if they routinely trespass on the site*

§ (24 visits per year), see Appendix C for details regarding exposure assumptions.

and come into contact with contaminated sediment. The site is partially fenced, but trespassers can gain access. The site is posted "No Trespassing".

ATSDR also considered possible exposure to contaminants from the volatilization of VOCs from groundwater into buildings near the site. *Based on modeled concentrations of contaminants from the volatilization of VOCs into buildings, ATSDR concludes that no adverse health effects are expected to occur. Therefore, the vapor intrusion pathway is classified as posing no apparent public health hazard.*

ATSDR considered the consumption of fish from Sinking Pond. Based on information provided to ATSDR, edible size fish from Sinking Pond could not be caught after several attempts. Because edible size fish could not be caught for evaluation, it is unlikely that persons accessing the W.R. Grace site are catching and consuming fish on a regular basis. Therefore, *ATSDR presently considers fish consumption from Sinking Pond to be a no apparent public health hazard.* However, if future conditions change at Sinking Pond, and fish of edible size can be caught and consumed by anglers, then a reassessment of this pathway may be warranted.

Based on its evaluation of completed and potential exposure pathways ATSDR recommends: (1) continued periodic monitoring of the municipal drinking water wells used by the Acton Water District to ensure that the air strippers are adequately removing VOC contamination and that the municipal drinking water supply meets all the requirements of the Safe Drinking Water Act; (2) that USEPA and the W.R. Grace and Company address areas of the site with elevated levels of arsenic and manganese (i.e., Sinking Pond, North Lagoon Wetland) in soil and sediment in a manner that would be protective of public health; (3) that the private irrigation and production wells in the vicinity of the W.R. Grace site that are used for non-drinking water purposes be monitored periodically by W.R. Grace to determine whether levels of contaminants are of public health significance; (4) that the Massachusetts Department of Environmental Protection periodically monitor the TNC water supply well at the sports arena in a manner that is protective of public health and, (5) that no new private wells be installed in the vicinity of the contaminated groundwater plume near the W.R. Grace site.

Purpose and Health Issues

The W.R. Grace Site was listed on the U.S. Environmental Protection Agency's National Priorities List for Uncontrolled Hazardous Waste Sites (NPL) on September 8, 1983. As mandated by Congress, the Agency for Toxic Substances and Disease Registry (ATSDR) has prepared this public health assessment for the W.R. Grace Site. The data available for this site have been reviewed and summarized in this document. The purpose of this public health assessment (PHA) is to evaluate and present information pertaining to whether exposures to site-related contaminants could have occurred in the past, are presently occurring, or may occur in the future, and whether health effects could result from these exposures, based on available data. In addition, ATSDR will make recommendations or identify actions needed to minimize exposure to contaminants, as warranted. This document has been drafted in accordance with the ATSDR Public Health Assessment Guidance Manual [2].

Background

Site Description and History

The W.R. Grace site** is located in the towns of Acton and Concord, Massachusetts, off of Independence Road, and covers approximately 260 acres. The site is bounded in the north by Fort Pond Brook and to the east and south by the Assabet River. The site was the former location of the American Cyanamid Company and the Dewey & Almy Chemical Company. These companies produced sealant products for rubber containers, latex products, plasticizers, resins, and other products. Operations at the W.R.Grace facility included the production of materials used to make concrete, container sealing compounds, latex products, and paper and plastic battery separators. Effluent wastes from these operations flowed into several unlined lagoons (the primary lagoon, secondary lagoon, north lagoon, and emergency lagoon), and solid and hazardous wastes were buried in or placed onto an on-site industrial landfill and several other disposal areas. These other waste sites include battery separator lagoons, the battery separator chip pile, the boiler lagoon, and the tank car area. In addition, the by-products of some chemical processes were disposed of in the blowdown pit. Since 1973, residents in south Acton have filed complaints about periodic odors and irritants in the air around the W.R. Grace plant. Investigations in 1978 indicated that two municipal wells, Assabet One and Assabet Two, were contaminated. As a result of these findings, the Acton Water District (AWD) took precautionary action and closed the two wells. The AWD currently operates and maintains air strippers to remove any VOCs that may be present in groundwater pumped from Assabet One, Assabet Two, Scribner, Lawsbrook, and Christofferson town wells. The AWD routinely samples and treats the water they provide to users to assure that safe quality standards are met. Discharge to all lagoons and the battery separator area ceased in 1980. Operable Unit-1 for the site, which included soil remediation, was completed in 1997.

** The term "site" in this document generally refers to all of the areas affected by contamination in the vicinity of the W.R. Grace property. As noted in the text, the W.R. Grace property consists of approximately 260 acres, however the area of contamination (specifically the groundwater plume) extends beyond the actual boundary of the W.R. Grace property.

Demographics

According to U.S. Census 2000 data, approximately 8,307 people reside within a one mile radius of the W.R. Grace Site. The majority of this population is white or Caucasian. However, the data reports that there are also approximately 66 blacks, 10 American Indian or Alaska Natives, and 552 Asians in this one mile radius. The residents in the vicinity include 874 children aged 6 and younger, and 933 adults aged 65 and older. More detailed demographic information is presented in Appendix B, Figure 1.

Land Use and Natural Resources

Industrial parks border the site to the south and residential housing borders the site to the northeast. The U.S. Census 2000 data indicates approximately 3,161 housing units within a one mile radius of the site.

Sinking Pond, located in the center of the W.R. Grace property, is the only natural water body on the property (Figure 2). Recreational use of the pond is unlikely since it appears that the pond does not support aquatic life and lacks aesthetic quality for swimming. The Assabet River which borders the site on the east and south is used for boating and fishing, but is not actively used for swimming. Fort Pond Brook borders the site on the north. It has been reported by the community that recreational uses of Fort Pond Brook include fishing, canoeing, and kayaking. The Massachusetts Department of Fish and Game stocks Fort Pond Brook with trout every spring.

The W.R. Grace site overlies the Sinking Pond Aquifer[††]. The AWD has six current wells‡‡ that draw water from the aquifer for the municipal water supply. Two wells, Assabet One and Assabet Two were closed in 1978 after monitoring by the Acton Water District detected levels of VOCs in the wells. There are no private wells on the W.R. Grace property; however, seven non-municipal wells have been identified within 500 feet of the plume.

Currently the W.R. Grace site is partially fenced to restrict some access. Some areas are posted with "No Trespassing" signs (Figure 6). A former guard station at the main gate is no longer staffed (Figure 4). Trespassers access the site to dirt bike, hike or horse back ride (Figure 7). Evidence of other activity on the site included domestic trash and campfire remnants. The area supports a variety of trees, shrubs, wild flowers, and wildlife. It has been reported in the past that children do access the site for play and recreation.

Discussion of Environmental Contamination

Evaluation Process

The process by which ATSDR evaluates the possible health impact of contaminants is summarized in the following section and described in more detail in Appendix C. There are two steps in the evaluation process. The first step involves screening the available data to determine the contaminants of concern (COCs) for each media. As part of the ATSDR screening process,

†† An aquifer is a geological formation that contains water of sufficient quantities to be tapped by wells.
‡‡ The Acton Water District has proposed the opening of a new municipal well at the site in the same location as an historic well, known as WRG-3, used by WR Grace Company in its former industrial processes. The AWD is currently going through the DEP permitting process for this well it refers to as "Assabet 3" and has already performed a pump test in pursuit of a new municipal drinking water permit.

maximum detected concentrations of contaminants are compared with Comparison Values (CVs) to determine which chemicals, if any, require additional evaluation. CVs are concentrations of chemicals in the environment, below which no adverse health effects are expected to occur. In the event that a contaminant concentration exceeds its respective CV, it does not necessarily indicate that health effects are expected to occur. Rather, it is indicated that further evaluation of the particular contaminant and the ways in which individuals might be exposed to it is necessary. It should also be noted that other contaminants may be evaluated further if concerns are received from the community regarding the presence of the particular contaminant(s).

During the second step of the evaluation process, several important factors are considered in order to determine whether chemicals and exposure situations could be a public health hazard. These factors include the sampling locations and data quality, specific exposure routes (ingestion, inhalation, or direct skin contact), contaminant concentration, exposure frequency, exposure duration, toxicity information, human susceptibility, and community health concerns. Therefore, the second step involves the calculation of child and adult exposure doses for the identified COCs, which incorporate site-specific (if available) information on these important factors. Exposure doses are estimated amounts of a contaminant that individuals come in contact with as a result of specific exposure situations. As part of its evaluation ATSDR considers chemical exposures that may result in cancer, as well as non-cancer health impacts.

The calculated, site-specific exposure doses are then compared with safe doses (also referred to as health guidelines), which indicate levels below which non-cancer health effects are unlikely to occur due to exposure. The health guidelines are health-protective values that have incorporated various safety factors to account for varying human susceptibility and the use of animal data to evaluate human exposure. In the event that the calculated, site-specific exposure dose for a chemical is greater than the established health guideline, it is then compared to the exposure doses from individual studies documented in the scientific literature that have reported health effects. Toxicological Profiles, prepared by ATSDR for various chemicals, are the primary source of the scientific literature that are utilized in this part of the evaluation process. Toxicological information derived by USEPA is also considered. If a COC has been determined to be cancer-causing (carcinogenic), a theoretical cancer risk is also estimated.

A detailed discussion of ATSDR's evaluation process is presented in Appendix C.

Pathways of Human Exposure

ATSDR evaluates exposure pathways that might result in human exposure to contaminants at a site. ATSDR considers a human exposure pathway to consist of five principal elements: (1) a source of contamination, (2) transport through an environmental medium, (3) a point of exposure, (4) a route of human exposure, and (5) a receptor population. If all five elements of an exposure pathway exist currently or did exist in the past, the pathway is considered complete. If one element or more is missing or if exposure is possible but not likely to occur, the pathway is considered a potential pathway of exposure.

ATSDR evaluated possible exposure pathways for the W.R. Grace site using mainly environmental data available through August 2004. A large portion of the data reviewed came from the 2002-2004 Remedial Investigation and Ecological and Public Health Risk Assessment documents produced under the guidance of EPA and from the limited historical data that was available from the Draft 1992 Public Health Assessment written by MDPH under cooperative agreement with ATSDR. The completed and potential exposure pathways are discussed in the following paragraphs, and a summary of the information is provided in Appendix A, Tables 1 and 2.

A review of the environmental data and site conditions indicates one completed and four potential exposure pathways by which people could be or could have been exposed to contaminants from the site. Exposure to contaminants in public water supply wells is a completed pathway. Exposure to contaminants in non-municipal wells, surface water, sediment, and vapor intrusion are potential exposure pathways. The implications of exposure to public health via these pathways are discussed in the following section.

ATSDR also considered exposure to contaminants through consumption of fish. ATSDR considers this pathway to be incomplete, because edible size fish could not be obtained after a considerable effort and no subsistence fish-consuming population was identified.

Public Water Supply, Private Well, and Groundwater Sampling

As part of a Remedial Investigation (RI) for Operable Unit 3[§§] (groundwater) and ongoing annual groundwater monitoring programs, W.R. Grace has collected groundwater samples from six non-municipal wells, five municipal water supply wells (Assabet 1, Assabet 2, Christofferson, Lawsbrook and Scribner), and over 100 monitoring wells. Two non-municipal wells are located north of the W.R. Grace site, and five are located south of the site. The School Street wellfield, which includes the Christofferson, Lawsbrook, and Scribner public water supply wells, is located north of the site. The Assabet wellfield, which includes Assabet One and Assabet Two public water supply wells, is located south of the site (Figure 3). Groundwater monitoring wells are located throughout and around the perimeter of the site.

There are no private wells on the W.R. Grace property; however seven non-municipal wells have been identified within 500 feet of the plume. A non-community public water supply well supplies drinking water, ice resurfacing, and bathing water for an area sports arena. Three wells are used as private irrigation wells and one is a private commercial irrigation well. Two others serve as production wells for non contact cooling water on a commercial property. On May 6, 2002, W.R. Grace collected samples from five of these wells and analyzed each sample for VOCs. Four of the non-municipal wells are located south of the site and beyond the horizontal extent of groundwater contamination. No contaminants were found in these four wells during the May 6, 2002 sampling. Two of the non-municipal wells are located north of the W.R. Grace site, within the horizontal extent of the VOC groundwater contamination plume from the site. One non-municipal private well was abandoned and properly closed, as requested by the property owner. The other of these wells contained vinyl chloride (0.35 parts per billion [ppb]) above its CV of 0.03. This well was converted to a monitoring well by W.R. Grace.

W.R. Grace has conducted several rounds of public water supply and groundwater monitoring well sampling. As part of the RI, groundwater sampling at the W.R. Grace site was conducted between August 2000 and June 2002. During this period, W.R. Grace collected samples from the public water supply wells, 25 transect[***] locations beneath the Assabet River, 22 transect

§§ Term for each of a number of separate activities undertaken as part of a Superfund site cleanup.
*** A sample area, usually in the form of a long continuous strip.

locations beneath Fort Pond Brook, and 10 transect locations adjacent to Fort Pond Brook. Samples were analyzed for VOCs, semi-volatile organic compounds (SVOCs), and metals [28]. Additional sampling under the site's annual monitoring program was conducted between October 14, 2002, and November 12, 2002. W.R. Grace collected samples, which were analyzed for VOCs, from public water supply wells and 101 monitoring wells [29]. A draft human health risk assessment also reports results from annual groundwater monitoring conducted in 1999, 2000, and 2001, as well as thallium sampling results from fall 2002 [36]. Arsenic and manganese were found above their CVs in public water supply wells. Groundwater monitoring wells contained 12 VOCs, 3 SVOCs, and 13 metals above CVs.

Surface Water and Sediment Sampling

W.R. Grace conducted surface water and sediment sampling to assess site contamination and to support a human health and baseline ecological risk assessment. Sinking Pond and Gravel Pit Wetland samples are combined because these areas are proximate to each other. Fort Pond Brook and North Lagoon samples are combined because these two areas are hydraulically connected.

In 2002, W.R. Grace collected surface water samples from the Assabet River, Sinking Pond, Gravel Pit Wetland, Fort Pond Brook, and North Lagoon as part of a screening-level ecological risk assessment. The sampling results are summarized in a draft human health risk assessment [36]. W.R. Grace collected additional surface water samples from Sinking Pond in August, September, and December 2002. The eight samples collected from two sampling stations were analyzed for dissolved metals. Three dry weather samples were collected at Fort Pond Brook on August 12, 2002, and analyzed for VOCs, SVOCs, and total and dissolved metals. Three wet weather samples were collected on October 23, 2002, and analyzed for total and dissolved chromium and hexavalent chromium [34]. In April 2003, additional surface water samples were collected from Sinking Pond (two sample locations) and North Lagoon (two sample locations). Sinking Pond samples were analyzed for total and dissolved metals; North Lagoon samples were analyzed for VOCs, SVOCs, and total and dissolved metals [35]. Only arsenic was found above CVs in the Assabet River [Table 7]. Sinking Pond and the Gravel Pit Wetland contained antimony, arsenic, and manganese above CVs [Table 7]. Phenanthrene, a non-carcinogenic polycyclic aromatic hydrocarbon (PAH) which has no CV, was also detected at less than 1 ppb (below the CVs for other non-carcinogenic PAHs). Fort Pond Brook and North Lagoon contained bis(2-ethylhexyl)phthalate, arsenic, and manganese above CVs and phenanthrene below 1 ppb [Table 7].

In 2002, W.R. Grace collected sediment samples from the Assabet River, Sinking Pond, Gravel Pit Wetland, Fort Pond Brook, and North Lagoon as part of a screening-level ecological risk assessment. The sampling results were summarized in a draft human health risk assessment [36]. W.R. Grace conducted additional sediment sampling in Sinking Pond, Fort Pond Brook, and the North Lagoon Wetland from August 12 to 15, 2002. Twelve samples from Sinking Pond were collected and analyzed for SVOCs, pesticides, polychlorinated biphenyls (PCBs), and metals. Three samples were collected from Fort Pond Brook and analyzed for VOCs, SVOCs, and metals. Six samples from North Lagoon Wetland were collected and analyzed for metals [34]. On April 28 and 29, 2004, W.R. Grace collected sediment samples from Sinking Pond (six samples), Gravel Pit Wetland (six samples), Fort Pond Brook (two samples), and North Lagoon (nine samples). These samples were analyzed for VOCs, SVOCs, pesticides, PCBs, and/or inorganics [35]. Benzo(a)pyrene, arsenic, and thallium were found above CVs in the Assabet

River [Table 8]. Acenaphthene, benzo(g,h,i)perylene, and phenanthrene (three PAHs without CVs) were also detected at concentrations below 1 part per million (ppm) (below the CVs for other non-carcinogenic PAHs). Sinking Pond and Gravel Pit Wetland contained benzo[a]pyrene, two PCBs, arsenic, iron, and manganese above CVs, as well as acenaphthene, benzo[g,h,i]perylene, and phenanthrene at concentrations below 1 ppm [Table 8]. Fort Pond Brook and North Lagoon contained three PAHs, arsenic, chromium, copper, iron, and manganese above CVs, as well as four PAHs, which have no CVs, at concentrations near or below 1 ppm [Table 8].

Fish Sampling

On September 24, 2002, W.R. Grace attempted to collect fish, using gill net and rod and reel methods, from Sinking Pond to support a baseline ecological risk assessment. Gill nets were set and checked once and then again 24 hours later. Rods and reels were set with earthworms, lures, and corn. No fish were caught in Sinking Pond using either method. Therefore, another effort to collect fish using baited minnow traps was completed on October 23, 2002. Common shiner minnows were collected and analyzed for SVOCs, pesticides, PCBs, and metals [34]. Dieldrin, arsenic and iron were detected slightly above their CVs in minnow samples from Sinking Pond [Table 9]. There is no CV for lead, however the detected level is below the World Health Organization guideline of 0.3 ug/g (ppm) for lead in fish.

Completed Exposure Pathways

Public Water Supply Wells

As previously discussed, arsenic and manganese were found above their CVs in public water supply wells; therefore, ATSDR calculated site specific exposure doses and compared them to health guidelines (Appendix C).

Arsenic

ATSDR calculated oral exposure doses using the maximum concentration of arsenic, 0.0052 milligrams per liter (mg/L), found in the public water supply wells. The estimated exposure doses for adults and children are 0.00015 mg/kg/day and 0.00033 mg/kg/day, respectively. The estimated dose for adults is below the health guideline while the estimated dose for children is slightly above the established health guideline of 0.0003 mg/kg/day. The health guideline is the USEPA's Reference Dose (RfD), which is based on a human study that indicated hyperpigmentation[†††], hyperkeratosis[‡‡‡], and possible vascular complications in a chronically exposed population in Taiwan. While the estimated dose for a child slightly exceeds the ATSDR health guideline, it is well below the dose that would result from ingesting water with an arsenic level at the USEPA MCL of 0.010 mg/L. *Adverse effects are unlikely at these doses.*

Several studies have shown that inorganic arsenic can increase the risk of lung cancer, skin cancer, bladder cancer, liver cancer, kidney cancer, and prostate cancer. The World Health Organization (WHO), the Department of Health and Human Services (DHHS), and the USEPA have determined that inorganic arsenic is a human carcinogen [4]. The USEPA has calculated a

††† Hyperpigmentation is a common, usually harmless condition in which patches of skin become darker in color than the normal surrounding skin.

‡‡‡ Hyperkeratosis is an excessive thickening of the outer layer of the skin.

cancer unit risk factor, which can be used to estimate the probability of theoretical excess cancer risk for a lifetime of exposure to arsenic. ATSDR calculated a theoretical excess lifetime cancer risk of 2.23E-05 for ingestion based on the maximum concentration (0.0052 mg/L) of arsenic in the public supply wells, indicating a low theoretical excess lifetime cancer risk. ATSDR also calculated a theoretical excess lifetime cancer risk for dermal exposure to the maximum concentration of arsenic in the public supply wells of 6.07E-07, indicating an insignificant theoretical excess lifetime cancer risk. In addition, ATSDR compared the calculated adult oral exposure dose to the Cancer Effect Level (CEL) in its Toxicological Profile for arsenic and found that it was more than 500 times lower than the CEL (0.038 mg/kg/day). *Therefore, it is unlikely that there is a significant increased risk of cancer due to ingestion of or dermal contact with arsenic in public water supply wells.*

Manganese

ATSDR calculated oral exposure doses using the maximum concentration of manganese, 0.52 mg/L, found in the public water supply wells. The estimated exposure doses for adults and children are 0.01486 mg/kg/day and 0.03250 mg/kg/day, respectively. The estimated dose for adults and children is below the established health guideline of 0.05 mg/kg/day. The health guideline is the USEPA's RfD, which is based on a human study that indicated central nervous system effects based on chronic ingestion. *Because the calculated exposure doses are below health guidelines, and because conservative assumptions were made in calculating doses, it is unlikely that adverse effects would be observed at these doses.*

Manganese is an essential trace mineral in human nutrition. Manganese is not classifiable as to human carcinogenicity. Existing studies are inadequate to determine its carcinogenicity.

Public Water Supply Wells, Historical Data, VOCs

In the 1992 Initial Release Public Health Assessment [45], prepared by the MDPH, there is some historical data reported on Volatile Organic Compounds (VOCs) [Table 5]. This data is very limited, and there is no Quality Assurance or Quality Control (QA/QC) information on this data. ATSDR believes this data to be of limited value for determining public health conclusions for past exposure. In most cases there is only one data point per year for the VOCs listed. In the case of benzene, there is only one data point for the years 1978 through 1992. The duration of exposure to these contaminants in drinking water wells could not be determined. Routine monitoring did not occur in these wells after they were opened in 1970, so there is no way to determine when the wells were contaminated. The contamination was detected in 1978 as part of a monitoring conducted for an application for expansion of operations at the W.R. Grace site [45]. After the contamination was discovered in 1978 the wells were closed. For the purpose of this evaluation, we assumed that the maximum duration of exposure was nine years, the length of time the wells were open (1970 to 1978). In addition, the water from these wells was mixed with water from other wells prior to distribution to homes, so it is highly unlikely that any home would have received the maximum reported contaminant concentration at the well from their tap.

Even though the data is limited, ATSDR has incorporated it in this assessment to answer community questions and concerns regarding past exposures. ATSDR has reviewed and calculated non-carcinogenic and carcinogenic risk for these VOCs, where possible. First, ATSDR compared the maximum concentrations for ethylbenzene, 1,1 dichloroethylene, benzene, 1,1,1 trichloroethane, trichloroethylene (TCE), methylene chloride, and 1,1 dichloroethane to its comparison values (CVs). The maximum concentrations of ethylbenzene, and 1,1,1 trichloroethane were below ATSDR's CVs and were therefore not evaluated further.

The following contaminants were reported at levels above their CVs in the historical public water supply well data. Therefore, ATSDR calculated site specific exposure doses and compared them to health guidelines. During the public comment period the Acton Water District provided another data set to ATSDR, which indicated the presence of vinyl chloride in the Assabet wells. This data set, like the previous one is very limited, and there is no QA/QC information. However, because there was information indicating vinyl chloride exceeded an ATSDR CV it was evaluated and added to this section.

Benzene

ATSDR calculated exposure doses using the maximum concentration of benzene, 0.0021 mg/L, found in the Assabet wells. The estimated exposure doses for adults and children are 0.00009 mg/kg/day and 0.00026 mg/kg/day, respectively. The estimated dose for adults and children is below the established health guideline of 0.004 mg/kg/day. The health guideline is the USEPA's Reference Dose (RfD), which is based on a human study that indicated a decreased lymphocyte count in an inhalation occupational study by Rothman, et al., 1996. The oral RfD is based on route to route extrapolation modeling of the results of benchmark dose modeling. *Because the calculated doses are well below the health guideline, and because conservative assumptions were made in calculating doses, it is unlikely that adverse effects would be observed at these doses.*

Benzene can cause cancer of the blood-forming organs. The DHHS has determined that benzene is a known human carcinogen. Long-term exposure to relatively high levels of benzene in the air can cause cancer of the blood-forming organs. This condition is called leukemia. The health effects that might occur in humans following long-term exposure to food and water contaminated with benzene are not as well known. In animals, exposure to food or water contaminated with benzene can damage the blood and immune system and can even cause cancer. Under the proposed revised Carcinogen Risk Assessment Guidelines (U.S. EPA, 1996), benzene is characterized as a known human carcinogen for all routes of exposure based upon convincing human evidence as well as supporting evidence from animal studies [5].

ATSDR calculated a theoretical excess lifetime cancer risk of 4.75E-06 based on the maximum concentration (0.0021 mg/L) of benzene in the Assabet wells, indicating a slight increased theoretical cancer risk. In addition, ATSDR compared the calculated adult oral exposure dose to the Cancer Effect Level (CEL) in its Toxicological Profile for benzene and found that it was thousands of times lower than the CEL (50 mg/kg/day) [5]. *Therefore, it is unlikely that there is a significant increased risk of cancer due to ingestion of benzene from the Assabet wells in the past.*

Methylene Chloride

ATSDR calculated exposure doses using the maximum concentration of methylene chloride, 0.046 mg/L, found in the Assabet wells. The estimated exposure doses for adults and children are 0.00197 mg/kg/day and 0.00575 mg/kg/day, respectively. The estimated dose for adults and children is below the established health guideline of 0.06 mg/kg/day. The health guideline is the USEPA's Reference Dose (RfD), which is based on a study of male and female rats that caused liver toxicity. *Because the calculated doses are well below the health guideline, and because conservative assumptions were made in calculating doses, it is unlikely that adverse effects would be observed at these doses.*

The Department of Health and Human Services (DHHS) has determined that methylene chloride may reasonably be anticipated to be a carcinogen. The International Agency for Research on Cancer (IARC) has classified methylene chloride in Group 2B, possibly carcinogenic to humans. The EPA has determined that methylene chloride is a probable human carcinogen [13].

ATSDR calculated an excess lifetime theoretical cancer risk of 1.42E-05 based on the maximum concentration (0.046 mg/L) of methylene chloride in the Assabet wells, indicating a low increased theoretical cancer risk. In addition, ATSDR compared the calculated adult oral exposure dose to the CEL in its Toxicological Profile for methylene chloride and found that it was thousands of times lower than the CEL (320 mg/kg/day) [13]. *Therefore, it is unlikely that there is a significant increased risk of cancer due to ingestion of methylene chloride from the Assabet wells in the past.*

Trichloroethylene (TCE)

ATSDR calculated exposure doses using the maximum concentration of TCE, 0.008 mg/L, found in the Assabet wells. The estimated exposure doses for adults and children are 0.00034 mg/kg/day and 0.00100 mg/kg/day, respectively. The estimated dose for adults and children slightly exceeds the established health guideline of 0.0003 mg/kg/day. The health guideline is the USEPA's Reference Dose (RfD), from the Region 9, Preliminary Remediation Guide Table [51]. ATSDR also compared the estimated exposure doses for adults and children with the LOAEL in the ATSDR Toxicological Profile for TCE and found that the estimated exposure doses were thousands of times lower than the LOAEL (250 mg/kg/day). The LOAEL is based on a study of rats exposed orally to TCE for 5 days per week for 52 weeks. *The available data indicates adverse health effects are not likely based on exposure to TCE in drinking water at this site.*

It is uncertain whether people who breathe or drink water containing TCE are at higher risk of cancer, or of having reproductive effects. Several studies suggest that more birth defects may occur when mothers drink water containing TCE. In one study, people who used water for several years from two wells that had high levels of TCE may have had a higher incidence of childhood leukemia than other people, but these findings are not conclusive [18]. In another study of TCE exposure from well water, increased numbers of children were reported to be born with heart defects, which is supported by data from some animal studies showing developmental effects of TCE on the heart. However, other chemicals were also in the water from this well and may have caused or contributed to these effects. One study reported a higher number of children with a rare defect in the respiratory system and eye defects. Another study reported that the risk for neural tube defects and oral cleft palates were higher among mothers with TCE in their water during pregnancy. Children listed in the National Exposure Subregistry of persons exposed to TCE were reported to have higher rates of hearing and speech impairment. There are many questions regarding these reports. There were small numbers of children with defects and TCE levels at which the effects occurred were not defined well. Thus, it is not possible to make firm conclusions about the exact effects of TCE from these studies, and more studies need to be done [18].

We do not have any clear evidence that TCE alone in drinking water can cause leukemia or any other type of cancer in humans. As part of the National Exposure Subregistry, ATSDR compiled data on 4,280 residents of three states (Michigan, Illinois, and Indiana) who had environmental exposure to TCE. It found no definitive evidence for an excess of cancers from TCE exposure. An increase of respiratory cancer was noted in older men, but this effect was thought to result from smoking rather than TCE exposure. A study in New Jersey found an association between leukemia in women and exposure to TCE in drinking water. A study in Massachusetts found that exposure was associated with leukemia in children. In studies with people, there are many factors that are poorly characterized or are unknown. More studies need to be done to establish the relationship between exposure to TCE and cancer [18].

In studies using high doses of TCE in rats and mice, tumors in the lungs, liver, and testes were found, providing some evidence that high doses of TCE can cause cancer in experimental animals. Based on the limited data in humans regarding TCE exposure and cancer, and evidence that high doses of TCE can cause cancer in animals, the IARC has determined that TCE is probably carcinogenic to humans. TCE has been nominated for listing in the National Toxicology Program (NTP) 9^{th} Report on Carcinogens. Evaluation of this substance by the NTP review committee is ongoing [18].

The EPA has withdrawn its Cancer Slope Factor (CSF) for TCE and a new one has not been adopted. ATSDR reviewed current literature on TCE and found that the California (CA) EPA has developed a CSF that is fairly commonly used in assessing excess lifetime theoretical cancer risk [26]. ATSDR calculated its excess lifetime theoretical cancer risk for TCE in this assessment using the withdrawn EPA CSF and the CA EPA CSF. ATSDR calculated an excess lifetime theoretical cancer risk of 5.26E-06 and 4.27E-06 based on the maximum concentration (0.008 mg/L) of TCE in the Assabet wells, indicating that there is a very low to insignificant increased theoretical cancer risk based on the assumptions and CSF's used. ATSDR also compared the calculated adult oral exposure dose to the CEL in its Toxicological Profile for TCE and found that it was thousands of times lower than the CEL (1,000 mg/kg/day) [18]. *Based on the former EPA CSF and the CA EPA CSF, there is a very low to insignificant increased risk of cancer due to ingestion of TCE from the Assabet wells in the past.*

1,1, dichloroethane

ATSDR calculated exposure doses using the maximum concentration of 1,1 dichloroethane, 0.028 mg/L, found in the Assabet wells. The estimated exposure doses for adults and children are 0.00120 mg/kg/day and 0.00350 mg/kg/day, respectively. The estimated dose for adults and children is below the established health guideline of 0.10 mg/kg/day. The health guideline is the USEPA's Reference Dose (RfD), from the EPA Region III Risk-Based Concentration Table. *Because the calculated doses are well below the health guideline, and because conservative assumptions were made in calculating doses, it is unlikely that adverse effects would be observed at these doses.*

The DHHS, the IARC, and the EPA have not classified 1,1 dichloroethane for carcinogenicity [8]. There is no cancer slope factor available for 1,1, dichloroethane, therefore an excess lifetime theoretical cancer risk could not be calculated.

1,1, dichlorethene (a.k.a. 1,1, dichloroethylene or vinylidene chloride or VDC)

ATSDR calculated exposure doses using the maximum concentration of 1,1 dichloroethene, 0.055 mg/L, found in the Assabet wells. The estimated exposure doses for adults and children are 0.00236 mg/kg/day and 0.00688 mg/kg/day, respectively. The estimated dose for adults and children is below the established health guideline of 0.009 mg/kg/day. The health guideline is ATSDR's Chronic Minimal Risk Level [9]. *Because the calculated doses are well below the health guideline, and because conservative assumptions were made in calculating doses, it is unlikely that adverse effects would be observed at these doses.*

The DHHS has not classified 1,1-dichloroethene with respect to carcinogenicity. The IARC has determined that 1,1-dichloroethene is not classifiable as to its carcinogenicity in humans, however the EPA has determined that 1,1-dichloroethene is a possible human carcinogen. NTP does not include it in its list of substances expected to be human carcinogens [9]. There is no cancer slope factor available for 1,1 dichloroethene; therefore, an excess lifetime theoretical cancer risk could not be calculated.

Vinyl chloride

ATSDR calculated exposure doses using the maximum concentration of vinyl chloride, 0.00034 mg/L, found in the Assabet wells. The estimated exposure doses for adults and children are 0.00015 mg/kg/day and 0.00043 mg/kg/day, respectively. The estimated dose for adults and children is below the established health guideline of 0.003 mg/kg/day, which is ATSDR's Chronic MRL and USEPA's Reference Dose. *Because the calculated doses are well below the health guideline, and because conservative assumptions were made in calculating doses, it is unlikely that adverse effects would be observed at these doses.*

The DHHS has determined that vinyl chloride is a known carcinogen [19]. ATSDR calculated an excess lifetime theoretical cancer risk of 1.96E-04 based on the maximum concentration (0.0034 mg/L) of vinyl chloride in the Assabet wells, *indicating a low increased theoretical cancer risk.*

Potential Exposure Pathways

Non-Municipal Wells

Seven non-municipal wells near the W.R. Grace site were identified (four private irrigation wells, two private production wells for contact cooling water and one non-community public water supply). The non-community public supply well was sampled in July 2006 (by the Massachusetts Department of Environmental Protection) and no VOC contamination was found. One non-municipal private well was abandoned and properly closed, as requested by the property owner. The remaining wells were sampled for VOC contamination by W.R. Grace. One of these wells was later converted to a monitoring well by W.R. Grace. Out of all the sampled wells, one contained vinyl chloride above its CV. The well containing vinyl chloride is not used for drinking water purposes, so ATSDR developed a health protective exposure scenario based on dermal contact and incidental ingestion. Inhalation of VOCs was considered; however, volatilization and dilution with outdoor air make this pathway insignificant.

Vinyl chloride

ATSDR calculated exposure doses for incidental ingestion and dermal contact using the maximum concentration of vinyl chloride, 0.00035 mg/L, found in the one private well. The estimated incidental ingestion doses for adults and children are 0.0000005 mg/kg/day and 0.000002 mg/kg/day, respectively. The estimated dose for adults and children are below the established health guideline of 0.00002 mg/kg/day. The health guideline is ATSDR's chronic Minimal Risk Level (MRL), which is based upon areas of cellular alteration in the livers of rats [19]. *Because the calculated doses are below the MRL, and because conservative assumptions were made in calculating doses, it is unlikely that adverse effects would be observed due to incidental ingestion of vinyl chloride in private well water.* ATSDR estimated dermal contact exposure doses for adults and children to vinyl chloride of 0.0000002 mg/kg/day and 0.0000001 mg/kg/day respectively. However, no studies regarding low dose, long term vinyl chloride absorption in humans were found for comparison. Animal data suggest that dermal absorption of vinyl chloride is not likely to be significant. *Because of the very low doses, exposure via dermal contact is unlikely to contribute to adverse health effects.*

Based on evidence from human epidemiological studies, vinyl chloride is considered carcinogenic to humans by the DHHS, the IARC, and the USEPA [19]. The USEPA has calculated a cancer unit risk factor, which can be used to estimate the probability of excess cancer risk for a lifetime of exposure to vinyl chloride. ATSDR calculated an excess lifetime theoretical cancer risk of 9.63E-08 from incidental ingestion and dermal contact based on the maximum concentration (0.00035 mg/L) of vinyl chloride. *Generally, an increased risk below 1.00E -06 is not considered significant; therefore, it is unlikely that there is a significant increased risk of cancer from vinyl chloride due to incidental ingestion and dermal contact with private well water.*

Surface Water

Surface water samples were collected and analyzed from the Assabet River, Sinking Pond, Gravel Pit Wetland, Fort Pond Brook, and North Lagoon. Arsenic, phenanthrene, antimony, manganese, and bis(2-ethylhexyl)phthalate were found above CVs, so ATSDR developed an exposure scenario based on dermal contact and incidental ingestion of contaminants in surface water.

Arsenic

ATSDR calculated incidental ingestion exposure doses using the maximum concentration of arsenic, 0.02705 mg/L, found in surface water. The estimated exposure doses for adults and children are 0.00000265 mg/kg/day and 0.00001159 mg/kg/day, respectively. The estimated doses for adults and children are below the established health guideline of 0.0003 mg/kg/day. The health guideline is the USEPA's RfD, which is based on a human study that indicated hyperpigmentation, hyperkeratosis, and possible vascular complications in a chronically exposed population in Taiwan. *Because the calculated doses are below health guidelines, and because conservative assumptions were made in calculating doses, it is unlikely that adverse effects from arsenic would be observed from incidental ingestion of surface water.* ATSDR calculated an exposure dose of 0.000481 mg/kg/day for an adult and 0.000834 mg/kg/day for a child for dermal contact to arsenic in surface water. The estimated dose for adults and children is thousands of times below the LOAEL (6.0 mg/kg/day) for dermal effects in ATSDR's arsenic

Toxicological Profile [4]. This LOAEL is based on a mouse study that caused hyperplasia§§§ and ulceration after 30 weeks of exposure. *Because the calculated doses are thousands of times below the LOAEL, and because conservative assumptions were made in calculating doses, it is unlikely that adverse effects from arsenic would be observed from dermal contact with surface water.*

Several studies have shown that inorganic arsenic can increase the risk of lung cancer, skin cancer, bladder cancer, liver cancer, kidney cancer, and prostate cancer. The WHO, the DHHS, and the USEPA have determined that inorganic arsenic is a human carcinogen [4]. The USEPA has calculated a cancer unit risk factor, which can be used to estimate the probability of excess theoretical cancer risk for a lifetime of exposure to arsenic. ATSDR calculated an excess lifetime theoretical cancer risk for an adult of 6.92E-03 for incidental ingestion and dermal contact using the maximum concentration (0.02705 mg/L) of arsenic in surface water. *This indicates a low to moderate increased risk for an adult. Even though these calculations indicate a moderate increased theoretical cancer risk the assumptions are very conservative and most likely overestimate actual exposure.*

Phenanthrene (PAH)

ATSDR calculated an incidental ingestion exposure dose using the maximum concentration of phenanthrene, 0.000014 mg/L, found in surface water. The estimated exposure dose for adults and children are 0.000000001 mg/kg/day and 0.000000006 mg/kg/day, respectively. The estimated doses for adults and children are thousands of times lower than the intermediate LOAEL for animals in ATSDR's Toxicological Profile for polycyclic aromatic hydrocarbons (PAHs) (125 mg/kg/day) [15]. This LOAEL is based on a mouse study that caused increased liver weight after 6 months of exposure. *Because the calculated doses are thousands of times below the LOAEL, and because conservative assumptions were made in calculating doses, it is unlikely that adverse effects from phenanthrene would be observed from incidental ingestion of surface water.* ATSDR calculated an exposure dose of 0.00000007 mg/kg/day for an adult and 0.00000012 mg/g/day for a child for dermal contact to phenanthrene in surface water. The estimated dose is thousands of times below the NOAEL (0.09 mg/kg/day) for dermal effects in ATSDR's PAH Toxicological Profile [15]. This NOAEL is based on a mouse study that caused skin tumors. *Because the calculated doses are thousands of times below the NOAEL, and because conservative assumptions were made in calculating doses, it is unlikely that adverse effects from phenanthrene would be observed from dermal contact with surface water.*

Presently, a quantitative risk estimate has only been developed for benzo(a)pyrene. It is a known animal carcinogen and considered a probable human carcinogen by the IARC and the USEPA [15]. The USEPA has calculated a cancer unit risk factor for benzo(a)pyrene which ATSDR used to estimate the probability of excess cancer risk for a lifetime of exposure. Because there is no cancer unit risk factor for the other PAHs, USEPA and others developed toxicity equivalent factors (TEFs), based on relative potency to benzo(a)pyrene, to estimate carcinogenic risk [15]. ATSDR calculated an excess lifetime theoretical cancer risk for phenanthrene based on incidental ingestion and dermal contact with phenanthrene in surface water. This estimate indicates a 5.02E-10 increased theoretical cancer risk. ATSDR also compared the total estimated incidental ingestion and dermal contact dose to the CEL in its Toxicological Profile for PAHs

§§§ The term *hyperplasia* refers to overgrowth of tissue due to an abnormal increase in the number of cells in the tissue.

and found that it was thousands of times lower than the CEL (0.57 mg/kg/day) [15]. *Therefore, it is unlikely that there is a significant increased risk of cancer from phenanthrene exposure to surface water.*

Antimony

ATSDR calculated incidental ingestion exposure doses using the maximum concentration of antimony, 0.02705 mg/L, found in surface water. The estimated exposure doses for adults and children are 0.00000265 mg/kg/day and 0.0000116 mg/kg/day respectively. The estimated dose for adolescents and children is below the established health guideline of 0.0004 mg/kg/day. The health guideline is the USEPA's RfD, which is based on a rat study that affected longevity, blood glucose, and cholesterol. *Because the calculated doses are more than thirty times lower than the RfD, and because conservative assumptions were made in calculating doses, it is unlikely that adverse effects would be observed.*

Antimony is not classifiable as to human carcinogenicity. Existing studies are inadequate to determine its carcinogenicity [3].

Manganese

Manganese is a trace element and eating a small amount from food or water is needed to stay healthy. At high levels, it can cause damage to the brain. ATSDR calculated an incidental ingestion dose using the maximum concentration of manganese, 4.8 mg/L, found in surface water. The estimated exposure doses for adults and children are 0.000470 mg/kg/day and 0.00206 mg/kg/day, respectively. The estimated dose for adults and children is below the established health guideline of 0.05 mg/kg/day (USEPA IRIS). The health guideline is the USEPA's RfD, which is based on a human study that indicated central nervous system effects based on chronic ingestion [12]. *Because the calculated exposure doses are below the RfD, and because conservative assumptions were made in calculating doses, it is unlikely that adverse effects would be observed at these doses.*

Manganese is not classifiable as to human carcinogenicity. Existing studies are inadequate to determine its carcinogenicity [12].

Bis(2-ethylhexyl)phthalate (a.k.a. Di(2-ethylhexyl)phthalate)

ATSDR calculated an incidental ingestion dose using the maximum concentration of bis(2-ethylhexyl)phthalate, 0.017 mg/L, found in surface water. The estimated exposure doses for adults and children are 0.00000166 mg/kg/day and 0.00000729 mg/kg/day, respectively. The estimated dose for adults and children is below the established health guideline of 0.02 mg/kg/day [48]. *Because the calculated exposure doses are thousands of times below the RfD, and because conservative assumptions were made in calculating doses, it is unlikely that adverse effects would be observed.*

The USEPA considers bis(2-ethylhexyl)phthalate to be carcinogenic; however, it is not classified by DHHS or IARC [11]. The USEPA has calculated a cancer unit risk factor, which can be used to estimate the probability of excess cancer risk for a lifetime of exposure to bis(2-ethylhexyl)phthalate. ATSDR calculated an excess lifetime theoretical cancer risk for incidental ingestion and dermal contact with surface water of 4.25E-06, using the maximum concentration (0.017 mg/L) of bis(2-ethylhexyl)phthalate in surface water, indicating a very low increased theoretical cancer risk . *Therefore, it is unlikely that there is a significant increased risk of cancer from bis(2-ethylhexyl)phthalate.*

Sediment

Arsenic

ATSDR calculated exposure doses for incidental ingestion and dermal contact using the maximum concentration of arsenic from the North Lagoon Wetland, 3900 mg/kg, found in sediment. ATSDR considered adolescents to be the most likely age group to access/ trespass on the site in these areas and based its exposure assumptions on this population. The estimated doses for incidental ingestion and dermal contact for adolescents are 0.0009 mg/kg/day and 0.00006 mg/kg/day, respectively. The estimated incidental ingestion dose for an adolescent slightly exceeds the established health guideline of 0.0003 mg/kg/day. The health guideline is the USEPA's RfD, which is based on a human study that indicated hyperpigmentation, hyperkeratosis, and possible vascular complications in a chronically exposed population in Taiwan. *The estimated incidental ingestion dose for an adolescent does slightly exceed the RfD; however, very conservative assumptions (i.e., exposure frequency and duration) were made in calculating doses, and it is not likely that adolescents or others would ingest sediment with the highest concentrations as often as ATSDR has estimated.*

Several studies have shown that inorganic arsenic can increase the risk of lung cancer, skin cancer, bladder cancer, liver cancer, kidney cancer, and prostate cancer. The WHO, the DHHS, and the USEPA have determined that inorganic arsenic is a human carcinogen [4]. The USEPA has calculated a cancer unit risk factor, which can be used to estimate the probability of excess cancer risk for a lifetime of exposure to arsenic. ATSDR calculated an excess lifetime theoretical cancer risk for an adult of 5.73E-04 for incidental ingestion and dermal exposure using the maximum concentration of arsenic in sediment (3900 mg/kg). *This indicates a low to moderate increased risk for an adult. Even though these calculations indicate an increased theoretical cancer risk the assumptions are very conservative (see appendix C) and most likely overestimate actual exposure, because adults are unlikely to trespass on the site and contact sediment as frequently as ATSDR estimated.*

Chromium

Chromium (III) found in the environment is an essential nutrient. Chromium (VI) at high levels can damage the nose and cause cancer. For conservatism, ATSDR assumed exposures were to the more toxic chromium (VI). ATSDR calculated an incidental ingestion exposure dose using the maximum concentration of chromium, 223 mg/kg, found in sediment. The estimated exposure dose for an adolescent is 0.00005 mg/kg/day. The estimated dose is below the established health guideline of 0.003 mg/kg/day. The health guideline is the USEPA's RfD, which is based on a one year study of rats that ingested drinking water containing between 0.45 and 11.2 ppm hexavalent chromium. ATSDR also compared the estimated exposure dose to the chronic oral LOAEL of 0.57 mg/kg/day in its Toxicological Profile for chromium [6]. The estimated dose is greater than 2,000 times below the LOAEL. *Because the calculated exposure dose is below the RfD and the LOAEL, and because conservative assumptions were made in calculating doses, it is unlikely that adverse effects would be observed.* ATSDR calculated an exposure dose of 0.00011 mg/kg/day for an adolescent for dermal contact to chromium in sediment. The estimated dose for an adolescent is approximately 40 times below the LOAEL

(0.004 mg/kg/day) for dermal effects in ATSDR's chromium Toxicological Profile [6]. This LOAEL is based on a human study that caused nasal septum ulceration, possible gastritis, and ulcers after an average exposure of seven and a half years. *Because the calculated doses are below the LOAEL, and because conservative assumptions were made in calculating doses, it is unlikely that adverse effects from chromium would be observed from dermal contact with sediment.*

Several studies have shown that chromium(VI) compounds can increase the risk of lung cancer and some animal studies have also shown an increased risk of cancer. The USEPA has determined that chromium(VI) in air is a human carcinogen, however carcinogenicity by the oral route of exposure cannot be determined and is classified as Group D [6]. There is no cancer slope factor for chromium, therefore an excess lifetime cancer risk could not be calculated.

Copper

ATSDR calculated an incidental ingestion exposure dose for copper using the maximum concentration, 6,000 mg/kg, found in sediment. ATSDR calculated an adolescent exposure dose of 0.00137 mg/kg/day. This exposure dose is well below the chronic LOAEL of 0.056 mg/kg/day listed in ATSDR's Toxicological Profile for copper [7]. *ATSDR also compared the calculated exposure doses to the recommended dietary allowances and found that they were below levels that might be expected to cause adverse health effects* [42]. According to the National Academy of Sciences (NAS), an occasional intake of up to 10 mg/day is probably safe for human adults. ATSDR calculated an exposure dose for adolescents for dermal contact with sediment; however, no studies were located regarding the rate and extent of absorption following dermal exposure of humans and animals to copper.

Copper is not classifiable as to human carcinogenicity [7].

Iron

ATSDR calculated an incidental ingestion exposure dose for iron using the maximum concentration, 390,000 mg/kg, found in sediment. ATSDR calculated an adolescent exposure dose of 0.089 mg/kg/day (or 6.23 mg/day). ATSDR has no Toxicological Profile or CV for iron, so ATSDR compared the estimated exposure doses to dietary intake levels published by the NAS. Adverse health effects are unlikely in a healthy person at daily intake levels between 25 and 75 mg/day according to the NAS [42]. *Therefore, it is unlikely that adverse health effects would be observed at these doses.* No human or animal studies were found regarding dermal exposure to iron.

Iron is not considered to be carcinogenic to humans or animals.

Manganese

ATSDR calculated an incidental ingestion dose for adolescents using the maximum concentration of manganese found in sediment from the North Lagoon Wetland (48,400 mg/kg). The estimated exposure dose for adolescents is 0.011 mg/kg/day. The estimated dose for adolescents is below the established health guideline of 0.05 mg/kg/day (USEPA IRIS). The health guideline is the USEPA's RfD, which is based on a human study that indicated central nervous system effects based on chronic ingestion. ATSDR also compared the total estimated exposure doses for adolescents to the chronic oral LOAEL in its Toxicological Profile for manganese [12]. This LOAEL (0.059 mg/kg/day) is based on a human study that indicated mild neurological signs. *The incidental ingestion exposure dose for adolescents is below the RfD and the LOAEL; therefore, it is unlikely that adverse health effects will occur, because conservative assumptions were made in calculating doses.* No studies were located regarding tissue distribution of manganese to use for comparison.

As previously cited, manganese is not classifiable as to human carcinogenicity. Existing studies are inadequate to determine its carcinogenicity [12].

Methyl Isobutyl Ketone (MIBK) a.k.a. 4-methyl-2-pentanone

ATSDR calculated an incidental ingestion dose for adolescents using the maximum concentration of MIBK found in sediment (0.0056 mg/kg). The estimated exposure dose for an adolescent is 0.000000001 mg/kg/day. The estimated dose for adolescents is below the health guideline of 0.08 mg/kg/day. The health guideline is a former USEPA Reference Dose (RfD). This oral RfD for MIBK was withdrawn in 1991. The health effects data for MIBK were reviewed by USEPA at that time and determined to be inadequate for derivation of an oral RfD. *Because the calculated doses are below the former RfD, and because conservative assumptions were made in calculating doses, it is unlikely that adverse effects from MIBK would be observed from dermal contact with sediment.* No human or animal studies were found regarding dermal exposure to MIBK.

Data are inadequate to determine the carcinogenicity of MIBK. No data were located regarding the existence of an association between cancer and MIBK exposure in humans, but studies of the in vivo[****] and in vitro[††††] genotoxicity of MIBK overwhelmingly provided negative responses [48].

Polycyclic Aromatic Hydrocarbons (PAHs)
[Acenaphthylene, Benzo(a)pyrene, Benzo(b)fluoranthene, Benzo(g,h,i)perylene, Dibenz(a,h)anthracene, Phenanthrene]

ATSDR calculated an incidental ingestion dose using the maximum concentration of acenaphthylene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(g,h,i)perylene, dibenz(a,h)anthracene, and phenanthrene found in sediment. The estimated total exposure dose for adolescents is 0.000001 mg/kg/day . There are no acute or chronic MRLs derived for PAHs because there are no adequate human or animal dose-response data available that identify threshold levels for appropriate noncancer health effects. Because there are no CVs, ATSDR compared the total estimated dose for adolescents and children to the LOAEL of 120 mg/kg/day in its Toxicological Profile for PAHs [15]. This LOAEL is based on hematopoetic[‡‡‡‡] effects in female mice that were exposed to benzo(a)pyrene for six months. *Because the calculated exposure doses are thousands of times below the LOAEL, and because conservative assumptions were made in calculating doses, it is unlikely that adverse effects would be observed.*

Presently, a quantitative risk estimate has only been developed for benzo(a)pyrene. It is a known animal carcinogen and considered a probable human carcinogen by the IARC and the USEPA [15]. The USEPA has calculated a cancer unit risk factor for benzo(a)pyrene which ATSDR used to estimate the probability of excess cancer risk for a lifetime of exposure. Because there is no

**** in vivo is defined as *within a living organism; "in vivo techniques"*
†††† in vitro is defined as *in an artificial environment outside the living organism; "in vitro fertilization"*
‡‡‡‡ Hematopoiesis is the formation of blood or blood cells in the living body.

cancer unit risk factor for the other PAHs, USEPA and others developed TEF's, based on relative potency to benzo(a)pyrene to estimate carcinogenic risk [15]. ATSDR calculated an excess lifetime theoretical cancer risk for acenaphthylene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(g,h,i)perylene, dibenz(a,h)anthracene, and phenanthrene. The combined (oral and dermal) estimated theoretical cancer risk of 2.48E-06 is based on the maximum concentration of each of the PAHs found in sediment. This estimate indicates a slight increased theoretical cancer risk from PAHs. ATSDR also compared the total estimated adult oral exposure dose to the CEL in its Toxicological Profile for PAHs and found that it was thousands of times lower than the CEL (2.6 mg/kg/day) [15]. *Therefore, it is unlikely that there is a significant increased risk of cancer from PAH exposure to sediment at this site.*

Polychlorinated Biphenyls (PCB's)
[Aroclor 1260, Aroclor 1248]

ATSDR calculated incidental ingestion exposure doses for an adolescent using the maximum concentrations of Aroclor 1260 and Aroclor 1248 found in sediment, 0.340 mg/kg and 0.43 mg/kg respectively. The combined estimated exposure dose for an adolescent is 0.0000002 mg/kg/day. The estimated exposure dose is below the health guideline of 0.00002 mg/kg/day. The health guideline is USEPA's RfD and ATSDR's MRL. ATSDR also compared the estimated doses to the LOAEL for PCB's in its Toxicological Profile [14]. The estimated dose was thousands of times lower than the LOAEL (0.005 mg/kg/day), which is based on inflammation of the tarsal glands, nails, and nail beds in female infant rhesus monkeys after 72 months of exposure to Aroclor 1254 [14]. *Because the calculated exposure doses are well below the RfD and LOAEL, and because conservative assumptions were made in calculating doses, it is unlikely that adverse effects would be observed.* ATSDR calculated an exposure dose of 0.00000005 mg/kg/day for an adolescent for dermal contact to PCB's in sediment. The estimated dose is thousands of times lower than the LOAEL (42.1 mg/kg/day) for dermal effects in ATSDR's PCB Toxicological Profile [14]. This LOAEL is based on a rabbit study that caused hyperkeratosis, acne, and decreased body weight after approximately 38 days of exposure. *Because the calculated dose is well below the LOAEL, and because conservative assumptions were made in calculating doses, it is unlikely that adverse effects from PCB's would be observed from dermal contact with sediment.*

A few studies of workers indicate that PCBs were associated with certain kinds of cancer in humans, such as cancer of the liver and biliary tract. Rats that ate food containing high levels of PCBs for two years developed liver cancer [14]. The DHHS has concluded that PCBs may reasonably be anticipated to be carcinogens. The USEPA and the IARC have determined that PCBs are probably carcinogenic to humans. ATSDR calculated an excess lifetime theoretical cancer risk for an adult of 2.34E-07 for sediment exposure to PCB's using the maximum concentrations in sediment (0.340 mg/kg and 0.43 mg/kg). *Because the estimated risk is below 1.00E -06 and because these assumptions are very conservative, it is unlikely that there is a significant increased risk of cancer from PCB's due to sediment exposure.*

Thallium

ATSDR calculated an incidental ingestion dose using the maximum concentration of thallium, 0.11 mg/kg, found in sediment. The estimated exposure dose for an adolescent is 0.00000003 mg/kg/day. The estimated dose is well below the USEPA RfD of 0.00007 mg/kg/day. In addition, ATSDR compared the estimated doses to the intermediate LOAEL in its Toxicological Profile for thallium [17]. The estimated exposure dose is thousands of times below the LOAEL (0.7 mg/kg/day), which is based on a study that produced reproductive effects (histological alteration of testis) in rats that were exposed to thallium for thirty to sixty days by gavage[§§§§]. *Because the calculated exposure dose is thousands of times below the RfD and the LOAEL, and because conservative assumptions were made in calculating doses, it is unlikely that adverse effects would be observed.* No reliable quantitative studies were located regarding absorption in humans or animals after dermal exposure to thallium.

Thallium is not classifiable as to human carcinogenicity. Existing studies are inadequate to determine its carcinogenicity [17].

Volatilization of VOCs from Groundwater into Buildings

In its review of the environmental data for the W. R. Grace site ATSDR considered the possibility of the volatilization of VOCs from groundwater into homes overlying the W.R. Grace groundwater plume. Some of the contaminants in the W.R. Grace site groundwater plume are VOCs that can volatilize into vapor. This vapor can, in turn, move from the groundwater through soil, and eventually seep into basements and affect the indoor air. Therefore, ATSDR considers this a future completed exposure pathway. Indoor air sampling data were not available for homes in the vicinity of the W.R. Grace site groundwater plume. Because air data was not available, ATSDR applied the USEPA's Johnson and Ettinger (1991) model to estimate possible indoor air concentrations for homes or buildings that may overlie the groundwater plume [50].

ATSDR estimated the concentrations of benzene, 1,1-dichloroethene, 1,2-dichloroethene, 1,2-dichloropropane, and vinyl chloride in indoor air from vapor intrusion to determine whether indoor air contaminants in buildings over-lying the W.R. Grace site groundwater plume could be associated with any unhealthy effects. The maximum concentration of these VOCs in groundwater was used for these calculations. ATSDR then compared the estimated concentrations to health guidance levels, such as ATSDR's inhalation MRL*****, LOAEL, or NOAEL and to information in the toxicological literature on these VOCs. An estimated indoor air concentration below the health guidance level is not expected to cause adverse health effects. Table D-1 lists the estimated indoor air concentrations for benzene, 1,1-dichloroethene, 1,2-dichloroethene, 1,2-dichloropropane, and vinyl chloride and the available health-guidance values.

This comparison suggests that the maximum level of VOCs estimated in buildings is much lower than the level at which we would expect to see adverse health effects. ATSDR used a very health protective model and the highest values found in the groundwater to create a worst-case evaluation. As a result, *ATSDR concludes that homes or buildings above the W.R. Grace site groundwater plume should not accumulate indoor air concentrations of VOCs at levels that could pose harm to residents in the vicinity of the plume.*

§§§§ Gavage is the introduction of material into the stomach by a tube.
***** The MRL is an amount of a contaminant in the air that is not expected to cause adverse health effects.

Pathways Considered and Eliminated

Fish

Although substantial effort was expended to collect fish of edible size from Sinking Pond, only minnows (Common Shiners) were obtained. Dieldrin, arsenic and iron were detected at levels slightly above comparison values in fish tissue from the minnows; however, these types of minnows are not commonly eaten by people [Table 9]. There is no CV for lead, however the detected level is below the World Health Organization guideline of 0.3 ug/g (ppm) for lead in fish [54]. One small Brown Bullhead was observed in the pond, but was not collected [38]. While people have access to this pond, it appears unlikely that fish of edible size are likely to be caught. Also, no subsistence fish-consuming population has been identified for this area. *This exposure pathway is currently considered to be incomplete and poses no public health hazard.* If future conditions at this pond change, due to fish stocking programs, or people report collecting fish of edible size, then we recommend that suitable samples be collected, analyzed and evaluated.

In 1994, MDPH issued a statewide advisory recommending that women should refrain from consumption of freshwater fish while they are pregnant. In 2001, MDPH expanded this advisory to include women of childbearing age who may become pregnant, nursing mothers, and children less than 12 years of age. This advisory does not apply to fish stocked in freshwater lakes or ponds. More information can be obtained by calling (617) 624-5757 or by visiting the MDPH website http://www.mass.gov/dph/environmental_health. None of the waterbodies associated with this site are specifically listed on the freshwater fish consumption advisory list posted at http://www.mass.gov/dph/fishadvisories.

Discussion

Public Health Implications

Based on ATSDR's evaluation and analysis of data for the W.R. Grace site, the primary risk occurs from exposure to arsenic and manganese. People may be exposed to arsenic and manganese through several exposure pathways, but the majority of elevated risk comes from exposure to these contaminants via soil, sediment, and surface water through incidental ingestion and dermal contact.

Comparison to Background Concentrations

To assist with determining background concentrations, USEPA and the Potentially Responsible Party chose a reference area for Sinking Pond to compare measurements of chemical concentrations. The reference area, called White Pond, is similar to Sinking Pond in that it is a kettle pond with no inlets or outlets, and it stratifies during the summer. A southwest cove in White Pond has organic sediments that are visually similar to those found in Sinking Pond. The average concentrations for arsenic and manganese in Sinking Pond were 471.4 mg/kg and 11,110 mg/kg, respectively. The average concentrations for arsenic and manganese in White Pond were 16.6 mg/kg and 125 mg/kg, respectively [38]. These samples indicate that the average concentrations of arsenic and manganese found on-site in Sinking Pond exceed the average concentrations in the reference pond.

Arsenic

Arsenic is an element that occurs naturally in rock and soil in many areas. It has been used commercially in products such as wood preservatives and pesticides. Studies conducted in other countries found harmful effects in persons who regularly drank water containing arsenic at 100 parts per billion (ppb) to 300 ppb. Compared with other groups, more of these people developed several kinds of cancer (lung, liver, kidney, and prostate) and had darkening skin, thickening of the skin on the palms of their hands and soles of their feet, skin cancer, and many small warts or corns [4].

A few studies found no harmful effects in persons in the United States who throughout their lifetimes drank water containing arsenic at levels of 50 ppb to 100 ppb [4]. Even though harmful effects were not found in persons who drank water containing arsenic levels of 50 ppb to 100 ppb, reducing exposure to arsenic can be expected to reduce any harmful health effects.

As discussed in the previous exposure pathways section, the estimated incidental ingestion dose for an adolescent slightly exceeds the USEPA RfD, but because very conservative assumptions were used and because it is unlikely that an adolescent would actually come into contact with or ingest sediment from these areas as frequently as ATSDR estimated, adverse health effects are unlikely to occur.

ATSDR also calculated a cumulative excess lifetime theoretical cancer risk for adults from arsenic exposure through ingestion and dermal contact of municipal well water, incidental ingestion of sediment, dermal contact with sediment, incidental ingestion of surface water, and dermal contact with surface water of 7.52E-03 (Table 10). Based on the combined estimate there is a moderate excess lifetime theoretical cancer risk, particularly for trespassers if they frequently contact or incidentally ingest sediment.

Manganese

Manganese is a naturally occurring metal found in rocks. It has also been used in pesticides (maneb and mancozeb), as an additive in gasoline, and can be produced from the burning of fossil fuels. While manganese is an essential nutrient required for normal body function, too much manganese may result in illness. Conflicting human studies are available regarding the potential health effects of manganese exposure from ingestion. Most information regarding exposure via ingestion to manganese has been derived from animal studies. Studies in animals have shown that very high concentrations of manganese in food and water may result in neurological effects [12].

As previously discussed, the main pathway of exposure to manganese at this site is through incidental ingestion of sediment. *Based on the ATSDR estimated dose for an adolescent exposure scenario, adverse health effects are unlikely.*

Trichloroethylene (TCE)

TCE is a nonflammable, colorless liquid with a somewhat sweet odor and a sweet, burning taste. It is used mainly as a solvent to remove grease from metal parts, but it is also an ingredient in adhesives, paint removers, typewriter correction fluids, and spot removers. Trichloroethylene dissolves a little in water, but it can remain in groundwater for a long time [18].

TCE is considered to be a breakdown product of perchoroethylene (PCE), and the two are found in combination at many hazardous waste sites. Therefore, many of the studies pertaining to potential health effects discuss both PCE and TCE [18]. Based on ATSDR's evaluation of historical data from past exposure to TCE in the Assabet wells, people may have been exposed to TCE at levels that slightly exceed the health guideline†††††. However, because conservative assumptions were used in calculating the exposure doses and because the possible duration of exposure was limited (9 years), it is unlikely that health effects would be observed.

To address community concerns regarding past exposure to TCE, ATSDR has reviewed and summarized the results of several human health studies related to PCE and TCE in the following paragraphs. The studies provide some information on the cancer and non-cancer health effects associated with exposure to humans. In general, the levels of TCE found in the Assabet wells were *much lower* than those reported in these studies, and the estimated length of exposure to TCE in the Assabet wells was generally shorter than the duration of exposure in these studies.

A study was conducted at the U.S. Marine Corps Base Camp LeJeune in North Carolina that examined adverse pregnancy outcomes associated with exposure to VOCs, including PCE and TCE, in the drinking water supply. Although the actual concentrations that women were exposed to and the duration of their exposure are unknown, concentrations of PCE and TCE in the water supply may have been as high as 215 µg/L and 1,400 µg/L, respectively. Estimates indicate that exposure may have occurred for over 25 years. The study concluded that women over 35 years of age that were exposed to PCE and TCE were 4 times more likely to have infants that were small for gestation age. Only a slightly increased incidence was observed among the entire study group of women [20]. ATSDR is currently conducting a more extensive study of this community [21].

Residents of Woburn, Massachusetts were exposed to drinking water contaminated with VOCs, including PCE at concentrations of 21 µg/L and TCE at concentrations of 250 µg/L or greater. The findings of one of the studies of this community indicated that developmental anomalies related to the central nervous system, chromosomes, and oral cleft were associated with exposure [32]. However, the scientific community has noted limitations with this study regarding the biological relevance of grouping these anomalies for the purpose of statistical analysis. As a result, the findings of this study are difficult to interpret and apply to other exposed individuals [16]. Studies of the exposed individuals in Woburn have also reported an association between exposure to contaminated drinking water and an increased risk of childhood leukemia [31,32,40]. Numerous studies have evaluated the findings of the Woburn study and have identified several shortcomings (for example, lack of information on exposure doses, duration of exposure, and the fact that several of the leukemia cases reported in the study did not have access to the contaminated drinking water) [16,33,41,43,44,53].

In response to an increased incidence of childhood cancer in Dover Township, New Jersey, a study evaluated potential community exposures to toxic chemicals in the environment. Chemicals, which include PCE, TCE, and various other contaminants, were detected in the area's drinking water supply. In addition, contaminants were also likely to be present in the air as a result of emissions from the nearby hazardous waste sites. The results of the study indicate an increased risk of leukemia among young females via prenatal exposure to contaminants in the drinking water supply and exposure to contaminants present in the air. Several uncertainties exist regarding this study, such as the potential exposure to various contaminants, limited available

††††† MCL = 5.0 ppb

groundwater and air data, lack of information on exposure dose and duration, and the unknown effects of other measured contaminants [39].

ATSDR reviewed another study of birth outcomes in 75 towns in New Jersey, where individuals ingested drinking water contaminated with VOCs, including PCE and TCE [24]. The study concluded that oral cleft defects were elevated. Several limitations have been identified in the study, such as confounders (smoking, additional occupational exposures, medical history), which do not allow for the results of this study alone to conclude definitively on the association between developmental effects and exposure [16]. A review of the available scientific data indicates that further study of the likelihood of the contaminants to result in developmental effects is necessary. Another study of these New Jersey communities reported an increased incidence of childhood leukemia and non-Hodgkin's lymphoma in females exposed to greater than 5.0 ug/L of TCE in drinking water [27]. Limitations of the studies include lack of information regarding contaminant levels, exposure duration, and water consumption variations among individuals.

A review of the available studies of PCE and TCE exposure via inhalation indicates that PCE and TCE has been associated with liver, kidney, neurological, developmental effects, and leukemia among subjects exposed to very high concentrations [16,18]. Studies have reported skin effects, such as chemical burns and blistering from prolonged exposure to concentrated PCE and TCE used in dry cleaning operations [30,18]. For the population surrounding the W.R. Grace site, exposure to PCE and TCE via inhalation and dermal contact is expected to be significantly lower than among study subjects. Although ingestion is the major route of exposure, individuals may also have been exposed to PCE and TCE via inhalation and dermal contact during showering.

ATSDR has a TCE exposure subregistry, which compiled health-related information from nearly 5,000 participants exposed to TCE from contaminated drinking water. The participants were exposed to TCE concentrations ranging from 2.0 µg/L to 24,000 µg/L (or 0.002 mg/L to 24 mg/L) for up to 18 years. Studies of this population indicate that individuals exposed to TCE may have an increased incidence of health effects, particularly stroke. Other health effects reported among participants of the TCE subregistry include anemia, urinary tract disorders, liver and kidney effects, diabetes, and skin conditions. Based on the available information, a cause-effect relationship has not been demonstrated between TCE exposure and the reported health effects. Studies of the participants of the subregistry and the potential for health effects related to TCE exposure are ongoing [1].

Child Health Considerations

ATSDR recognizes that the unique vulnerabilities of infants and children demand special emphasis in communities faced with contamination of their water, soil, air, or food. Infants and children are usually more susceptible to toxic substances than adults due to their immature and developing organs. Children are smaller, which results in higher doses when compared with adults. Most importantly, children depend completely on adults for risk identification and management decisions, housing decisions, and access to medical care. ATSDR's evaluation in this document considered children as a susceptible subpopulation. The possible risks for children exposed to contaminants at the W.R. Grace site are discussed in the previous section under Public Health Implications.

Health Outcome Data

Health outcome data (HOD) record certain health conditions that occur in populations. These data can provide information on the general health of communities living near a hazardous waste site. They can also provide information on patterns of specified health conditions. Some examples of health outcome databases are tumor registries, birth defects registries, and vital statistics. Information from local hospitals and other health care providers can also be used to investigate patterns of disease in a specific population. ATSDR looks at appropriate and available health outcome data when there is a completed exposure pathway or community concern.

ATSDR requested that the Community Assessment Program (CAP) of the Massachusetts Department of Public Health (MDPH), Center for Environmental Health conduct an evaluation of cancer incidence in the town Acton and Concord Census Tract (CT) 3612 in southwestern Concord. The evaluation was initiated based on community concerns about cancer and possible environmental exposures in relation to the W.R. Grace Site. The cancer incidence assessment was completed under cooperative agreement with ATSDR.

Specifically, the purpose of the investigation was to provide a review of the pattern of cancer in the town of Acton as a whole and its individual census tracts, through comparison of the incidence of six cancer types with the incidence of those cancers in the state of Massachusetts as a whole. Cancer incidence data were also reviewed for Concord CT 3612, which is located adjacent to Acton, in response to a supplemental request from the community because part of the W.R. Grace site is located in Concord. A qualitative evaluation of the geographic pattern of cancer diagnoses in Acton and Concord CT 3612 was conducted to see if there were any patterns in any one particular area or in relation to the W.R. Grace site. Additionally, available information about risk factors related to the development of cancer was evaluated.

Cancer incidence data for the years 1982–2000 were obtained for the town of Acton and for Concord CT 3612 from the Massachusetts Cancer Registry (MCR). Six cancer types were evaluated, including cancers of the bladder, brain and central nervous system (CNS), kidney, liver, and lung and bronchus, as well as leukemia. These cancer types were selected for evaluation based on knowledge of community cancer and environmental concerns and/or potential associations with contaminants of concern at the W.R. Grace site. To evaluate possible trends over time, these data were also analyzed by three smaller time periods, 1982–1987, 1988–1993, and 1994–2000.

With one exception, the six cancer types evaluated occurred approximately at the expected rates in the town of Acton as a whole during the 19-year time period 1982–2000, as well as during the three smaller time periods. Brain and central nervous system (CNS) cancer occurred more often than expected during 1982–2000 and two smaller time periods, 1982–1987 and 1988–1993. The observed elevation was statistically significant during the first time period, 1982–1987 (14 diagnoses observed vs. 6.9 expected, SIR=204, 95% CI=112-343). Lung and bronchus cancer occurred statistically significantly less often than expected among males and among both sexes combined in Acton during 1982–2000. While females in the town as a whole were diagnosed with bladder cancer more often than expected during 1982-2000, the elevation was not statistically significant and there were no consistent trends over time. Bladder cancer and kidney cancer occurred less often than expected among males and females combined, and leukemia and liver cancer occurred about as expected during 1982–2000. In general, most Acton census tracts experienced cancer approximately near the rates expected during 1982–2000 and during the smaller time periods evaluated in the report. In Concord CT 3612, most of the six cancer types also generally occurred at or near the rates expected and several occurred below expected rates during 1982-2000 and during the smaller time periods evaluated. One statistically significant elevation was observed in this census tract during the middle time period, 1988-1993, among males and females diagnosed with leukemia (6 diagnoses observed vs. 2.2 expected, SIR=278, 95% CI=102-606).

Available risk factor information for individuals diagnosed with cancer in the town Acton and Concord CT 3612 was compared to known or established trends to assess whether any unexpected patterns existed. In general, trends observed in these areas were similar to those seen in the general population. Review of the MCR data suggests that smoking likely played some role in the diagnosis of some cancer types (e.g., cancers of the bladder, kidney, and lung and bronchus) among some individuals. Also, occupational exposures may have been important in the development of cancer among some individuals.

For the majority of cancer types evaluated, analysis of the geographic distribution of place of residence for individuals diagnosed with cancer in Acton revealed no apparent spatial patterns at the neighborhood level that are not likely to be attributed to factors such as areas of higher population density. While diagnoses of brain and CNS cancer in Acton were fairly evenly distributed throughout the town and seemed to coincide closely with the pattern of population, there were a few locations in the town where two or three individuals with this cancer type were located in relative close proximity to each other, with some located in the southern area of town near the W.R. Grace site. However, an analysis of the dates of diagnosis did not suggest any temporal trends among these individuals, and a variety of cell types of brain and CNS cancer were represented among children and adults, indicating that a common factor among individuals in these locations was unlikely. In Concord CT 3612, the geographic distribution of the six cancer types evaluated also seemed to coincide closely with population density. There were no apparent concentrations of diagnoses in any one area of the census tract. While a statistically significant elevation in leukemia was observed among males and females combined during 1988-1993 in Concord CT 3612, none of the individuals were unusually concentrated in neighborhoods closest to the Acton town line or in relation to the W.R. Grace site.

In summary, based on the information reviewed in this evaluation, it does not appear that environmental exposures played a major role in the overall incidence of cancer in the town of Acton, in Concord CT 3612, or in relation to the W. R. Grace site during the 19-year time period 1982–2000.

MDPH's complete report on the Assessment of Cancer Incidence in the town Acton and Concord Census Tract CT 3612 will be released at a later date.

Limitations and Uncertainty

ATSDR worked with the Environmental Protection Agency, the Town of Acton, the Water Supply District of Acton, the Remedium Group, Inc. (a subsidiary of W.R. Grace & Co.) and the Acton Citizens for Environmental Safety to collect relevant data for this Public Health Assessment. This assessment was not intended to be a complete review and evaluation of all data available on the W.R. Grace Site (Acton, MA) from past to present. ATSDR does not have the staffing ability or resources to collect, review and analyze all of the documents on record for the W.R. Grace Site in Acton. This Public Health Assessment is intended to be a review of additional data (through August 5, 2004) and an opportunity to address potential public health concerns that were not addressed by the 1992 Public Health Assessment.

Limitations and uncertainty exist in ATSDR's evaluation of contaminants, pathways of exposure and the possibility of harmful effects to residents. In general, uncertainties exist in the development of exposure dose scenarios, in comparing estimated doses to animal and human studies and in deciding whether harmful effects might occur.

For example, the route of exposure can at times affect the toxicity of a chemical in two ways: a chemical may cause a harmful effect by one route of exposure such as inhalation, but not by another route such as ingestion. In addition, the chemical amount that causes a harmful effect might be different according to the route of exposure. A chemical might be more toxic by inhalation than by ingestion, or vice versa.

When several routes of exposure occur at the same time, evaluating each route of exposure may or may not be appropriate. For example, people exposed to contaminated municipal well water (as is the case for people in the vicinity of the W.R. Grace site from 1970 to 1978) are exposed through ingestion, inhalation and dermal contact when they take a shower. The total amount of exposure is probably just as important as the individual route of exposure. However, a decision needs to be made as to which toxicity studies should be used for comparison. Should inhalation studies be used or should dermal absorption studies be used. In the case of dermal absorption studies, such studies are not frequently available. Because the uncertainty about the most appropriate route of exposure exists, ATSDR combined the dose used in both inhalation and ingestions studies to decide whether harmful effects might occur.

Totaling all VOCs to decide if harmful effects might occur may or may not be appropriate. Very few controlled studies have been conducted looking at exposure to a mixture of chlorinated VOCs. Some occupational studies exist where exposure was to a mixture of VOCs, but it is unclear which chemicals might be responsible for the effects found in those studies.

There are some specific uncertainties related to ATSDR's assessment of past exposure to VOCs in the municipal drinking water supply that have been mentioned previously, but should be reiterated here.

- ATSDR based its evaluation on very limited historical data.
- There is no Quality Assurance or Quality Control information for this data.
- The exact duration of exposure to contaminants in municipal drinking water cannot be determined.
- ATSDR based its evaluation of past exposure on the maximum contaminant level detected in municipal wells, even though it is unlikely people received the maximum concentration at their tap, because water from the Assabet wells was mixed with water from other uncontaminated wells prior to distribution to homes.
- ATSDR assumed people were exposed to the maximum contaminant concentration for nine years when evaluating non-carcinogenic exposure (the time elapsed between when the Assabet wells were opened in 1970 until the time contamination was discovered and they were taken off-line in 1978), although it is unlikely that people would have been continuously exposed to these maximum concentrations.
- In its assessment of carcinogenic risk associated with historical VOC exposure ATSDR used the default assumption for a lifetime of exposure (70 years).

Community Health Concerns *(comments in italics)*

The ATSDR site team held a public availability session on Tuesday October 28, 2003 from 7:00pm to 9:00pm at the Acton Town Hall in Acton, Massachusetts. Some of the community health concerns below were gathered at the meeting, and some were submitted to ATSDR in writing afterward.

Is the municipal drinking water supply safe? Are the municipal drinking water supply wells monitored?

ATSDR response: Municipal drinking water supplied by the Acton Water District (AWD) currently meets or exceeds all the requirements of the Safe Drinking Water Act. The AWD operates and maintains air strippers that remove volatile organic compounds that may be present in groundwater pumped from the town wells. The AWD routinely samples and treats the water provided to users to ensure a safe water supply is provided.

Was the well water actually sampled for vinyl chloride?
Table C-12 of the Initial Release ATSDR Public Health Assessment for the site lists "NA" (not analyzed?) under the category of vinyl chloride for Assabet 2 for 1978 and 1979. (The only other data provided for Assabet 2 in this report are from 1992. Data are provided for Assabet 1 for 1992 only—no data from 1978 or 1979.)

ATSDR response: ATSDR reviewed the November 4, 1992, initial release Public Health Assessment for the W.R. Grace Site, Acton, MA, completed by the Massachusetts Department of Public Health. It appears that data are "not available" or were "not analyzed" in 1978 and 1979. Without access to the original sampling data it is not possible for ATSDR to determine why there is no data from 1978 or 1979. Samples may not have been collected for vinyl chloride at that time or they may have been collected, but not analyzed due to poor quality samples, contamination in the samples or a multitude of other reasons. However, during the public comment period the AWD provided another data set to ATSDR, which indicated the presence of vinyl chloride in the Assabet wells. This data set, like the previous one is very limited, and there is no QA/QC information. This data was evaluated and added to the section: *Public Water Supply Wells, Historical Data, VOCs* for the final release.

Even if the well had been sampled, couldn't the lack of vinyl chloride detection in the well water in the late 1970s to early 1980s be due to technological (sampling) limitations, rather than the actual absence of vinyl chloride in the drinking water?

It is ACES‡‡‡‡‡ understanding that routine VOC testing of drinking water supplies by certified labs was not required until after 1985. It is also our understanding that vinyl chloride was regulated differently than other VOCs due in part to the difficulty in obtaining accurate sampling results. Drinking water sampling for vinyl chloride, a "known human carcinogen of high potency" was not required for all systems, and sampling errors for vinyl chloride in drinking water, before 1987 could be plus or minus 40 percent. (See Federal Register, Vol. 50. No. 219 Nov. 13, 1985/ Proposed Rules and Federal Register Vol. 52, No. 130 July 8, 1987/ Rules and Regulations.)

ATSDR response: Yes, it is possible that vinyl chloride was not detected due to technological sampling limitations in the late 1970's and early 1980's.

Given these considerations it seems appropriate that ATSDR consider that it was possible that individuals drinking Acton public water from the contaminated wells, between 1970 and 1978, did ingest vinyl chloride, and that vinyl chloride induced health effects could have occurred. (Exposure routes could have included ingestion, inhalation, and dermal exposure.)

ATSDR response: ATSDR evaluated exposure to vinyl chloride in this Public Health Assessment (PHA) based on the maximum concentration of vinyl chloride found in a private well. ATSDR considered incidental ingestion and dermal contact with private well water in its exposure assessment. ATSDR also estimated an excess lifetime theoretical cancer risk for an adult based on a 70 year exposure to the maximum concentration found in the private well.

In addition, during the public comment period the AWD provided another data set to ATSDR, which indicated the presence of vinyl chloride in the Assabet wells. This data set was evaluated and added to the section of the final PHA which discusses historical exposure to public water supply wells.

Was the well water actually sampled for acrylonitrile? What other data are available for acrylonitrile at the W.R. Grace Site? Many of the Tables in the 1992 ATSDR report show data gaps for acrylonitrile. According to these Tables, while 1700 ppb of acrylonitrile was detected in the groundwater under the Secondary Lagoon, acrylonitrile was NA (not analyzed), in the groundwater beneath the Primary Lagoon, North Lagoon, Blowdown Pit, and Battery Separator Area.

ATSDR response: In the 1992 Initial Release PHA [45] acrylonitrile was sampled for in groundwater down-gradient from the landfill, groundwater and soil below the waste sites, groundwater and soil below the lagoons, sludge in the landfill, soil below the landfill and in

‡‡‡‡‡ Acton Citizens for Environmental Safety (ACES)

surface water. However it does not appear that acrylonitrile was sampled for in the Assabet wells. Of the locations sampled for acrylonitrile it was found only in groundwater below the secondary lagoon. Acrylonitrile was not found in more recent sampling of groundwater and surface water at the W.R. Grace Site most likely because it rapidly breaks down and disappears from water. ATSDR contacted the Massachusetts Department of Public Health to see if the data from the 1992 Initial Release PHA could be located for review to better interpret the data gaps, however these data could not be located. In addition, there was no acrylonitrile data in the data set provided to ATSDR from the AWD during the public comment period.

How sensitive/accurate were sampling techniques for acrylonitrile in the late 1970's to mid 1980's? Could mid to low levels of acrylonitrile have gone undetected due to technological limitations at that time?
Given:

- that VOC testing of drinking water supplies by certified labs was not required until after 1985,

- acrylonitrile is not routinely included in VOC sampling rounds,

- the detection of 1700 ppb of acrylonitrile in groundwater onsite, (between 1979 and 1982),

- USEPA's limit of 0.058 ppb for surface water, because of public health concerns about ingestion of acrylonitrile, and

- that ATSDR's report states that "Acrylonitrile exposure occurred via ingestion, inhalation and dermal contact for residents who received water from Assabet One and Two"

It seems appropriate that ATSDR consider that individuals drinking Acton public water from the contaminated wells, between 1970 and 1978, may have been exposed to acrylonitrile and that the dose may have been at a high enough level to have caused health effects. (Exposure routes could have included ingestion, inhalation, and dermal exposure.)

ATSDR response: The limits of detection for most chemicals, including VOCs, have improved since the 1970's and 1980's. It is possible that low levels of acrylonitrile could have gone undetected due to technological limitations during this time period, and it is possible that persons receiving drinking water from the Assabet wells between 1970 and 1978 could have been exposed to acrylonitrile; however, ATSDR has no data that indicates there was acrylonitrile contamination in the wells during that period. Because there is no acrylonitrile data for that time period, it is not possible to calculate an estimated exposure dose.

Could exposure to contaminants at this site contribute to squamous cell carcinoma of the throat?

ATSDR response: ATSDR worked with the Massachusetts Department of Public Health to select and evaluate cancer types based on their potential association with contaminants of concern identified at the W.R. Grace site. The six cancer types evaluated include: cancers of the bladder, brain and central nervous system, kidney, liver, lung and bronchus, and leukemia. Cancers of the throat area, specifically cancers of the oral cavity, oropharynx, larynx, or esophagus are not thought to be health outcomes potentially associated with the contaminants of concern at this site. In general, the primary causes for cancers that occur in the throat area are tobacco and alcohol use [22,23]. ATSDR did conclude in this PHA that there is potential elevated carcinogenic risk from arsenic, primarily through incidental ingestion and dermal contact with surface water and sediment; however, it would be very difficult to determine if site related exposure may or may not have contributed to squamous cell carcinoma of the throat.

Are there birth defects related to contaminant exposures at this site?

ATSDR response: ATSDR found no specific birth defects related to contaminant exposures at this site. ATSDR has concluded that past exposure to trichloroethylene (TCE) may have slightly exceeded the health guideline between 1970 and 1978. However, adverse health effects are not likely based on past exposure to TCE in drinking water at this site, because very conservative assumptions were used in the assessment and the duration of exposure was limited. ATSDR refers to some studies related to TCE exposure in the PHA, because these studies suggest that birth defects may occur when mothers drink water containing TCE during pregnancy. In general the levels of TCE found in the Assabet wells were much lower than those reported in these studies, and the estimated length of exposure to TCE in the Assabet wells was generally shorter than the duration of exposure in these studies. Therefore, birth defects related to TCE exposure at this site are unlikely.

Can benzene exposure lead to cancer?

ATSDR response: The DHHS has determined that benzene is a known human carcinogen. Long-term exposure to high levels of benzene in the air can cause leukemia, cancer of the blood-forming organs. Benzene was found above ATSDR comparison values in some groundwater samples from monitoring wells and in the historical data from Assabet wells One and Two. ATSDR estimated a lifetime theoretical excess cancer risk based on the highest concentration of benzene found in the Assabet wells (0.0021 mg/L). Based on this information there is a very low increased theoretical cancer risk (4.75E-06). Therefore, ATSDR has concluded that it is unlikely there is a significant increased risk of cancer due to ingestion of benzene from the Assabet wells in the past.

Is there a cancer cluster in the Acton area?

ATSDR response: The Community Assessment Program of the Massachusetts Department of Health (MDPH), Bureau of Environmental Health, conducted an evaluation of cancer incidence in Acton, Massachusetts.

- Based on the information reviewed in this assessment, it does not appear that the pattern of cancer in Acton or in Concord CT 3612 was unusual nor does it appear that environmental exposures played a major role in the overall incidence of cancer in these areas, or in relation to the W.R. Grace site during the 19-year time period 1982-2000.
- In general, the six cancer types evaluated in this report (leukemia and cancers of the bladder, brain and CNS, kidney, liver, and lung and bronchus) occurred approximately at or near the expected rates for Acton, its individual census tracts, and Concord CT 3612 during the 19-year time period 1982–2000. However, statistically significant elevations were observed for brain and CNS cancer in the town of Acton as a whole during the first time period, 1982–1987, and for leukemia in Concord CT 3612 during the middle time period, 1988–1993. While females in Acton were diagnosed with bladder cancer slightly more often than expected during 1982–2000, the elevation was not statistically significant and there were no consistent trends over time.
- For the majority of cancer types evaluated the analysis revealed no apparent spatial patterns at the neighborhood level that are not likely to be attributed to factors such as areas of higher population density. There were a few locations in the town where two or

three individuals with brain and CNS cancer were located in relative close proximity to each other, with some located in the southern area of town near the W.R. Grace site. However, an analysis of the dates of diagnosis did not suggest any temporal trends among these individuals, and a variety of cell types of brain and CNS cancer were represented among children and adults, indicating that a common factor among individuals in these locations was unlikely.

- Review of available risk factor information for individuals diagnosed with cancer (i.e. age, gender, smoking history, and occupation) suggests that trends observed in Acton and in Concord CT 3612 are similar to those seen in the general population.

Conclusions

Based on the data evaluated, ATSDR has assigned a public health hazard category for each of the pathways evaluated in this PHA. Appendix E presents a description of each of the public health hazard categories that were considered during the classification process.

- Individuals supplied water by the AWD's Assabet One and Assabet Two wells between 1970 and 1978 may have previously drunk, bathed, and showered with groundwater contaminated with VOCs. The historical data available to ATSDR for review from this time period is very limited and there is no QA/QC information available for the data. However, to address community concerns regarding past exposure the data was evaluated. *ATSDR concludes that past levels of VOCs in the Assabet wells pose an indeterminate public health hazard due to data limitations and gaps.* Levels of TCE may have exceeded current health guidelines, but because of the short duration of exposure (about 9 years) and the relatively low levels compared to those associated with potential effects in health studies, it is unlikely that adverse health effects have occurred. There is no historical data from this period for manganese or arsenic in the Assabet wells. Therefore, *ATSDR also considers past exposure to arsenic and manganese in the municipal drinking water supply to be an indeterminate public health hazard.* Since the early 1980's, the AWD has been treating the groundwater through an air stripping process to remove VOC contamination from the active water supply wells. Therefore, there is no current or expected future exposure to VOCs in the municipal drinking water supply. While recent sampling has indicated no VOC contamination (due the treatment process), it has indicated the presence of arsenic and manganese. Based upon the concentrations reported for the wells and toxicological evaluations, adverse health effects are not expected to occur. Therefore, *ATSDR considers current and future exposure to VOCs, arsenic, and manganese in the municipal drinking supply to be a no apparent public health hazard*.

- Six non-municipal wells have been identified in the vicinity of the W.R. Grace site groundwater plume that are used for non-drinking water purposes. One well contained vinyl chloride above the CV and was converted to a monitoring well by W.R. Grace. Four wells indicate no present VOC contamination, one well was not sampled, but at the request of the owner was properly sealed and permanently closed. Potential past exposure was limited to possible dermal contact from swimming in pools that were filled with well water or irrigation activities. Based on the concentrations reported and toxicological evaluations, adverse health effects are not expected to occur. Therefore, *ATSDR concludes that exposure to groundwater from non-municipal wells for non-drinking water uses poses no apparent public health hazard.*

- One non-municipal well was indentified in the vicinity of the W.R. Grace site groundwater plume that is used for drinking water purposes at a sports arena. This well is classified as a transient non-community (TNC) public water system by the Massachusetts Department of Public Health. This well was sampled in May 2002 and again in July 2006. No VOCs were detected. *Therefore, ATSDR concludes that the TNC water supply well at the sports arena poses no public health hazard.*

- Based on the data reviewed, trespassers accessing the W.R. Grace site may have been exposed in the past, may be presently exposed, and may be exposed in the future to contaminants in soil, sediment and surface water. Of the contaminants evaluated in sediment and surface water, only arsenic indicates elevated risk. The evaluation of potential health effects from exposure to contaminants in sediment and surface water, conducted in this PHA, incorporated conservative assumptions for health effects, which may have resulted in an overestimation of potential exposure to individuals. However, *ATSDR concludes that trespassers exposed to the highest levels of arsenic in sediment and surface water from Sinking Pond and the North Lagoon Wetland may have a slightly elevated risk for adverse health effects. There is a moderate elevated excess lifetime theoretical cancer risk for trespassers who frequent the site and come into contact with or incidentally ingest the highest levels of contaminated sediment over a lifetime.*

- Due to elevated concentrations of VOCs present in shallow groundwater, it is appropriate to consider whether there may be health effects related to the possible migration of contaminants from groundwater through the soil into indoor air in residences and other buildings overlying the plume near the W.R. Grace site. Based on modeled concentrations of contaminants, no adverse health effects are expected to occur. Therefore, *ATSDR concludes that this pathway is classified as posing no apparent public health hazard.*

- Based on the information provided to ATSDR, edible size fish from Sinking Pond could not be caught after several attempts. Because edible size fish could not be caught for evaluation, it is unlikely that persons accessing the W.R. Grace site are catching and consuming fish from Sinking Pond on a regular basis. If an occasional edible size fish were caught and consumed it is not likely that this infrequent exposure would be sufficient to cause adverse health effects. Therefore, *ATSDR considers fish consumption from Sinking Pond to be a no apparent public health hazard.*

Recommendations

- ATSDR recommends continued monitoring of the Assabet, Scribner, Lawsbrook, and Christofferson wells, by the Acton Water District, to ensure that the air strippers are adequately removing VOC contamination and that the municipal drinking water supply meets all the requirements of the Safe Drinking Water Act.

- Consistent with USEPA's clean-up plan in the 2005 Record of Decision for the site, ATSDR recommends addressing the areas of the site with elevated levels of arsenic and manganese (i.e. Sinking Pond, North Lagoon Wetland) in sediment in a manner that would be protective of public health.

- ATSDR recommends that the non-municipal wells that are used for non-drinking water purposes in the vicinity of the W.R. Grace site be monitored periodically by W.R. Grace or an appropriate public health agency to ensure that the wells continue to be used for non-drinking water purposes and/or that contaminant levels are not adversely affecting public health.
- Periodic monitoring of the TNC public water system at the sports arena should be conducted by the Massachusetts Department of Environmental Protection to ensure protection of public health.
- It is recommended that no new private wells be installed in the vicinity of the groundwater plume near the W.R. Grace site. This should be accomplished through institutional controls, local town ordinance and/or deed restrictions. Currently there is an "administrative hold" in effect, which prevents the issuing of new permits for private wells in the subject area.
- If land use changes for the W.R. Grace property in the future, ATSDR recommends that the property owner assess the impact of the potential reuse on public health, especially for children.

Public Health Action Plan

A public health action plan describes the actions designed to mitigate or prevent adverse human health effects that might result from exposure to hazardous substances associated with site contamination. The following paragraphs summarize the public health actions that have been taken at the W.R. Grace Site and the actions that are to be completed.

Actions Taken

- ATSDR conducted an initial site visit to the W.R. Grace site in July 2003.
- ATSDR conducted a public availability session to gather community concerns and discuss ATSDR's role in the Superfund process in October 2003.
- ATSDR accepted comments from state and federal agencies and from ACES during the Initial Release of the PHA and incorporated responses to those comments into the Public Comment version of the PHA. The comments and responses are provided in Appendix H.
- ATSDR released the Public Comment version of the W.R. Grace site PHA in August 2008.
- ATSDR conducted a public availability and poster session for the Public Comment W.R. Grace PHA on August 26, 2008 at the Acton Boxborough Regional High School.
- ATSDR incorporated comments received during the Public Comment period in the Final version of the PHA. The comments and responses are provided in Appendix I.
- Requests received by ATSDR's Division of Health Assessment and Consultation for evaluation of new data will be reviewed by ATSDR and the MDPH Cooperative Agreement Program to determine the best course of action.

Author, Reviewers

Prepared by:

Robert B. Knowles, MS, REHS
Regional Representative, Region 9
Division of Regional Operations

Public Comment Review by:

Alan W. Yarbrough, MS
Team Lead
Cooperative Agreement and Program Evaluation Branch
Division of Health Assessment and Consultation

Richard Gillig, MCP
Branch Chief
Cooperative Agreement and Program Evaluation Branch
Division of Health Assessment and Consultation

Sven E. Rodenbeck, P.E, DEE, Sc.D
Deputy Branch Chief
Cooperative Agreement and Program Evaluation Branch
Division of Health Assessment and Consultation

Final Review by:

CAPT Susan Muza
Senior Regional Representative, Region 9
Division of Regional Operations

William Sweet
Senior Regional Representative, Region 1
Division of Regional Operations

Tina Forrester, PhD
Director
Division of Regional Operations

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Appendices

Appendix A

Tables

Table 1. Completed Exposure Pathways for the W.R. Grace site							
Pathway Name	Environmental Media and Transport Mechanisms	Point of Exposure	Route of Exposure	Exposure Population	Estimated Number Exposed	Time of Exposure	Chemical
Drinking water (public water supply wells)	Movement of contaminant from source to groundwater	Municipal drinking water supply	Ingestion, inhalation, direct skin contact	Residents	Unknown	Past	ethylbenzene, 1,1, dichloroethylene, benzene, 1,1,1 trichloroethane, TCE, methylene chloride
Drinking water (public water supply wells)	Movement of contaminant from source to groundwater	Municipal drinking water supply	Ingestion, inhalation, direct skin contact	Residents	Unknown	Past, present	arsenic, manganese

Table 2. Potential Exposure Pathways for the W.R. Grace site

Pathway Name	Environmental Media and Transport Mechanisms	Point of Exposure	Route of Exposure	Exposure Population	Estimated Number Exposed	Time of Exposure	Chemical
Private well water	Movement of contaminant from source to groundwater	Private wells	Incidental ingestion, inhalation, direct skin contact	Residents	Unknown	Past, present, future	vinyl chloride
Surface water	Movement of contaminants into surface water	Sinking Pond, Fort Pond Brook and associated wetlands	Incidental ingestion, inhalation, direct skin contact	Recreational users of Sinking Pond and Fort Pond Brook	Unknown	Past, present, future	Antimony, arsenic, manganese, phenanthrene, bis(2-ethylhexyl) phthalate
Sediment	Movement of contaminants into sediment	Sinking Pond, Fort Pond Brook and associated wetlands	Incidental ingestion, inhalation, direct skin contact	Recreational users of Sinking Pond and Fort Pond Brook	Unknown	Past, present, future	Arsenic, Aroclor 1248, Aroclor 1260, benzo(a)pyrene, chromium, copper, iron, manganese, thallium
Volatilizing of VOCs from groundwater into buildings	Indoor air	Air within homes and buildings overlying the plume	Inhalation	Residents, workers, visitors	Unknown	Past, present, future	1,1-DCE, vinyl chloride

Table 3. Pathways currently considered incomplete for the W.R. Grace site							
Pathway Name	Environmental Media and Transport Mechanisms	Point of Exposure	Route of Exposure	Exposure Population	Estimated Number Exposed	Time of Exposure	Chemical
Consumption of fish	Fish tissue	Sinking Pond	Ingestion	Recreational anglers in Sinking Pond	Unknown	Past, present, future	arsenic, dieldrin, iron, lead

Tables 1 through 3 include the completed, potential and incomplete pathways of exposure evaluated in this Public Health Assessment. There may be other pathways of exposure that were evaluated in previous reports (i.e. the Draft 1992 Public Health Assessment), but if they were not discussed in this PHA they were not included these Tables.

Table 4. Contaminants Detected Above Comparison Values in Assabet Public Water Supply and School Street Wellfield Public Water Supply					
Contaminant	Minimum Detected (ppb)	Maximum Detected (ppb)	Frequency of Detection[1]	Comparison Value (ppb)	Source
Inorganics					
Arsenic	--	5.2 (J)	N/A	0.02	CREG
Manganese	0.99 (J)	520	N/A	500	Child RMEG

Source: GeoTrans 2002, 2003; Menzie-Cura 2003c.

Notes:
-- no minimum value available, only a single detection was reported
(J) - data qualifier; reported value is an estimate
CREG - Cancer Risk Evaluation Guideline for drinking water
EMEG - Exposure Media Evaluation Guideline for drinking water
LTHA - Lifetime health advisory for drinking water
MCL - USEPA maximum contaminant level for drinking water
RBC-N - USEPA Region III Risk Based Concentration for tap water, non-carcinogenic effects
RMEG - Reference Media Evaluation Guideline for drinking water
N/A - not available
ppb - parts per billion

Table 5. Historical Municipal Well Data
Contaminants Detected Above Comparison Values in Assabet Wells (or retained for additional evaluation)

Contaminant	Minimum Detected (ppb)	Maximum Detected (ppb)	Frequency of Detection[1]	Comparison Value (ppb)	Source
Volatile Organic Compounds					
Benzene	--	2.1	N/A	0.6	CREG
Trichloroethylene (TCE)	--	8.0	N/A	2	RSL
1,1 dichloroethane	1.9	24	N/A	2	RSL
Methylene Chloride	1.0	46	N/A	5	CREG
1,1 dichloroethene/ 1,1 dichloroethylene	1.2	55	N/A	90	EMEG c

Source: 1992 Initial Release Public Health Assessment, MDPH, ACES comments submitted 9/16/2005
The maximum contaminant concentration detected in historical well data is provided in this table. Historical well data from different sources was reported to ATSDR from years 1978 to 1987.
Notes:
-- no minimum value available, only a single detection was reported
N/A - not available
ppb - parts per billion
CREG - Cancer Risk Evaluation Guideline for drinking water
EMEG – Environmental Media Evaluation Guide
MRL – ATSDR Minimal Risk Level
RfD – USEPA Reference Dose, EPA Region III RBC
RSL – USEPA Regional Screening Level

Table 6. Contaminants Detected Above Comparison Values in Groundwater Monitoring Wells (or retained for additional evaluation)

Contaminant	Minimum Detected (ppb)	Maximum Detected (ppb)	Frequency of Detection[1]	Comparison Value (ppb)	Source
Organics					
Acetone	1.4	1,500	N/A	9,000	Child RMEG
Benzene	0.22 (J)	6,000	N/A	0.6	CREG
Bis(2-chloroethyl)ether	1.6 (J)	30	N/A	0.03	CREG
Bis(2-ethylhexyl)phthalate	0.46 (J)	7.5 (J)	N/A	3	CREG
Bromodichloromethane	--	0.76 (J)	N/A	0.6	CREG
Chloroethane	0.4 (J)	85	N/A	2100	RSL
Chloromethane	0.29 (J)	10.45	N/A	30	LTHA
1,2-Dichloroethane	0.23 (J)	120	N/A	0.4	CREG
1,1-Dichloroethene	0.21 (J)	660	N/A	90	Child chronic EMEG
Indeno(1,2,3-cd)pyrene	--	0.6	N/A	0.03	RSL
Methylene Chloride	0.21 (J)	140	N/A	5	CREG
Tetrachloroethene	0.21 (J)	11	N/A	10	LTHA
1,1,2-Trichloroethane	0.25 (J)	1.4	N/A	0.6	CREG
Trichloroethene	0.24 (J)	26	N/A	5	MCL
Vinyl Chloride	0.2 (J)	200	N/A	0.03	CREG
Inorganics					
Aluminum	13.7 (J)	35,400	N/A	10,000	Child intermediate EMEG
Antimony	3.7 (J)	75.7	N/A	4	Child RMEG
Arsenic	3.9 (J)	1,240	N/A	0.02	CREG
Cadmium	0.32 (J)	4.3	N/A	1	Child chronic EMEG
Chromium	0.71 (J)	5,150	N/A	30	Child RMEG (chromium VI)
Cobalt	2.1 (J)	1,230	N/A	100	Child intermediate EMEG
Copper	1.9 (J)	450	N/A	100	Child intermediate EMEG
Iron	26.7	107,000	N/A	26,000	RSL
Lead	1.6 (J)	144	N/A	15	MCL action level
Manganese	2.2	13,000	N/A	500	Child RMEG
Nickel	1.6 (J)	945	N/A	100	LTHA
Thallium	0.11 (J)	21.6	N/A	0.5	LTHA
Vanadium	2.4 (J)	39.8	N/A	30	Child intermediate EMEG

Source: GeoTrans 2002, 2003; Menzie-Cura 2003c

Notes:
-- no minimum value available, only a single detection was reported
(J) - data qualifier; reported value is an estimate
CREG - Cancer Risk Evaluation Guideline for drinking water
EMEG - Exposure Media Evaluation Guideline for drinking water
LTHA - Lifetime health advisory for drinking water
MCL - USEPA maximum contaminant level for drinking water
RBC-N - USEPA Region III Risk Based Concentration for tap water, non-carcinogenic effects
RBC-C - USEPA Region III Risk Based Concentration for tap water, carcinogenic effects
RMEG - Reference Media Evaluation Guideline for drinking water
RSL – USEPA Regional Screening Level
1 Frequency of detection could not be accurately determined; sources presented overlapping data sets.

N/A - not available
ppb - parts per billion

Table 7. Contaminants Detected Above Comparison Values in Surface Water

Contaminant	Minimum Detected (ppb)	Maximum Detected (ppb)	Frequency of Detection[1]		Comparison Value (ppb)	Source
Assabet River						
Inorganics						
Arsenic	--	1.6	1	7	0.02	CREG
Sinking Pond and Gravel Pit Wetland						
Organics						
Phenanthrene	0.012	0.014	2	8	N/A	N/A
Inorganics						
Antimony	0.69 T	5.2 (J)	4	12	4	RMEG Child
Arsenic	2.6	27.05	12	12	0.02	CREG
Manganese	49.8 (J)	2,400 T	20	20	500	RMEG Child
Fort Pond Brook and North Lagoon						
Organics						
Bis(2-Ethylhexyl) Phthalate	0.61	17	6	11	3	CREG
Phenanthrene	--	0.013	1	11	N/A	N/A
Inorganics						
Arsenic	0.38 T	7 T	11	11	0.02	CREG
Manganese	160 T	4,800 T	11	11	500	RMEG Child

Source: Menzie-Cura 2003a, 2003b, 2003c

Notes:
-- no minimum value available, only a single detection was reported
(J) - data qualifier; reported value is an estimate
CREG - Cancer Risk Evaluation Guideline for drinking water
EMEG - Exposure Media Evaluation Guideline for drinking water
LTHA - Lifetime health advisory for drinking water
MCL - USEPA maximum contaminant level for drinking water
RBC-N - USEPA Region III Risk Based Concentration for tap water, non-carcinogenic effects
RMEG - Reference Media Evaluation Guideline for drinking water
1 - Frequency of detection = times detected/times sought

D - Dissolved
N/A - not available
ppb - parts per billion
T - Total

Table 8. Contaminants Detected Above Comparison Values in Sediment (or retained for additional evaluation)

Contaminant	Minimum Detected (ppm)	Maximum Detected (ppm)	Frequency of Detection[1]		Comparison Value (ppm)	Source
Assabet River						
Organics						
Acenaphthylene	0.016 (EB)	0.14 (EB)	7	7	N/A	N/A
Benzo(a)pyrene	0.043 (EB)	0.68 (EB)	7	7	0.1	CREG
Benzo(g,h,i)perylene	0.023 (EB)	0.22 (EB)	7	7	N/A	N/A
Phenanthrene	0.055	0.8	7	7	N/A	N/A
Inorganics						
Arsenic	2.3	6.6	7	7	20	EMEG Child
Thallium	0.061	0.11	7	7	5.2	RBC-N
Sinking Pond and Gravel Pit Wetland						
Organics						
Acenaphthylene	0.0018	0.09	31	31	N/A	N/A
Benzo(a)pyrene	0.0071 (J)	0.4 (J)	31	31	0.1	CREG
Benzo(g,h,i)perylene	0.0018 (JEB)	0.16	30	31	N/A	N/A
Phenanthrene	0.0085 (EB)	0.68 (EB)	31	31	N/A	N/A
Pesticides and Polychlorinated Biphenyls						
Aroclor 1248	--	0.430	1	16	0.22	RSL
Aroclor 1260	0.039 (J)	0.34	6	16	0.22	RSL
Inorganics						
Arsenic	3.3	1,500	31	31	0.5	CREG
Iron	10,000	260,000	28	28	55,000	RSL
Manganese	78	80,000 (J)	28	28	3,000	RMEG Child
Fort Pond Brook and North Lagoon Wetland						
Organics						
Acenaphthylene	0.0025	0.220	21	27	N/A	N/A
Benzo(a)pyrene	0.0023	1.1	23	27	0.1	CREG
Benzo(b)fluoranthene	0.0015	1.2	24	27	0.15	RSL
Benzo(g,h,i)perylene	0.0019	0.830 (J)	23	27	N/A	N/A
Dibenzo(a,h)anthracene	0.0022	0.220 (J)	21	27	0.015	RSL
4-Methyl-2-pentanone	--	0.0056 (J)	1	27	N/A	N/A
Phenanthrene	0.0024	1.2	24	27	N/A	N/A
Inorganics						
Arsenic	6.9 (J)	3,900	33	33	20	EMEG Child
Chromium	1.4	223	33	33	200	RMEG Child (chromium VI)
Copper	3.9	6,000	32	32	500	EMEG Child intermediate
Iron	5,200	390,000	33	33	55,000	RSL
Manganese	60	48,400 (J)	33	33	3,000	RMEG Child

Source: Menzie-Cura 2003a, 2003b, 2003c

Notes:

-- no minimum value available, only a single detection was reported
(EB) - contaminant detected in the equipment blank
(TB) - contaminant detected in the trip blank

1 - Frequency of detection = times detected/times sought
(J) - data qualifier; reported value is an estimate
ppm parts per million

CREG - Cancer Risk Evaluation Guideline for drinking water
EMEG - Exposure Media Evaluation Guideline for drinking water
LTHA - Lifetime health advisory for drinking water
MCL - USEPA maximum contaminant level for drinking water
RBC-N - USEPA Region III Risk Based Concentration for Residential, non-carcinogenic effects
RBC-C - USEPA Region III Risk Based Concentration for Residential, carcinogenic effects
RMEG - Reference Media Evaluation Guideline
RSL – USEPA Regional Screening Level
N/A - not available

Table 9. Contaminants Detected Above Comparison Values in Fish

Contaminant	Minimum Detected (ppm)	Maximum Detected (ppm)	Frequency of Detection[1]		Comparison Value (ppm)	Source
Sinking Pond						
Pesticides and Polychlorinated Biphenyls						
Dieldrin	0.00039	0.00073	3	3	0.0002	RBC-C
Inorganics						
Arsenic	2.3	3.1	3	3	0.0021	RBC-C
Iron	410	650	3	3	410	RBC-N
Lead	0.032	0.057	3	3	0.3	WHO

Source: Menzie-Cura 2003a
Notes:
-- no minimum value available, only a single detection was reported
N/A - not available
(J) - data qualifier; reported value is an estimate
ppm - parts per million
1 - Frequency of detection = times detected/times sought
RBC-N USEPA Region III Risk Based Concentration for fish, non-carcinogenic effects
RBC-C USEPA Region III Risk Based Concentration for fish, carcinogenic effects
WHO World Health Organization, CODEX, General Standard for Contaminants and Toxins in Food, 193-1995

Table 10. Estimated Carcinogenic Risk

Chemical	Routes of Exposure	Pathway	Numeric Cancer Risk Estimate	Total Numeric Cancer Risk Estimate	Qualitative Cancer Risk Estimate
Arsenic	Ingestion, Direct Contact	Ingestion of municipal water	2.23E -05	7.52E -03	Moderate
		Dermal contact municipal water	6.07E-07		
		Incidental ingestion of sediment	5.50E -04		
		Dermal contact with sediment	2.34E -05		
		Incidental ingestion of surface water	3.81E -06		
		Dermal contact with surface water	6.92E -03		
Benzene	Ingestion, Inhalation, Dermal	Municipal well water (Historical): ingestion, inhalation and dermal contact	4.75E -06	4.75 -06	Slight
Bis(2-ethylhexyl)phthalate	Ingestion, Direct Contact	Incidental ingestion of surface water	2.24E -08	4.25E -06	Slight
		Dermal contact with surface water	4.23E -06		
Methylene Chloride	Ingestion, Inhalation, Dermal	Municipal well water (Historical): ingestion, inhalation and dermal contact	1.42E -05	1.42 -05	Very low
Polycyclic Aromatic Hydrocarbons (PAHs)	Ingestion, Direct Contact	Incidental ingestion of sediment	1.60E -06	2.48E -06	Slight
		Dermal contact with sediment	8.83E -07		
		Incidental ingestion of surface water	9.60E -12		
		Dermal contact with surface water	4.92E -10		
Polychlorinated Biphenyls's (PCBs)	Ingestion, Direct Contact	Incidental ingestion of sediment	1.45E -07	2.34E -07	Insignificant
		Dermal contact with sediment	8.98E -08		
Trichloroethylene	Ingestion, Inhalation, Dermal	Municipal well water (Historical): ingestion, inhalation and dermal contact	5.26E -06 to 4.27 -06	5.26E -06 to 4.27 -06	Slight
Vinyl Chloride	Ingestion, Inhalation, Dermal	Municipal well water (Historical): ingestion, inhalation and dermal contact	1.96E-04	1.96E-04	Low
	Ingestion, Direct Contact	Incidental ingestion private wells	7.00E -08		
		Dermal contact from private well water	2.63E -08		

Notes: See Appendix C see for explanation of numeric cancer risk estimates; All theoretical cancer risk estimates are based on the default assumption of a lifetime of exposure (70 years); theoretical excess cancer risks in this table are based on maximum contaminant concentrations available to ATSDR in data through August 2004

Theoretical Cancer Risk

Cancer risk estimates do not reach zero no matter how low the level of exposure to a carcinogen. Terms used to describe this risk are defined below as the number of excess cancers expected in a lifetime:

Term		# of Excess Cancers
moderate	is approximately equal to	1 in 1,000
low	is approximately equal to	1 in 10,000
very low	is approximately equal to	1 in 100,000
slight	is approximately equal to	1 in 1,000,000
insignificant	is less than	1 in 1,000,000

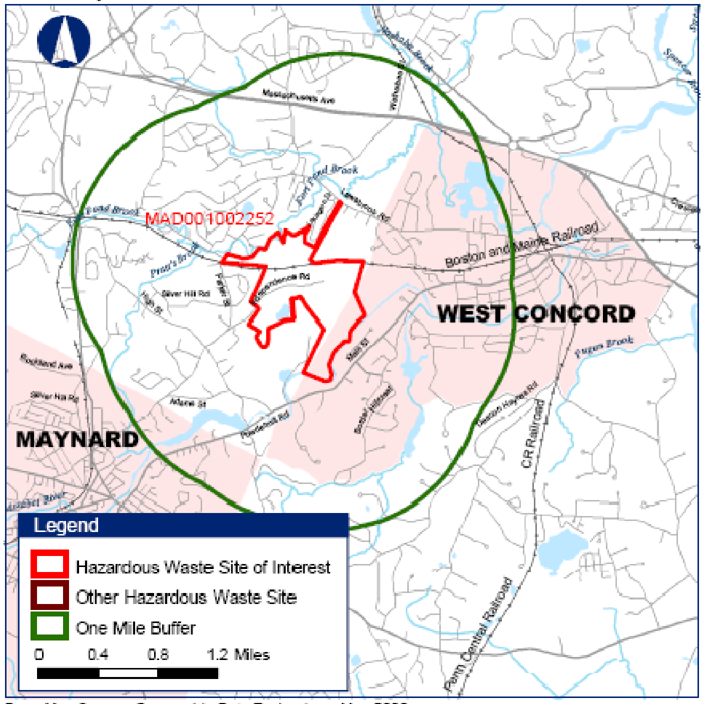
Appendix B

Figures

Figure 1 – Demographic Map

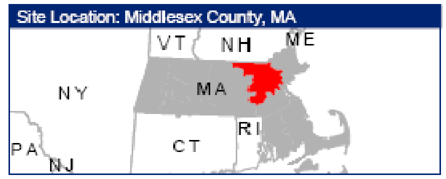
W.R. Grace & Co., Inc. (Acton Plant)
Acton, MA

EPA Facility ID: MAD001002252



Base Map Source: Geographic Data Technology, May 2005.
Site Boundary Data Source: ATSDR Geospatial Research, Analysis, and Services Program, Current as of Generate Date (bottom left-hand corner).
Coordinate System (All Panels): NAD 1983 StatePlane Massachusetts Mainland FIPS 2001 Feet

Site Location: Middlesex County, MA

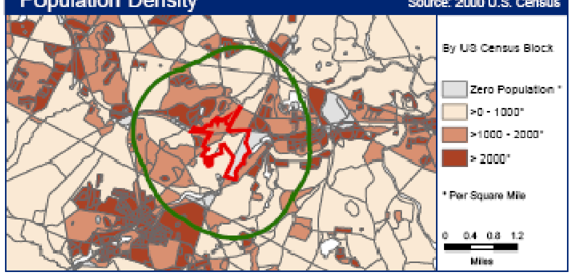


Demographic Statistics
Within One Mile of Site*

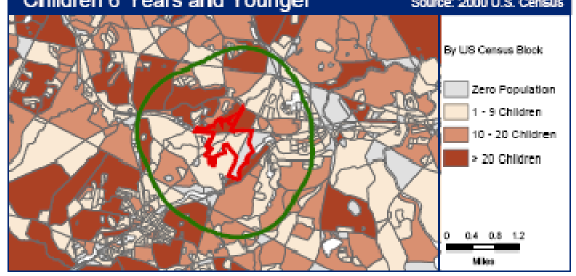
Total Population	8,307
White Alone	7,497
Black Alone	66
Am. Indian & Alaska Native Alone	10
Asian Alone	552
Native Hawaiian & Other Pacific Islander Alone	0
Some Other Race Alone	56
Two or More Races	126
Hispanic or Latino**	150
Children Aged 6 and Younger	874
Adults Aged 65 and Older	933
Females Aged 15 to 44	1,610
Total Housing Units	3,161

Demographics Statistics Source: 2000 U.S. Census
* Calculated using an area-proportion spatial analysis technique
** People who identify their origin as Hispanic or Latino may be of any race.

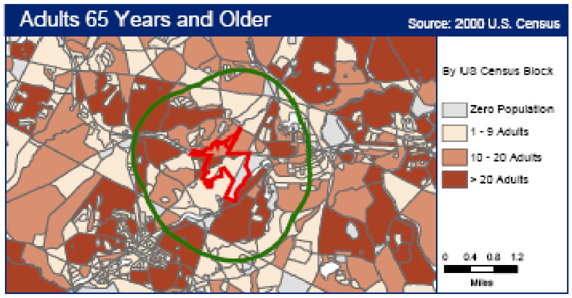
Population Density Source: 2000 U.S. Census



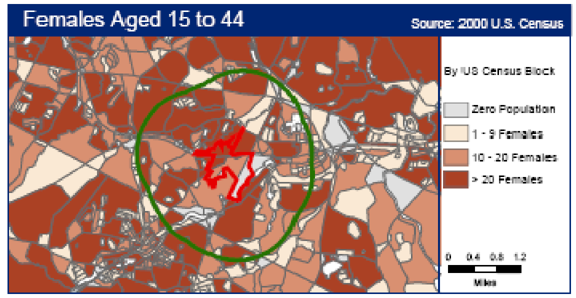
Children 6 Years and Younger Source: 2000 U.S. Census



Adults 65 Years and Older Source: 2000 U.S. Census



Females Aged 15 to 44 Source: 2000 U.S. Census



<project=03D00><userid=JXA0><geo=Middlesex County, MA><keywords=MAD001002252>

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Figure 2 – General Extent of Groundwater Plume

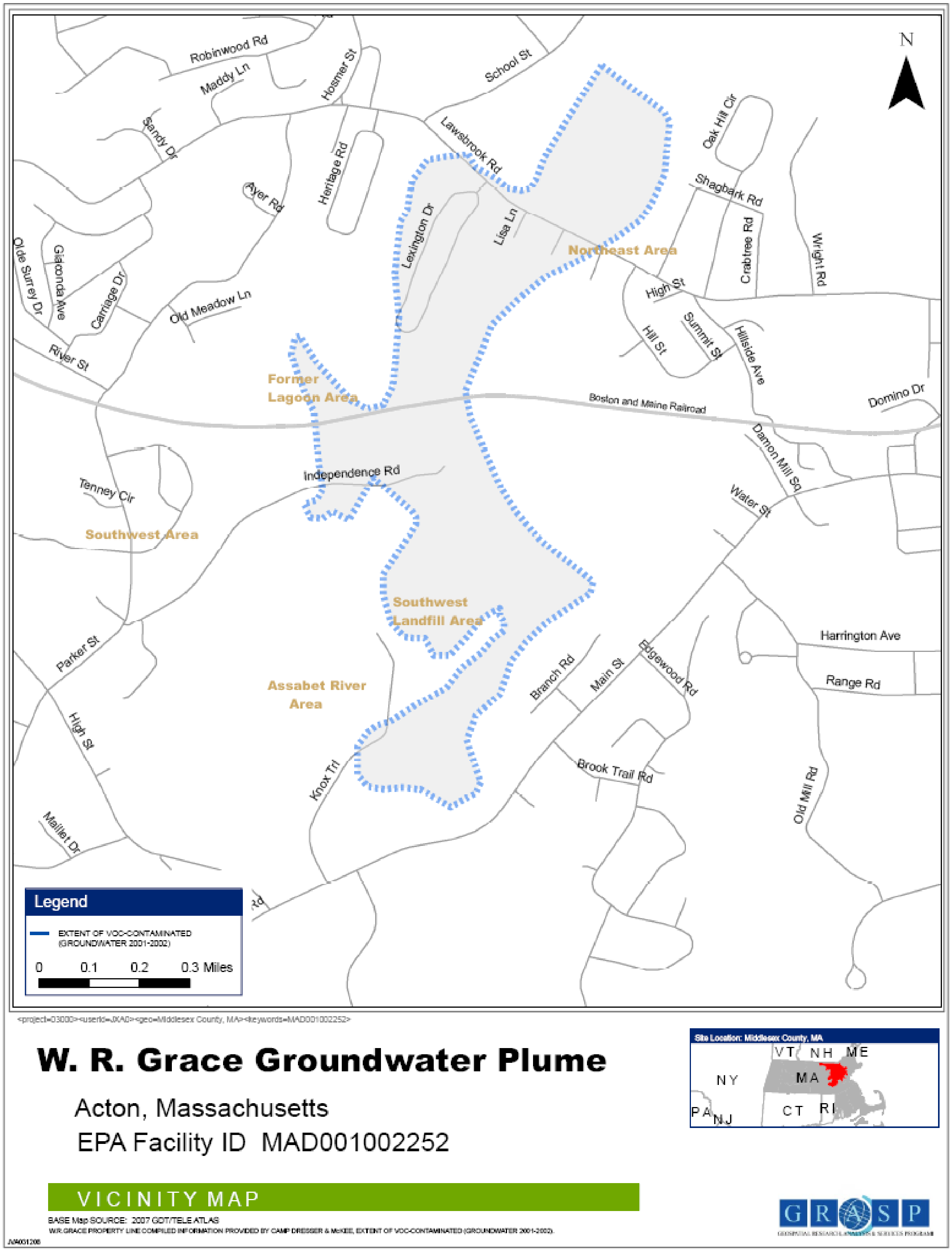

Figure 3 – Public Water Supply Wells (Assabet 1 & 2, Lawsbrook, Scribner and Christofferson), along with WR Grace Property Boundary (red), and 2002 Groundwater Plume (blue)

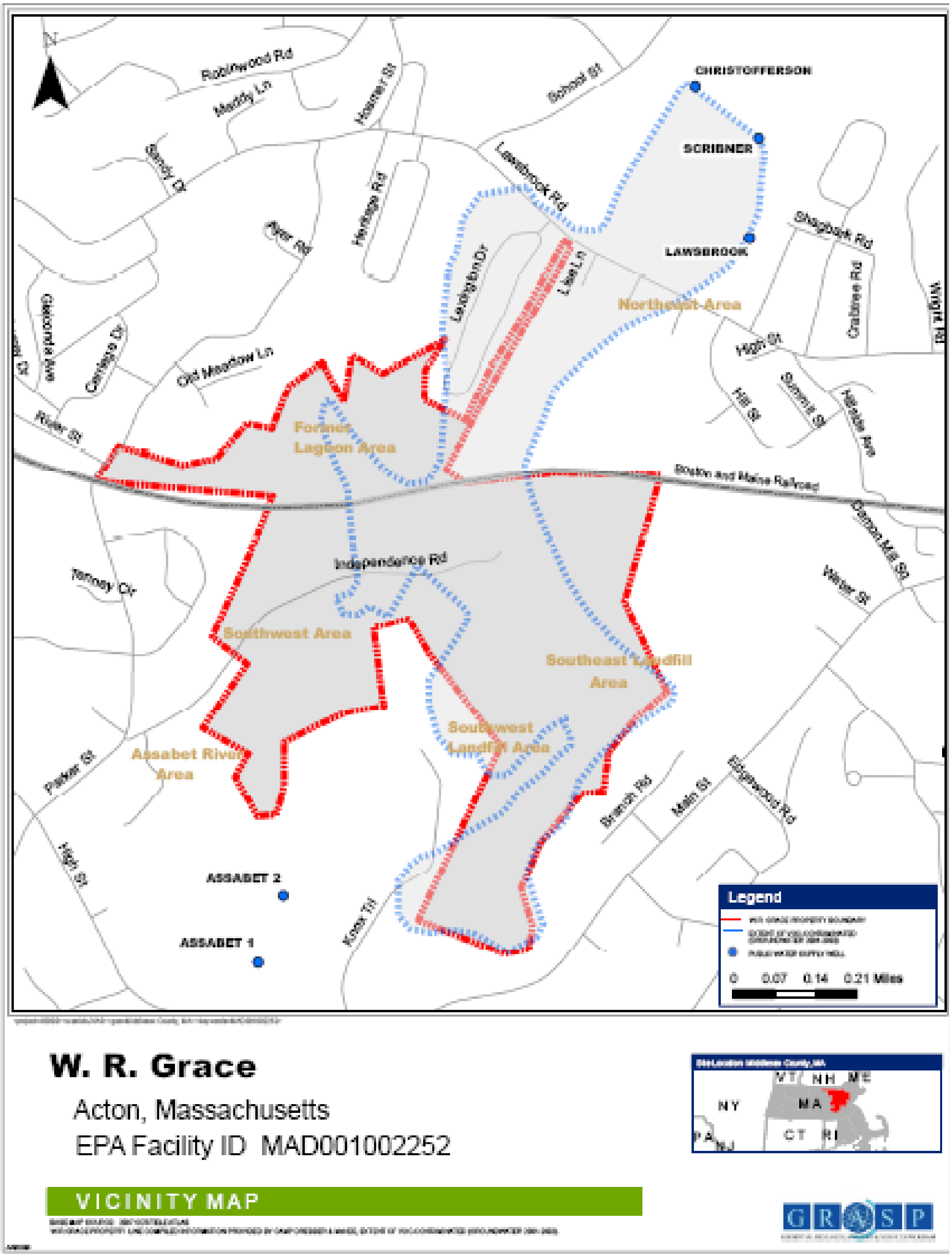

Figure 4 – Entrance Gate

Figure 5 – Sinking Pond

Figure 6 – Signs

Figure 7 - Dirt Bike Tracks

Figure 8 – Groundwater Treatment Area

Figure 9 – Fort Pond Brook

Appendix C

ATSDR's Evaluation Process

ATSDR's Evaluation Process

Step 1 – Comparison Values and the Screening Process

In order to evaluate the available data, ATSDR used comparison values (CVs) to determine which chemicals to examine more closely. CVs are the contaminant concentrations found in a specific media (for example: air, soil, or water) and are used to select contaminants for further evaluation. CVs incorporate assumptions of daily exposure to the chemical and a standard amount of air, water, and soil that someone may inhale or ingest each day. CVs are generated to be conservative and non-site specific. These values are used only to screen out chemicals that do not need further evaluation. CVs are not intended to be used as environmental clean-up levels or to indicate that health effects occur at concentrations that exceed these values.

CVs can be based on either carcinogenic (cancer-causing) or non-carcinogenic effects. Cancer-based comparison values are calculated from the U.S. Environmental Protection Agency's (USEPA) oral cancer slope factor (CSF) or inhalation risk unit. CVs based on cancerous effects account for a lifetime exposure (70 years) with an unacceptable theoretical excess lifetime cancer risk of 1 new case per 1 million exposed people. Non-cancer values are calculated from ATSDR's Minimal Risk Levels (MRLs), USEPA's Reference Doses (RfDs), or USEPA's Reference Concentrations (RfCs). When a cancer and non-cancer CV exists for the same chemical, the lower of these values is used in the comparison for conservatism. The chemical and media-specific CVs utilized during the preparation of this PHA are listed below:

A **Reference Dose Media Evaluation Guide (RMEG)** is a comparison concentration that is based on USEPA's estimate of the daily exposure to a contaminant that is unlikely to cause adverse health effects.

A **Cancer Risk Evaluation Guide (CREG)** is a comparison concentration that is based on an excess cancer rate of one in a million persons and is calculated using USEPA's cancer slope factor (CSF).

A **Maximum Contaminant Level (MCL)** is a contaminant concentration that USEPA deems protective of public health, and may consider the availability and economics of water treatment technology.

A **Life Time Health Advisory (LTHA)** is developed by USEPA and is considered a lifetime exposure level for contaminants specifically in drinking water (assuming 20% of an individual's exposure comes from drinking water) at which adverse, non-carcinogenic health effects would not be expected to occur.

Preliminary Remediation Goal (PRG) is a screening tool, generated by EPA Region IX, which is used at the early stages of human exposure evaluation and clean-up considerations at contaminated sites. PRGs are risk-based concentrations derived from standardized equations, combining exposure assumptions and USEPA toxicity data. These values are generic and do not take into account available site-specific information.

Step 2 – Evaluation of Public Health Implications

The next step in the evaluation process is to take those contaminants that are above their respective CVs and further identify which chemicals and exposure situations are likely to be a health hazard. Separate child and adult exposure doses (or the amount of a contaminant that gets into a person's body) are calculated for site-specific exposure scenarios, using assumptions regarding an individual's likelihood of accessing the site and contacting contamination. A brief explanation of the calculation of estimated exposure doses for the site is presented below. Calculated doses are reported in units of milligrams per kilograms per day (mg/kg/day). Separate calculations have been performed to account for non-cancer and cancer health effects for each chemical based on the health impacts reported for each chemical. The same dose equations have been used for non-cancer and cancer calculations with the indicated modifications. Some chemicals are associated with non-cancer effects while the scientific literature many indicate that cancer-related health impacts are not expected from exposure.

Exposure Dose Estimation

When chemical concentrations at the site exceed the established CVs, it is necessary for a more thorough evaluation of the chemical to be conducted. In order to evaluate the potential for human exposure to contaminants present at the site and potential health effects from site-specific activities, ATSDR estimates human exposure to the site contaminant from different environmental media by calculating exposure doses. A brief discussion of the calculations and assumptions is presented below. The equations and the assumptions are based on the USEPA Risk Assessment Guidance for Superfund, Part A and the USEPA Exposure Factors Handbook, unless otherwise specified. A discussion of the cancer and non-cancer evaluation of exposure is presented following the equations for each pathway.

Ingestion of Contaminants in Municipal Wells

The exposure dose for ingestion of drinking water is presented below.

$$\text{Dose (mg/kg/day)} = \frac{C \times IR \times EF \times ED}{BW \times AT}$$

C = chemical concentration (mg/L)
IR = ingestion rate (L/day)
EF = exposure frequency (days/years)
ED = exposure duration (years)
BW = body weight (kg)
AT = averaging time (days)

Exposure doses were calculated using the maximum detected concentration of a contaminant (C) from the environmental data in mg/L. An ingestion rate (IR) of 2 liters per day (L/day) for adults, 1.5 L/day for adolescents, and 1 L/day for children. An exposure frequency (EF) of 350 days per year was assumed (year minus two weeks of vacation or other time spent away from the home). It was assumed that the exposure duration (ED) was 30, 12, and 6 years for adults, adolescents, and children, respectively. A body weight (BW) of 70 kilograms (kg) for adults, 45 kg for adolescents and 16 kg for children was also assumed. It should be noted that different averaging times (AT) are used for evaluating non-cancer and cancerous health effects. The averaging time (AT) for non-cancer chemicals is equal to the ED multiplied by the EF, which is 10,500 days for adults, 4,200 days for adolescents, and 2,100 days for children. For chemicals associated with cancerous effects, AT of 25,550 days was used to account for lifetime exposure to a particular chemical (365 days per year multiplied by 70 years).

Incidental Ingestion of Contaminants in Private Well

The exposure dose for incidental ingestion of private well water is presented below.

$$\text{Dose (mg/kg/day)} = \frac{C \times IR \times EF \times ED}{BW \times AT}$$

C = chemical concentration (mg/L)
IR = ingestion rate (L/day)
EF = exposure frequency (days/years)
ED = exposure duration (years)
BW = body weight (kg)
AT = averaging time (days)

Exposure doses were calculated using the maximum detected concentration of a contaminant (C) from the environmental data in mg/L. An incidental ingestion rate (IR) of 0.1 liters per day (L/day) for adults and children. An exposure frequency (EF) of 350 days per year was assumed (year minus two weeks of vacation or other time spent away from the home).

It was assumed that the exposure duration (ED) was 30 years for adults and 6 years for children. A body weight (BW) of 70 kilograms (kg) for adults and 16 kg for children was also assumed. It should be noted that different averaging times (AT) are used for evaluating non-cancer and cancerous health effects. The averaging time (AT) for non-cancer chemicals is equal to the ED multiplied by the EF, which is 10,500 days for adults and 2,100 days for children. For chemicals associated with cancerous effects, AT of 25,550 days was used to account for lifetime exposure to a particular chemical (365 days per year multiplied by 70 years).

Direct Skin Contact to Contaminants in Private Well Water

The exposure dose for direct skin contact with drinking water is presented below.

$$\text{Dose (mg/kg/day)} = \frac{C \times SA \times PC \times ET \times EF \times ED \times CF}{BW \times AT}$$

C = chemical concentration (mg/L)
SA = surface area (cm^2)
PC = permeability constant (cm/hour)
ET = exposure time (hours/day)
EF = exposure frequency (days/years)
ED = exposure duration (years)
CF = conversion factor (cm^3/L)?
BW = body weight (kg)
AT = averaging time (days)

Exposure doses were calculated using the maximum detected concentration of a contaminant (C) from the environmental data in mg/L. A surface area (SA) of 18,150 square centimeters (cm^2) for adults and 7,195 cm^2 for children was used. The chemical specific permeability constants (cm/hour) are based on USEPA's 1992 Dermal Exposure Guidance, if available. If no chemical specific permeability constant (PC) was available, ATSDR assumed a conservative PC value. An exposure frequency (EF) of 90 days per year was assumed (3 summer months). An exposure time (ET) of 1.5 hours per day was assumed (estimate of time wading or swimming in a pool per day). It was assumed that the exposure duration (ED) was 30 and 6 years for adults and children, respectively. A body weight (BW) of 70 kilograms (kg) for adults and 16 kg for children was also assumed. It should be noted that different averaging times (AT) are used for evaluating non-cancer and cancerous health effects. The averaging time (AT) for non-cancer chemicals is equal to the ED multiplied by the EF, which is 10,500 days for adults and 2,100 days for children. For chemicals associated with cancerous effects, AT of 25,550 days was used to account for lifetime exposure to a particular chemical (365 days per year multiplied by 70 years).

Direct Skin Contact to Contaminants in Surface Water

The exposure dose for direct skin contact with surface water is presented below.

$$\text{Dose (mg/kg/day)} = \frac{C \times SA \times PC \times ET \times EF \times ED \times CF}{BW \times AT}$$

C = chemical concentration (mg/L)
SA = surface area (cm^2)
PC = permeability constant (cm/hour)
ET = exposure time (hours/day)
EF = exposure frequency (days/years)
ED = exposure duration (years)
CF = conversion factor (cm^3/L)
BW = body weight (kg)
AT = averaging time (days)

Exposure doses were calculated using the maximum detected concentration of a contaminant (C) from the environmental data in mg/L. A surface area (SA) of 18,150 square centimeters (cm^2) for adults, 14,900 for adolescents, and 7,195 cm^2 for children was used. The chemical specific permeability constants (cm/hour) are based on USEPA's 1992 Dermal Exposure Guidance, if available. If no chemical specific permeability constant (PC) was available, ATSDR assumed a conservative PC value of one. An exposure frequency (EF) of 24 days per year was assumed (2 days per week during 3 summer months). An exposure time (ET) of 1 hour per day was assumed (estimate of time wading in river, pond or wetland per day). It was assumed that the exposure duration (ED) was 30, 12, and 6 years for adults, adolescents, and children, respectively. A body weight (BW) of 70 kilograms (kg) for adults, 45 kg for adolescents, and 16 kg for children was also assumed. It should be noted that different averaging times (AT) are used for evaluating non-cancer and cancerous health effects. The averaging time (AT) for non-cancer chemicals is equal to the ED multiplied by the EF, which is 10,500 days for adults, 4,200 for adolescents and 2,100 days for children. For chemicals associated with cancerous effects, AT of 25,550 days was used to account for lifetime exposure to a particular chemical (365 days per year multiplied by 70 years).

Incidental Ingestion of Contaminants in Surface Water

The exposure dose for incidental ingestion of private well water is presented below.

$$\text{Dose (mg/kg/day)} = \frac{C \times IR \times EF \times ED}{BW \times AT}$$

C = chemical concentration (mg/L)
IR = ingestion rate (L/day)
EF = exposure frequency (days/years)
ED = exposure duration (years)
BW = body weight (kg)
AT = averaging time (days)

Exposure doses were calculated using the maximum detected concentration of a contaminant (C) from the environmental data in mg/L. An incidental ingestion rate (IR) of 0.1 liters per day (L/day) for adults, adolescents and children. An exposure frequency (EF) of 24 days per year was assumed (2 days per week for 3 summer months).

It was assumed that the exposure duration (ED) was 30 years for adults, 12 years for adolescents and 6 years for children. A body weight (BW) of 70 kilograms (kg) for adults, 45 kg for adolescents, and 16 kg for children was also assumed. It should be noted that different averaging times (AT) are used for evaluating non-cancer and cancerous health effects. The averaging time (AT) for non-cancer chemicals is equal to the ED multiplied by the EF, which is 10,500 days for adults, 4,200 for adolescents and 2,100 days for children. For chemicals associated with cancerous effects, AT of 25,550 days was used to account for lifetime exposure to a particular chemical (365 days per year multiplied by 70 years).

Incidental Ingestion of Contaminants in Sediment

The exposure dose for incidental ingestion of private well water is presented below.

$$\text{Dose (mg/kg/day)} = \frac{C \times IR \times EF \times ED}{BW \times AT}$$

C = chemical concentration (mg/L)
IR = ingestion rate (L/day)
EF = exposure frequency (days/years)
ED = exposure duration (years)
BW = body weight (kg)
AT = averaging time (days)

Exposure doses were calculated using the maximum detected concentration of a contaminant (C) from the environmental data in mg/L. An incidental ingestion rate (IR) of 100 milligrams per day (mg/day) for adults, 150 mg/day for adolescents and 200 mg/day for children. An exposure frequency (EF) of 24 days per year was assumed (2 days per week for 3 summer months). An exposure time (ET) of 1 hour per day was assumed.

It was assumed that the exposure duration (ED) was 30 years for adults, 12 years for adolescents and 6 years for children. A body weight (BW) of 70 kilograms (kg) for adults, 45 kg for adolescents, and 16 kg for children was also assumed. It should be noted that different averaging times (AT) are used for evaluating non-cancer and cancerous health effects. The averaging time (AT) for non-cancer chemicals is equal to the ED multiplied by the EF, which is 10,500 days for adults, 4,200 for adolescents and 2,100 days for children. For chemicals associated with cancerous effects, AT of 25,550 days was used to account for lifetime exposure to a particular chemical (365 days per year multiplied by 70 years).

Direct Skin Contact with Contaminants in Sediment

The exposure dose for direct skin contact with sediment is presented below.

$$\text{Dose (mg/kg/day)} = \frac{DA_{event} \times EF \times ED \times EV \times SA}{BW \times AT}$$

DA_{event} = Absorbed dose per event (mg/cm^2-event)
EF = exposure frequency (days/years)
ED = exposure duration (years)
EV = Event frequency (events/day)
SA = skin surface area (cm^2)
BW = body weight (kg)
AT = averaging time (days)

$\underline{DA_{event}} = C \times CF \times AF \times ABS_d$

C = Chemical concentration in soil
CF = Conversion factor (10^{-6} kg/mg)
AF = Adherence factor of soil to skin
ABS_d = Dermal absorption fraction

Exposure doses were calculated using the maximum detected concentration of a contaminant (C) from the environmental data in milligrams per liter (mg/kg). A surface area (SA) of 6,074 square centimeters (cm^2) for adults, 4,471 for adolescents, and 2178 cm^2 for children was used. A skin adherence factor of 0.07 was used for adults and adolescents and AF of 0.2 was used for children [USEPA, RAGS, Part E, Chap 3]. If a chemical specific absorption factor (ABS) was available it was used, if not a conservative ABS of 1.0 was used. An exposure frequency (EF) of 24 days per year was assumed (2 days per week during 3 summer months). It was assumed that the exposure duration (ED) was 30, 12, and 6 years for adults, adolescents, and children, respectively. A body weight (BW) of 70 kilograms (kg) for adults, 45 kg for adolescents, and 16 kg for children was also assumed. It should be noted that different averaging times (AT) are used for evaluating non-cancer and cancerous health effects. The averaging time (AT) for non-cancer chemicals is equal to the ED multiplied by the EF, which is 10,500 days for adults, 4,200 for adolescents and 2,100 days for children. For chemicals associated with cancerous effects, AT of 25,550 days was used to account for lifetime exposure to a particular chemical (365 days per year multiplied by 70 years).

Non-Cancer Health Effects

The doses calculated for exposure to each individual chemical are then compared to an established health guideline, such as a Minimal Risk Level (MRL) or a Reference Dose (RfD), in order to assess whether adverse non-cancer health impacts from exposure are expected. These health guidelines, developed by ATSDR and USEPA, are chemical-specific values that are based on the available scientific literature and are considered protective of human health. Non-carcinogenic effects, unlike carcinogenic effects, are believed to have a threshold, that is, a dose below which adverse health effects will not occur. As a result, the current practice for deriving health guidelines is to identify, usually from animal toxicology experiments, a No Observed Adverse Effect Level (or NOAEL), which indicates that no effects are observed at a particular exposure level. This is the experimental exposure level in animals (and sometimes humans) at which no adverse toxic effect is observed. The NOAEL is then modified with an uncertainty (or safety) factor, which reflects the degree of uncertainty that exists when experimental animal data are extrapolated to the general human population. The magnitude of the uncertainty factor considers various factors such as sensitive subpopulations (for example; children, pregnant women, and the elderly), extrapolation from animals to humans, and the completeness of available data. Thus, exposure doses at or below the established health guideline are not expected to result in adverse health effects because these values are much lower (and more human health protective) than doses, which do not cause adverse health effects in laboratory animal studies. For non-cancer health effects, the following health guidelines are described below in more detail. It is important to consider that the methodology used to develop these health guidelines does not provide any information on the presence, absence, or level of cancer risk. Therefore, a separate cancer evaluation is necessary for potentially cancer-causing chemicals detected in samples at this site. A more detailed discussion of the evaluation of cancer risk is presented in the Cancer Risks Section of this Appendix.

Non-Cancer Health Guidelines

Minimal Risk Levels (MRLs) – developed by ATSDR

ATSDR has developed MRLs for contaminants commonly found at hazardous waste sites. The MRL is an estimate of daily exposure to a contaminant below which non-cancer, adverse health effects are unlikely to occur. MRLs are developed for different routes of exposure, such as inhalation and ingestion, and for lengths of exposure, such as acute (less than 14 days), intermediate (15-364 days), and chronic (365 days or greater). At this time, ATSDR has not developed MRLs for dermal exposure. A complete list of the available MRLs can be found at http://www.atsdr.cdc.gov/mrls/index.html.

References Doses (RfDs) – developed by USEPA

An estimate of the daily, lifetime exposure of human populations to a possible hazard that is not likely to cause non-cancerous health effects. RfDs consider exposures to sensitive sub-populations, such as the elderly, children, and the developing fetus. USEPA RfDs have been developed using information from the available scientific literature and have been calculated for oral and inhalation exposures. A complete list of the available RfDs can be found at http://www.epa.gov/iris.

If the estimated exposure dose for a chemical is less than the health guideline value, the exposure is unlikely to result in non-cancer health effects.

If the calculated exposure dose is greater than the health guideline, the exposure dose is compared to known toxicological values for the particular chemical and is discussed in more detail in the text of the PHA. The known toxicological values are doses derived from human and animal studies that are presented in the ATSDR Toxicological Profilesand USEPA's Integrated Information System (IRIS). A direct comparison of site-specific exposure doses to study-derived exposures and doses found to cause adverse health effects is the basis for deciding whether health effects are likely to occur. This in-depth evaluation is performed by comparing calculated exposure doses with known toxicological values, such as the no-observed adverse-effect-level (NOAEL) and the lowest-observed-adverse-effect-level (LOAEL) from studies used to derive the MRL or RfD for a chemical. As part of this comparison to toxicological values, a margin of exposure (MOE) is calculated by dividing the NOAEL and/or LOAEL by the site-specific exposure dose. Generally, when the MOE is greater than 1,000, harmful health effects are not expected. When the MOE ranges from approximately 100 to 1,000, further toxicological evaluation is necessary to determine whether harmful effects are likely. This may include looking more closely at the studies used to derive the NOAELs and LOAELs. Adverse health effects may occur when the MOE is less than 10.

Cancer Risk

Exposure to a cancer-causing compound, even at low concentrations, is assumed to be associated with some increased risk for evaluation purposes. The estimated excess risk of developing cancer from exposure to contaminants associated with the site was calculated by multiplying the maximum contaminant concentration by ATSDR's estimated site-specific adult exposure parameters by USEPA's chemical-specific Cancer Slope Factors (CSFs or cancer potency estimates), which are available at http://www.epa.gov/iris.

An increased excess lifetime theoretical cancer risk is not a specific estimate of expected cancers. Rather, it is an estimate of the increase in the probability that a person may develop cancer sometime during his or her lifetime following exposure to a particular contaminant. Therefore, the theoretical cancer risk calculation incorporates the equations and parameters (including the exposure duration and frequency) used to calculate the dose estimates, but the estimated value is divided by 25,550 days (or the averaging time), which is equal to a lifetime of exposure (70 years) for 365 days/year.

There are varying suggestions among the scientific community regarding an acceptable excess lifetime cancer risk, due to the uncertainties regarding the mechanism of cancer. The recommendations of many scientists and USEPA have been in the risk range of 1 in 1 million to 1 in 10,000 (as referred to as 1×10^{-6} to 1×10^{-4}) excess cancer cases. An excess lifetime cancer risk of one in one million or less is generally considered an insignificant increase in cancer risk.

Cancer risk less than 1 in 10,000 are not typically considered a health concern. An important consideration when determining cancer risk estimates is that the risk calculations incorporate several very conservative assumptions that are expected to overestimate actual exposure scenarios. For example, the method used to calculate USEPA's CSFs assumes that high-dose animal data can be used to estimate the risk for low dose exposures in humans. As previously stated, the method also assumes that there is no safe level for exposure. Lastly, the method computes the 95% upper bound for the risk, rather than the average risk, suggesting that the cancer risk is actually lower, perhaps by several orders of magnitude.

Because of the uncertainties involved with estimating carcinogenic risk, ATSDR employs a weight-of-evidence approach in evaluating all relevant data. Therefore, the carcinogenic risk is also described in words (qualitatively) rather than giving a numerical risk estimate only. The numerical risk estimate must be considered in the context of the variables and assumptions involved in their derivation and in the broader context of biomedical opinion, host factors, and actual exposure conditions. The actual parameters of environmental exposures have been given careful and thorough consideration in evaluating the assumptions and variables relating to both toxicity and exposure. A complete review of the toxicological data regarding the doses associated with the production of cancer and the site-specific doses for the site is an important element in determining the likelihood of exposed individuals being at a greater risk for cancer. A table with the numeric and qualitative cancer risk estimates for each of the completed or potential exposure pathways is presented in Appendix A, Table 10.

Appendix D

Vapor Intrusion and Johnson and Ettinger Indoor Air Model

VOC Indoor Air Modeling

The U.S. Environmental Protection Agency (USEPA) developed the Johnson and Ettinger model to estimate indoor air concentrations and associated health hazards from subsurface vapor intrusion into buildings. This model is a *screening-level* model that estimates the transport of contaminated vapors from either subsurface soils or groundwater into the spaces directly above the source of contamination [50].

The Johnson and Ettinger model is a first-tier screening tool that uses data about properties of the soil, chemical properties of the contaminant, and structural properties of the building. All but the most sensitive parameters have been set to either an upper bound value or the median value. As a result, the model is very conservative when predicting indoor air concentrations. To predict indoor air concentrations in homes in the vicinity of the W.R. Grace site groundwater plume, ATSDR entered the maximum groundwater concentrations for benzene, 1,1-dichloroethene, 1,2-dichloroethene, and 1,2-dichloropropane and vinyl chloride into the Johnson and Ettinger model. The model generates an infinite source building indoor concentration, which is the estimated indoor air concentration of the VOC contaminant for a house located above the plume. Although the model is a useful tool that enables ATSDR and other scientists to conservatively predict indoor air concentration, it has limitations:

- It does not consider the effects of multiple contaminants.
- Its calculations do not account for preferential vapor pathways due to soil fractures, vegetation root pathways, or the effects of a gravel layer beneath the floor slab.
- The groundwater model does not account for the rise and fall of the water table due to aquifer discharge and recharge.
- The model also assumes that all vapors will enter the building, implying that a constant pressure field is generated between the interior spaces and the soil surface.
- It neglects periods of near zero pressure differential.
- Soil properties in the area of contamination are assumed to be identical to those in the area above the contamination.

VOC Indoor Air Model Approach

Table D-1 lists the indoor air concentrations that ATSDR estimated for VOCs considered in this analysis. We emphasize that these are *conservative estimates:* our initial modeling application assumed that the maximum concentration of VOCs detected in the plume entered the home. As the table indicates, the estimates of the indoor air concentrations of the VOCs were lower than the associated ATSDR chronic inhalation LOAEL or NOAEL and the levels at which effects have been observed in animal studies or exposed humans. These findings suggest that the estimated air concentrations of VOCs inside homes above the W.R. Grace site groundwater plume would not reach unhealthy levels.

Rather than simulating the many complex factors that affect how toxic chemicals disperse in air, ATSDR evaluated a simple and overestimated exposure situation: *What would be the estimated indoor air concentration of a VOC contaminant for a house located directly above a groundwater plume with a VOC concentration equal to the highest level measured in the specified area?* Though obviously unrealistic, this scenario provides an extreme upper bound estimate of what the actual ambient air concentrations might have been. We used the Johnson and Ettinger indoor air model to estimate indoor air concentrations for residences near the Former Lagoon Area, Southeast Landfill Area, and the Southwest Landfill Area.

For predicting indoor air concentrations in homes at or near these areas, ATSDR entered the maximum groundwater concentrations for each identified VOC of concern into the Johnson and Ettinger model. Incremental risks obtained for each contaminant of concern for vapor intrusion into indoor air were then converted into predicted concentrations and compared to a reference value for that compound. Based on this strategy, ATSDR found that none of the predicted incremental risks or air concentrations exceeded reference values and thus were not at levels that are known to cause adverse health effects.

Table D-1. Model Incremental Risk and Indoor Air Concentrations

Exposure Point	Chemical of Potential Concern	Maximum Groundwater Concentration (ppb)	Incremental Risk (unitless)	Model Air Concentration (ppb)	Guidance Value (ppb)	Source
Former Lagoon Area	1,1-dichloroethene	100	5.4E-03[1]	272	5,000	NOAEL [9]
	vinyl chloride	27	1.5E-06	156	10,000	LOAEL [19]
Southeast Landfill Area	1,1-dichloroethene	59	2.1E-03[1]	106	25,000	NOAEL [9]
	1,2-dichloroethene	110	2.6E-03[1]	23	None	N/A
	1,2-dichloropropane	15	7.1E-08	3	15,000	LOAEL [10]
	benzene	190	8.2E-07	77	570	LOAEL [5]
	vinyl chloride	17.5	6.5E-07	67	10,000	LOAEL [19]
Southwest Landfill Area	benzene	7.2	9.1E-08	9	780	LOAEL [5]
	vinyl chloride	3	5.3E-08	5	10,000	LOAEL [19]

[1]Denotes the hazard quotient for a noncarcinogenic contaminant.

References:

Johnson and Ettinger (1991) Model for Subsurface Vapor Intrusion into Buildings. Available at http://www.epa.gov/oswer/riskassessment/airmodel/johnson_ettinger.htm.
EPA Integrated Risk Information System. Available at http://www.epa.gov/iris/.

Appendix E

Levels of Public Health Hazard

Levels of a Public Health Hazard

ATSDR categorizes exposure pathways at hazardous waste sites according to their level of public health hazard to indicate whether people could be harmed by exposure pathways and site conditions. The categories are:

Urgent Public Health Hazard:	This category applies to exposure pathways and sites that have certain physical features or evidence of short-term (less than 1 year), site-related chemical exposure that could result in adverse health effects and requires quick intervention to stop people from being exposed.
Public Health Hazard:	The category applies to exposure pathways and sites that have certain physical features or evidence of chronic (long-term), site-related chemical exposure that could result in adverse health effects.
Indeterminate Public Health Hazard:	The category applies to exposure pathways and sites where important information is lacking about chemical exposures, and a health determination cannot be made.
No Apparent Public Health Hazard:	The category applies to pathways and sites where exposure to site-related chemicals may have occurred in the past or is still occurring, however, the exposure is not at levels expected to cause adverse health effects.
No Public Health Hazard:	The category applies to pathways and sites where there is evidence of an absence of exposure to site-related chemicals.

Appendix F

Comparison of Public Health Assessments and Risk Assessments

ATSDR
AGENCY FOR TOXIC SUBSTANCES AND DISEASE REGISTRY

Comparison of Public Health Assessments and Risk Assessments

Issue	Public Health Assessments (PHA)	Risk Assessments (RA)
What it is:	■ A process to evaluate exposure to chemicals in the environment and the impact of those exposures on public health ■ It defines likely exposure pathways and potentially exposed populations to address community health concerns ■ It recommends actions to protect public health	■ A process to provide risk managers and the community with an understanding of the potential human health risk posed by a site in the absence of any cleanup ■ A transparent assessment process for making consistent remedial decisions that are protective of human health and ecological receptors ■ It estimates unacceptable risks as defined by regulatory standards and requirements
What it is not:	■ A medical evaluation ■ A health study ■ A regulatory document ■ An evaluation of ecological risks	■ A prediction of the likely health effects from exposure ■ A document containing public health recommendations
Data / Information Used	■ Environmental & biologic data ■ Community health concerns ■ Health effects data (i.e., epidemiological, toxicological, and health outcome data) ■ Site-specific exposure considerations ■ Health guidelines to screen for chemicals needing further evaluation	■ Environmental data ■ Remedial goals ■ Toxicity data ■ Default and site specific exposure assumptions ■ Regulatory guidelines to determine unacceptable risk that need to be addressed through remediation

Issue	Public Health Assessments (PHA)	Risk Assessments (RA)
Health Guidelines Used	For Screening: ■ Minimal Risk Levels (MRLs) ■ Reference Doses (RfDs) ■ Reference Concentation (RfCs) ■ 10^{-6} cancer risk	To Determine Unacceptable Risk: ■ RfDs ■ RfCs ■ 10^{-4} to 10^{-6} cancer risk ■ Cancer Slope Factors
Findings	■ Identify actual chemical and radiological exposures to environmental contamination ■ Assess real or perceived site-related health problems ■ Focus on the past, the present and the future ■ Recommend measures to prevent or reduce exposure ■ Develop mechanisms to re-evaluate public health issues as site conditions change ■ Recommend health-based follow-up actions	■ Calculate reasonable maximum exposures to derive cleanup goals that are protective of sensitive populations and ecological endpoints ■ Establish site-specific cleanup goals ■ Focus on the present and the future
Outcome / Endpoint	■ Reduce exposures ■ Fill data gaps (via sampling or research) ■ Health Studies ■ Health Education ■ Exposure Registries ■ Address community concerns ■ Leverage public and private partnerships to implement public health actions	■ Support for regulatory decisions (based on human and ecological risks)

Appendix G

ATSDR Glossary of Environmental Health Terms

ATSDR Glossary of Environmental Health Terms

The Agency for Toxic Substances and Disease Registry (ATSDR) is a federal public health agency with headquarters in Atlanta, Georgia, and 10 regional offices in the United States. ATSDR's mission is to serve the public by using the best science, taking responsive public health actions, and providing trusted health information to prevent harmful exposures and diseases related to toxic substances. ATSDR is not a regulatory agency, unlike the U.S. Environmental Protection Agency (USEPA), which is the federal agency that develops and enforces environmental laws to protect the environment and human health.

This glossary defines words used by ATSDR in communications with the public. It is not a complete dictionary of environmental health terms. If you have questions or comments, call ATSDR's toll-free telephone number, (800) 232-4636.

Absorption
The process of taking in. For a person or animal, absorption is the process of a substance getting into the body through the eyes, skin, stomach, intestines, or lungs.

Acute
Occurring over a short time [compare with **chronic**].

Acute exposure
Contact with a substance that occurs once or for only a short time (up to 14 days) [compare with **intermediate duration exposure** and **chronic exposure]**.

Additive effect
A biologic response to exposure to multiple substances that equals the sum of responses of all the individual substances added together [compare with **antagonistic effect** and **synergistic effect]**.

Adverse health effect
A change in body function or cell structure that might lead to disease or health problems.

Aerobic
Requiring oxygen [compare with **anaerobic**].

Ambient
Surrounding (for example, *ambient* air).

Anaerobic
Requiring the absence of oxygen [compare with **aerobic**].

Analyte
A substance measured in the laboratory. A chemical for which a sample (such as water, air, or blood) is tested in a laboratory. For example, if the analyte is mercury, the laboratory test will determine the amount of mercury in the sample.

Analytic epidemiologic study
A study that evaluates the association between exposure to hazardous substances and disease by testing scientific hypotheses.

Antagonistic effect
A biologic response to exposure to multiple substances that is **less** than would be expected if the known effects of the individual substances were added together [compare with **additive effect** and **synergistic effect**].

Background level
An average or expected amount of a substance or radioactive material in a specific environment, or typical amounts of substances that occur naturally in an environment.

Biodegradation
Decomposition or breakdown of a substance through the action of microorganisms (such as bacteria or fungi) or other natural physical processes (such as sunlight).

Biologic indicators of exposure study
A study that uses (a) **biomedical testing** or (b) the measurement of a substance [an **analyte**], its **metabolite**, or another marker of exposure in human body fluids or tissues to confirm human exposure to a hazardous substance [also see **exposure investigation**].

Biologic monitoring
Measuring hazardous substances in biologic materials (such as blood, hair, urine, or breath) to determine whether exposure has occurred. A blood test for lead is an example of biologic monitoring.

Biologic uptake
The transfer of substances from the environment to plants, animals, and humans.

Biomedical testing
Testing of persons to find out whether a change in a body function might have occurred because of exposure to a hazardous substance.

Biota
Plants and animals in an environment. Some of these plants and animals might be sources of food, clothing, or medicines for people.

Body burden
The total amount of a substance in the body. Some substances build up in the body because they are stored in fat or bone or because they leave the body very slowly.

CAP
See **Community Assistance Panel**.

Cancer
Any one of a group of diseases that occurs when cells in the body become abnormal and grow or multiply out of control.

Cancer Effect Level
The Cancer effect level or CEL is the lowest exposure level associated with the onset of carcinogenesis in experimental or epidemiologic studies.

Cancer risk
A theoretical risk for getting cancer if exposed to a substance every day for 70 years (a lifetime exposure). The true risk might be lower.

Carcinogen
A substance that causes cancer.

Case study
A medical or epidemiologic evaluation of one person or a small group of people to gather information about specific health conditions and past exposures.

Case-control study
A study that compares exposures of people who have a disease or condition (cases) with people who do not have the disease or condition (controls). Exposures that are more common among the cases may be considered as possible risk factors for the disease.

CAS registry number
A unique number assigned to a substance or mixture by the American Chemical Society Abstracts Service.

Central nervous system
The part of the nervous system that consists of the brain and the spinal cord.

CERCLA [see **Comprehensive Environmental Response, Compensation, and Liability Act of 1980**]

Chronic
Occurring over a long time (more than 1 year) [compare with **acute**].

Chronic exposure
Contact with a substance that occurs over a long time (more than 1 year) [compare with **acute exposure** and **intermediate duration exposure**].

Cluster investigation
A review of an unusual number, real or perceived, of health events (for example, reports of cancer) grouped together in time and location. Cluster investigations are designed to confirm

case reports; determine whether they represent an unusual disease occurrence; and, if possible, explore possible causes and contributing environmental factors.

Community Assistance Panel (CAP)
A group of people, from a community and from health and environmental agencies, who work with ATSDR to resolve issues and problems related to hazardous substances in the community. CAP members work with ATSDR to gather and review community health concerns, provide information on how people might have been or might now be exposed to hazardous substances, and inform ATSDR on ways to involve the community in its activities.

Comparison value (CV)
Calculated concentration of a substance in air, water, food, or soil that is unlikely to cause harmful (adverse) health effects in exposed people. The CV is used as a screening level during the public health assessment process. Substances found in amounts greater than their CVs might be selected for further evaluation in the public health assessment process.

Completed exposure pathway [see **exposure pathway**].

Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA)
CERCLA, also known as **Superfund**, is the federal law that concerns the removal or cleanup of hazardous substances in the environment and at hazardous waste sites. ATSDR, which was created by CERCLA, is responsible for assessing health issues and supporting public health activities related to hazardous waste sites or other environmental releases of hazardous substances.

Concentration
The amount of a substance present in a certain amount of soil, water, air, food, blood, hair, urine, breath, or any other media.

Contaminant
A substance that is either present in an environment where it does not belong or is present at levels that might cause harmful (adverse) health effects.

Delayed health effect
A disease or injury that happens as a result of exposures that might have occurred in the past.

Dermal
Referring to the skin. For example, dermal absorption means passing through the skin.

Dermal contact
Contact with (touching) the skin [see **route of exposure**].

Descriptive epidemiology
The study of the amount and distribution of a disease in a specified population by person, place, and time.

Detection limit
The lowest concentration of a chemical that can reliably be distinguished from a zero concentration.

Disease prevention
Measures used to prevent a disease or reduce its severity.

Disease registry
A system of ongoing registration of all cases of a particular disease or health condition in a defined population.

DOD
United States Department of Defense.

DOE
United States Department of Energy.

Dose (for chemicals that are not radioactive)
The amount of a substance to which a person is exposed over some time period. Dose is a measurement of exposure. Dose is often expressed as milligram (amount) per kilogram (a measure of body weight) per day (a measure of time) when people eat or drink contaminated water, food, or soil. In general, the greater the dose, the greater the likelihood of an effect. An Aexposure dose@ is how much of a substance is encountered in the environment. An Aabsorbed dose@ is the amount of a substance that actually got into the body through the eyes, skin, stomach, intestines, or lungs.

Dose (for radioactive chemicals)
The radiation dose is the amount of energy from radiation that is actually absorbed by the body. This is not the same as measurements of the amount of radiation in the environment.

Dose-response relationship
The relationship between the amount of exposure [**dose**] to a substance and the resulting changes in body function or health (response).

Environmental media
Soil, water, air, **biota** (plants and animals), or any other parts of the environment that can contain contaminants.

Environmental media and transport mechanism
Environmental media include water, air, soil, and **biota** (plants and animals). Transport mechanisms move contaminants from the source to points where human exposure can occur. The **environmental media and transport mechanism** is the second part of an **exposure pathway**.

USEPA
United States Environmental Protection Agency.

Epidemiologic surveillance
The ongoing, systematic collection, analysis, and interpretation of health data. This activity also involves timely dissemination of the data and use for public health programs.

Epidemiology
The study of the distribution and determinants of disease or health status in a population; the study of the occurrence and causes of health effects in humans.

Exposure
Contact with a substance by swallowing, breathing, or touching the skin or eyes. Exposure may be short-term [**acute exposure**], of intermediate duration, or long-term [**chronic exposure**].

Exposure assessment
The process of finding out how people come into contact with a hazardous substance, how often and for how long they are in contact with the substance, and how much of the substance they are in contact with.

Exposure-dose reconstruction
A method of estimating the amount of people's past exposure to hazardous substances. Computer and approximation methods are used when past information is limited, not available, or missing.

Exposure investigation
The collection and analysis of site-specific information and biologic tests (when appropriate) to determine whether people have been exposed to hazardous substances.

Exposure pathway
The route a substance takes from its source (where it began) to its end point (where it ends), and how people can come into contact with (or get exposed to) it. An exposure pathway has five parts: a **source of contamination** (such as an abandoned business); an **environmental media and transport mechanism** (such as movement through groundwater); a **point of exposure** (such as a private well); a **route of exposure** (eating, drinking, breathing, or touching); and a **receptor population** (people potentially or actually exposed). When all five parts are present, the exposure pathway is termed a **completed exposure pathway**.

Exposure registry
A system of ongoing follow-up of people who have had documented environmental exposures.

Feasibility study
A study by USEPA to determine the best way to clean up environmental contamination. A number of factors are considered, including health risk, costs, and what methods will work well.

Geographic information system (GIS)
A mapping system that uses computers to collect, store, manipulate, analyze, and display data. For example, GIS can show the concentration of a contaminant within a community in relation to points of reference such as streets and homes.

Grand rounds
Training sessions for physicians and other health care providers about health topics.

Groundwater
Water beneath the earth's surface in the spaces between soil particles and between rock surfaces [compare with **surface water**].

Half-life (t_2)
The time it takes for half the original amount of a substance to disappear. In the environment, the half-life is the time it takes for half the original amount of a substance to disappear when it is changed to another chemical by bacteria, fungi, sunlight, or other chemical processes. In the human body, the half-life is the time it takes for half the original amount of the substance to disappear, either by being changed to another substance or by leaving the body. In the case of radioactive material, the half life is the amount of time necessary for one half the initial number of radioactive atoms to change or transform into another atom (that is normally not radioactive). After two half lives, 25% of the original number of radioactive atoms remain.

Hazard
A source of potential harm from past, current, or future exposures.

Hazardous waste
Potentially harmful substances that have been released or discarded into the environment.

Health consultation
A review of available information or collection of new data to respond to a specific health question or request for information about a potential environmental hazard. Health consultations are focused on a specific exposure issue. Health consultations are therefore more limited than a public health assessment, which reviews the exposure potential of each pathway and chemical [compare with **public health assessment**].

Health education
Programs designed with a community to help it know about health risks and how to reduce these risks.

Health investigation
The collection and evaluation of information about the health of community residents. This information is used to describe or count the occurrence of a disease, symptom, or clinical measure and to estimate the possible association between the occurrence and exposure to hazardous substances.

Health promotion
The process of enabling people to increase control over, and to improve, their health.

Health statistics review
The analysis of existing health information (i.e., from death certificates, birth defects registries, and cancer registries) to determine if there is excess disease in a specific population, geographic area, and time period. A health statistics review is a descriptive epidemiologic study.

Indeterminate public health hazard
The category used in ATSDR's public health assessment documents when a professional judgment about the level of health hazard cannot be made because information critical to such a decision is lacking.

Incidence
The number of new cases of disease in a defined population over a specific time period [contrast with **prevalence**].

Ingestion
The act of swallowing something through eating, drinking, or mouthing objects. A hazardous substance can enter the body this way [see **route of exposure**].

Inhalation
The act of breathing. A hazardous substance can enter the body this way [see **route of exposure**].

Intermediate duration exposure
Contact with a substance that occurs for more than 14 days and less than a year [compare with **acute exposure** and **chronic exposure**].

In vitro
In an artificial environment outside a living organism or body. For example, some toxicity testing is done on cell cultures or slices of tissue grown in the laboratory, rather than on a living animal [compare with **in vivo**].

In vivo
Within a living organism or body. For example, some toxicity testing is done on whole animals, such as rats or mice [compare with **in vitro**].

Lowest-observed-adverse-effect level (LOAEL)
The lowest tested dose of a substance that has been reported to cause harmful (adverse) health effects in people or animals.

Medical monitoring
A set of medical tests and physical exams specifically designed to evaluate whether an individual's exposure could negatively affect that person's health.

Metabolism
The conversion or breakdown of a substance from one form to another by a living organism.

Metabolite
Any product of **metabolism**.

mg/kg
Milligram per kilogram.

mg/cm^2
Milligram per square centimeter (of a surface).

mg/m^3
Milligram per cubic meter; a measure of the concentration of a chemical in a known volume (a cubic meter) of air, soil, or water.

Migration
Moving from one location to another.

Minimal risk level (MRL)
An ATSDR estimate of daily human exposure to a hazardous substance at or below which that substance is unlikely to pose a measurable risk of harmful (adverse), noncancerous effects. MRLs are calculated for a route of exposure (inhalation or oral) over a specified time period (acute, intermediate, or chronic). MRLs should not be used as predictors of harmful (adverse) health effects [see **reference dose**].

Morbidity
State of being ill or diseased. Morbidity is the occurrence of a disease or condition that alters health and quality of life.

Mortality
Death. Usually the cause (a specific disease, condition, or injury) is stated.

Mutagen
A substance that causes **mutations** (genetic damage).

National Priorities List for Uncontrolled Hazardous Waste Sites
(National Priorities List or **NPL)**
USEPA's list of the most serious uncontrolled or abandoned hazardous waste sites in the United States. The NPL is updated on a regular basis.

No apparent public health hazard
A category used in ATSDR's public health assessments for sites where human exposure to contaminated media might be occurring, might have occurred in the past, or might occur in the future, but where the exposure is not expected to cause any harmful health effects.

No-observed-adverse-effect level (NOAEL)
The highest tested dose of a substance that has been reported to have no harmful (adverse) health effects on people or animals.

No public health hazard
A category used in ATSDR's public health assessment documents for sites where people have never and will never come into contact with harmful amounts of site-related substances.

NPL [see **National Priorities List for Uncontrolled Hazardous Waste Sites]**

Physiologically based pharmacokinetic model (PBPK model)
A computer model that describes what happens to a chemical in the body. This model describes how the chemical gets into the body, where it goes in the body, how it is changed by the body, and how it leaves the body.

Pica
A craving to eat nonfood items, such as dirt, paint chips, and clay. Some children exhibit pica-related behavior.

Plume
A volume of a substance that moves from its source to places farther away from the source. Plumes can be described by the volume of air or water they occupy and the direction they move. For example, a plume can be a column of smoke from a chimney or a substance moving with groundwater.

Point of exposure
The place where someone can come into contact with a substance present in the environment [see **exposure pathway**].

Population
A group or number of people living within a specified area or sharing similar characteristics (such as occupation or age).

Potentially responsible party (PRP)
A company, government, or person legally responsible for cleaning up the pollution at a hazardous waste site under Superfund. There may be more than one PRP for a particular site.

ppb
Parts per billion.

ppm
Parts per million.

Prevalence
The number of existing disease cases in a defined population during a specific time period [contrast with **incidence**].

Prevalence survey
The measure of the current level of disease(s) or symptoms and exposures through a questionnaire that collects self-reported information from a defined population.

Prevention
Actions that reduce exposure or other risks, keep people from getting sick, or keep disease from getting worse.

Public comment period
An opportunity for the public to comment on agency findings or proposed activities contained in draft reports or documents. The public comment period is a limited time period during which comments will be accepted.

Public availability session
An informal, drop-by meeting at which community members can meet one-on-one with ATSDR staff members to discuss health and site-related concerns.

Public health action
A list of steps to protect public health.

Public health advisory
A statement made by ATSDR to USEPA or a state regulatory agency that a release of hazardous substances poses an immediate threat to human health. The advisory includes recommended measures to reduce exposure and reduce the threat to human health.

Public health assessment (PHA)
An ATSDR document that examines hazardous substances, health outcomes, and community concerns at a hazardous waste site to determine whether people could be harmed from coming into contact with those substances. The PHA also lists actions that need to be taken to protect public health [compare with **health consultation**].

Public health hazard
A category used in ATSDR's public health assessments for sites that pose a public health hazard because of long-term exposures (greater than 1 year) to sufficiently high levels of hazardous substances or **radionuclides** that could result in harmful health effects.

Public health hazard categories
Public health hazard categories are statements about whether people could be harmed by conditions present at the site in the past, present, or future. One or more hazard categories might be appropriate for each site. The five public health hazard categories are **no public health hazard**, **no apparent public health hazard**, **indeterminate public health hazard**, **public health hazard**, and **urgent public health hazard**.

Public health statement
The first chapter of an ATSDR **toxicological profile**. The public health statement is a summary written in words that are easy to understand. The public health statement explains how people might be exposed to a specific substance and describes the known health effects of that substance.

Public meeting
A public forum with community members for communication about a site.

Radioisotope
An unstable or radioactive isotope (form) of an element that can change into another element by giving off radiation.

Radionuclide
Any radioactive isotope (form) of any element.

RCRA [see **Resource Conservation and Recovery Act (1976, 1984)**]

Receptor population
People who could come into contact with hazardous substances [see **exposure pathway**].

Reference dose (RfD)
An USEPA estimate, with uncertainty or safety factors built in, of the daily lifetime dose of a substance that is unlikely to cause harm in humans.

Registry
A systematic collection of information on persons exposed to a specific substance or having specific diseases [see **exposure registry** and **disease registry**].

Remedial investigation
The CERCLA process of determining the type and extent of hazardous material contamination at a site.

Resource Conservation and Recovery Act (1976, 1984) (RCRA)
This Act regulates management and disposal of hazardous wastes currently generated, treated, stored, disposed of, or distributed.

RFA
RCRA Facility Assessment. An assessment required by RCRA to identify potential and actual releases of hazardous chemicals.

RfD
See **reference dose**.

Risk
The probability that something will cause injury or harm.

Risk reduction
Actions that can decrease the likelihood that individuals, groups, or communities will experience disease or other health conditions.

Risk communication
The exchange of information to increase understanding of health risks.

Route of exposure
The way people come into contact with a hazardous substance. Three routes of exposure are breathing [**inhalation**], eating or drinking [**ingestion**], or contact with the skin [**dermal contact**].

Safety factor [see **uncertainty factor]**

SARA [see **Superfund Amendments and Reauthorization Act**]

Sample
A portion or piece of a whole. A selected subset of a population or subset of whatever is being studied. For example, in a study of people the sample is a number of people chosen from a larger population [see **population**]. An environmental sample (for example, a small amount of soil or water) might be collected to measure contamination in the environment at a specific location.

Sample size
The number of units chosen from a population or environment.

Solvent
A liquid capable of dissolving or dispersing another substance (for example, acetone or mineral spirits).

Source of contamination
The place where a hazardous substance comes from, such as a landfill, waste pond, incinerator, storage tank, or drum. A source of contamination is the first part of an **exposure pathway**.

Special populations
People who might be more sensitive or susceptible to exposure to hazardous substances because of factors such as age, occupation, sex, or behaviors (for example, cigarette smoking). Children, pregnant women, and older people are often considered special populations.

Stakeholder
A person, group, or community who has an interest in activities at a hazardous waste site.

Statistics
A branch of mathematics that deals with collecting, reviewing, summarizing, and interpreting data or information. Statistics are used to determine whether differences between study groups are meaningful.

Substance
A chemical.

Substance-specific applied research
A program of research designed to fill important data needs for specific hazardous substances identified in ATSDR's **toxicological profiles**. Filling these data needs would allow more accurate assessment of human risks from specific substances contaminating the environment. This research might include human studies or laboratory experiments to determine health effects resulting from exposure to a given hazardous substance.

Superfund Amendments and Reauthorization Act (SARA)
In 1986, SARA amended CERCLA and expanded the health-related responsibilities of ATSDR. CERCLA and SARA direct ATSDR to look into the health effects from substance exposures at hazardous waste sites and to perform activities including health education, health studies, surveillance, health consultations, and toxicological profiles.

Surface water
Water on the surface of the earth, such as in lakes, rivers, streams, ponds, and springs [compare with **groundwater**].

Surveillance [see **epidemiologic surveillance**]

Survey
A systematic collection of information or data. A survey can be conducted to collect information from a group of people or from the environment. Surveys of a group of people can be conducted by telephone, by mail, or in person. Some surveys are done by interviewing a group of people [see **prevalence survey**].

Synergistic effect
A biologic response to multiple substances where one substance worsens the effect of another substance. The combined effect of the substances acting together is greater than the sum of the effects of the substances acting by themselves [see **additive effect** and **antagonistic effect**].

Teratogen
A substance that causes defects in development between conception and birth. A teratogen is a substance that causes a structural or functional birth defect.

Toxic agent
Chemical or physical (for example, radiation, heat, cold, microwaves) agents that, under certain circumstances of exposure, can cause harmful effects to living organisms.

Toxicological profile
An ATSDR document that examines, summarizes, and interprets information about a hazardous substance to determine harmful levels of exposure and associated health effects. A Toxicological Profile also identifies significant gaps in knowledge on the substance and describes areas where further research is needed.

Toxicology
The study of the harmful effects of substances on humans or animals.

Tumor
An abnormal mass of tissue that results from excessive cell division that is uncontrolled and progressive. Tumors perform no useful body function. Tumors can be either benign (not cancer) or malignant (cancer).

Uncertainty factor
Mathematical adjustments for reasons of safety when knowledge is incomplete. For example, factors used in the calculation of doses that are not harmful (adverse) to people. These factors are applied to the lowest-observed-adverse-effect-level (LOAEL) or the no-observed-adverse-effect-level (NOAEL) to derive a minimal risk level (MRL). Uncertainty factors are used to account for variations in people's sensitivity, for differences between animals and humans, and for differences between a LOAEL and a NOAEL. Scientists use uncertainty factors when they have some, but not all, the information from animal or human studies to decide whether an exposure will cause harm to people [also sometimes called a **safety factor**].

Urgent public health hazard
A category used in ATSDR's public health assessments for sites where short-term exposures (less than 1 year) to hazardous substances or conditions could result in harmful health effects that require rapid intervention.

Volatile organic compounds (VOCs)
Organic compounds that evaporate readily into the air. VOCs include substances such as benzene, toluene, methylene chloride, and methyl chloroform.

Other Glossaries and Dictionaries
Environmental Protection Agency - http://www.epa.gov/OCEPAterms/
National Library of Medicine (NIH) - http://www.nlm.nih.gov/medlineplus/mplusdictionary.html

Appendix H

Response to Comments from Initial Release

Responses to Comments Received

ATSDR has provided its Response to Comments received during the Initial Release of the W.R. Grace Public Health Assessment below. It includes comments submitted by various agencies and The Acton Citizens for Environmental Safety (ACES). ACES has a long history of active involvement with the W.R. Grace site in Acton, MA. ACES has been actively involved in working with the state, federal and other public health agencies.

The table below is provided as a quick reference guide for some topics addressed in the response to comments for the Initial Release of the PHA.

Page numbers mentioned in this response to comments section may not reflect the actual page numbers in the final version of the PHA. References used by MDPH are provided at the end of Appendix H.

Concern	Response to comment
Acrylonitrile exposure	Response to comment # 29
Airborne contaminants	Response to comment # 46
ALS (Lou Gehrig's Disease)	Response to comment # 43
Asthma	Response to comment # 43
Autism	Response to comment # 43
Birth Defects	Response to comment # 43
Cancer cluster	Response to comment # 30
Cancer incidence vs. cancer mortality	Response to comment # 39
Infant mortality & low birth weight	Response to comment # 40
Prostate Cancer	Response to comment # 17
Skin cancer & arsenic	Response to comment # 17

Comment #1:
Evaluation of past exposures?
Summary, page iv
ACES and other members of the Acton community are looking to ATSDR to help answer some of the questions that will not be addressed under EPA's Superfund process as EPA looks at current and future risk at the WR Grace Superfund Site in Acton and Concord. These unanswered questions have to do with past exposures at the WR Grace Superfund Site, and they include:

a. What are the cumulative health risks (over the past 27 plus years), due to **past**, as well as present exposures to organic and inorganic contaminants from the WR Grace Site?

b. Have there been/could there be any adverse health effects, including increased cancer incidence, cancer mortality, or other health effects as a result of **past** plus present exposure to site contaminants?

EPA's Risk Assessment process does not take into account past exposures to site contaminants.

* Would ATSDR please do a comprehensive public health assessment that accounts for the past exposures that individuals may have had to site contaminants over many years, in addition to current potential exposure? *

For example, please consider the cumulative risk to an individual who has used tap water from the Assabet wells from 1978, (or 1970), until the present, was exposed to onsite contaminants in soils, sludge, groundwater, and surface water, both before and after soils and sludge in source areas were remediated, and has been exposed to airborne VOCs including those released into the air by the onsite stripping tower used to remove contaminants from groundwater.

Data are available for both the Assabet public wells and for onsite source areas, and groundwater from 1978 onward, and some of the older historical data have already been summarized in ATSDR's 1992 Initial Release PHA. (See comment 2 below.) Due to active cleanup on a portion of the site there have been changing conditions over the years. Some exposure pathways that are currently incomplete, were complete in the past (ie past exposure to contaminated soils, sludge, surface water from lagoon areas, higher level of contaminants in air due to air stripper, etc.).

Simply assessing current conditions does not answer the outstanding question of cumulative health effects due to past and present exposures to multiple chemicals over many years.

ATSDR Response:
ATSDR's estimated dose calculations for non-carcinogenic risk for all pathways (ingestion, inhalation, dermal contact), are based on a 30 year exposure duration, except for past exposure to VOCs which are based on a nine year exposure period (1970-1978). Thirty years is the national upper-bound time persons may spend at one residence. The nine year exposure period used for VOCs is from the time that Assabet wells One and Two were opened until they were taken out of service in 1978. ATSDR's exposure dose calculations are conservative but realistic (see Appendix C in the PHA for additional exposure parameters used in the exposure dose calculations).

ATSDR's calculations for theoretical excess cancer risk are based on a 70 year exposure duration, except for past exposure to VOCs which are based on a nine year exposure period (1970-1978). Seventy years is generally accepted as a lifetime exposure. ATSDR's theoretical excess cancer risk is conservative and would encompass the potential exposure period (see Appendix C in the PHA for additional exposure parameters used in the calculations for theoretical excess cancer risk).

ATSDR indicates in the Public Health Assessment that there is very limited historical data for the Town of Acton municipal wells for the time period of 1970 to 1978 (the year the wells were opened until the year the VOC contamination was first identified). Even though the data is limited, ATSDR did evaluate past exposure in the health assessment to try and address this community concern.

Comment #2:
Historical data available; Important to include 1992 ATSDR reports in 2005 PHA.
Summary, page iv
There is a lack of groundwater data and data from the public wells pre-1978, but data since then are available. (Contaminant levels in the wells between 1970 and 1978 may have been similar to those detected in the public wells before the ARS went online in 1985.)

ACES has hard copies of two different versions of ATSDR's 1992 PHA. One is the Initial Release PHA, dated September 30, 2005; with a notation that the "Comments Period Ends. November 4, 1992". The first paragraph of the Summary Section of the Aug 2005 PHA refers to this report.

The other version appears to be an earlier draft of the 1992 Initial Release PHA. It is labeled "Draft: Public Comment Release PHA". (See Attachment B to these comments.)

Both reports include data tables (C-1 through C-10), of maximum concentrations of various contaminants found in groundwater and soils below or near waste sites, (including the various lagoons, and the landfill), as well as in sludge and surface water in these areas. Table C-11 of these reports includes concentrations of contaminants in ambient air during on-site pilot excavation activities. Table C-12 lists maximum concentrations of contaminants found in drinking water wells. The "Draft: Public Comment" version summarizes data for the two Assabet public wells for each of the years from 1978 to 1987. The "Initial Release" version lists data from 1978, 1979, and 1992. See summary below of contaminant detections as presented in one or both Tables C-12. (Also see Attachments B. and C.)

Summary of Maximum Concentration of Substance identified in Assabet Wells by Year

Contaminant Concentration (ppb) by Year

	1978	**1979**	**1980**	**1981**	**1982**	**1983**	**1984**	**1985**	**1986**	**1987**	**1992**
Ethylbenzene		23									
1,1, Dichloroethylene	1.2	56	32.5		7.0	9.0	31	32	33	5.2	8
Benzene		2.1									
TCA					134	151					6.7
TCE	8.0					0.11	0.12	0.8	2.9	1.0	
Methylene Chloride		46			3.0	0.5					
1,1-Dichloroethane						3.4	7.6	28	1.9		

Note: The 1992 Draft: Public Comment PHA cites the data sources for specific data, (AWD, GZD, GZA, MA DEP, or RMC). The report does not indicate whether these concentrations are in "raw" water or treated water.

[Are additional data for the public wells also available from the Acton Water District? What concentrations of contaminants have been detected in the past at the School Street wells in the Northeast part of the site? Are additional data available for the source areas and groundwater in Operational Unit -1 (OU-1) documents, (including the OU-1 Initial Site Characterization Report), and/or in the 1997 ISCR for OU-3?]

Requests:
Given the data included in the ATSDR 1992 PHA Reports, (and any other relevant historical data that may be available), and the outstanding questions about past exposures to contaminants:

a. Please include the 1992 ATSDR Initial Release Public Health Assessment [as an appendix??], in the 2005 Public Health Assessment.

b. At a minimum, please include Tables C-1 through C-12 in the current PHA, (including all the data from both versions of Table C-12), along with a discussion of these data, and the significance of past exposures.

c. Please include any additional relevant data since 1992, in the 2005 PHA.

d. Part of the WR Grace site is in Concord. Please consider that area residents, including those from Concord, may have accessed the site and been exposed to site contaminants before, during, and after the completion of soil remediation in 1997.

e. As already stated in comment 1, please include an analysis of the historical plus current risk posed by site contaminants, considering all possible past and present exposures.

ATSDR Response:
ATSDR believes that the limited data provided in the 1992 Initial Release Public Health Assessment, prepared by the Massachusetts Department of Health, is of limited value for determining public health conclusions for past exposure. In most cases there is only one data point per year for the VOCs listed in the table above. In the case of benzene there is only one data point for the years 1978 through 1992. However, in order to address ACES concern ATSDR has evaluated the available historical data in the Public Health Assessment.

Please refer to the section entitled: Public Water Supply Wells, Historical Data, VOCs

Comment #3:
Future exposure?
Summary, Fourth paragraph, last sentence:
Please omit the word "future" in this sentence. (See comparison of EPA Risk Assessment and ATSDR Public Health Assessment, re: time frame focus---on handout from Oct. 2003 public meeting in Acton---ATSDR looks at present and past exposures, while EPA looks at present and future.)

Also, the possibility of higher concentrations of contaminants, including arsenic and manganese reaching the School Street wells in the future, cannot be ruled out, especially given EPA's proposed plan to allow the plume of contamination in the Northeast Area to continue to be pulled into the public wells. There are much higher concentrations of arsenic and manganese within this plume, upgradient of the wells, than the current detections at the public wells. The arsenic detection at the public wells, from the Remedial Investigation, already results in a 1E-04 theoretical cancer risk due to arsenic, according to WR Grace's Public Health Risk Assessment.

ATSDR Response:
ATSDR removed the word "future" in the fourth paragraph, last sentence of the Summary.

ATSDR agrees that arsenic and manganese contaminant levels could increase in the School Street wells in the future; however, these wells are being monitored by the Acton Water District (AWD) in accordance with the Safe Drinking Water Act (SDWA). If levels of contaminants in these wells rise, the AWD will take action to ensure that water distributed through the public drinking water supply does not exceed the Maximum Contaminant Level or other standards set forth in the SDWA. Therefore, it is unlikely that persons will be exposed in the future to levels of arsenic and manganese through the municipal drinking water system at levels of public health concern.

Comment #4:
Irrigation wells, additional data available
Summary, Fifth paragraph
Additional data are available for at least two irrigation wells at the WR Grace Site, showing higher detections of VOCs than were referenced in the Aug. 2005 PHA. According to a "December 4, 2002 Letter Re: Lisa Lane and Bellantoni Drive, Public Irrigation Well Evaluation Results" detections included the following:

a. Lisa Lane Well
   - VDC (1,1-Dichloroethylene) at 14 to 17 ug/L
   - Vinyl chloride at approximately 0.3 ug/L
   - Benzene at approximately 0.5 to 0.6 ug/L
   - Acetone at approximately 3 to 36 ug/L

b. Bellantoni Drive Well
   - VDC (1,1-Dichloroethylene) at 4 to 5 ug/L
   - Vinyl chloride at approximately 0.2 to 0.3 ug/L
   - Acetone at approximately 2 to 5 ug/L

No testing was done for Arsenic or other inorganics in any of the irrigation wells at the site.

(The December 4, 2002 letter is in "Appendix A of Phase 2 Remedial Investigation Data Report, May 14, 2003"; See also Attachment A of these comments and http://doc.acton-ma.gov/dsweb/Get/Document-6723/WRGracePrivateWellEvaluation.PDF)

The Lisa Lane well was in use from 1995 to 2002. It is in one of the more concentrated contours of the VDC plume. Please consider that residents may have been exposed to this water via ingestion, inhalation, and dermal exposure over approximately eight years, and that past levels of contamination in this well may have been higher than those detected in 2002.

ATSDR Response:
ATSDR reviewed the GeoTrans, Inc. letter (dated December 4, 2002) regarding concentrations of VOCs found in the Lisa Lane and Bellantoni Drive irrigation wells. As ATSDR discussed in the response to comment 2, caution must be used when using very limited data sets for determining public health conclusions for past exposure.

However, in an effort to answer ACES question regarding past exposures, based on the limited data provided in the GeoTrans, Inc letter, ATSDR did review and calculate non-carcinogenic and carcinogenic risk for benzene, vinyl chloride, and 1,1 dichloroethane (VDC) for an eight year exposure to the maximum concentration of the contaminants found in either the Lisa Lane or Bellantoni Drive irrigation wells. ATSDR did not calculate risk for acetone, because the maximum concentration of acetone was below the ATSDR comparison value.

ATSDR calculated non-carcinogenic risk for adults and children for benzene, vinyl chloride, and VDC. In its exposure scenario for these calculations, ATSDR assumed an incidental ingestion rate of 0.1 liters per day for adults and children. ATSDR assumed that incidental ingestion occurred 350 days per year and that an adult was exposed for 8 years and that a child was exposed for 6 years. ATSDR assumed the default weights of 70 kilograms for an adult and 16 kilograms for a child. Based on the maximum concentration and the exposure parameters above the estimated exposure doses for benzene, vinyl chloride, and VDC were below established EPA or ATSDR health guidelines. ATSDR also calculated a theoretical excess carcinogenic risk for an adult exposed to benzene and vinyl chloride, based on the assumptions above, for an eight year exposure. The theoretical excess cancer risks for an adult exposed to benzene (4.92E-08) and vinyl chloride (6.26E-08) are well below the generally acceptable excess lifetime cancer risk of 1 in 1 million (1.00E-06). The theoretical excess cancer risk for VDC could not be calculated, because there is no cancer slope factor available.

In addition, ATSDR calculated non-carcinogenic risk for adults and children for benzene, vinyl chloride and VDC for dermal contact. Exposure doses were calculated using the maximum detected concentration and a surface area of 6,074 square centimeters (cm^2) for adults and 2,178 cm^2 for children. A skin adherence factor (AF) of 0.07 was used for adults and an AF of 0.2 was used for children. If a chemical absorption factor (ABS) was available it was used, if not an ABS of 1.0 was used for conservatism. An exposure frequency of 1.5 hours per day for 90 days per year was assumed. It was assumed that the exposure duration was 8 years for adults and 6 years for children. A body weight of 70 kilograms (kg) for adults and 16 kg for children was also assumed. *Based on the exposure parameters listed above, the estimated exposure doses for benzene, vinyl chloride, and VDC were below established EPA or ATSDR health guidelines.* ATSDR also calculated a theoretical excess cancer risk for an adult exposed to benzene and vinyl chloride, based on the assumptions above, for an eight year exposure. The theoretical excess cancer risks for an adult exposed to benzene (1.85E-08) and vinyl chloride (2.35E-08) are well below the generally acceptable excess lifetime cancer risk of 1 in 1 million (1.00E-06). The theoretical excess cancer risk for VDC dermal exposure could not be calculated, because there is no cancer slope factor available.

Comment #5:
Irrigation wells, additional data available
Summary, Fifth paragraph
In addition to the VOCs at both the Lisa Lane and Bellantoni Drive irrigation wells, two VOC contaminants: TCE (1.2 ug/L) and MTBE (0.31 ug/L) were detected in the Powder Mill Plaza irrigation well. (See: July 2005 Public Review Draft Remedial Investigation Report; p. 2-7.) This well is still being used.

ATSDR Response:
The levels of trichloroethylene (TCE) and methyl-tertiary butyl ether (MTBE) detected in the Powder Mill Plaza irrigation well are very low. The detected level of TCE (1.2 ug/L) is below the USEPA Maximum Contaminant Level (MCL) of 5ug/L or ppb. MCL's are set at levels to ensure that drinking water does not pose either a short-term or long-term health risk. Because the detected level is well below the MCL, no adverse health effects would be expected to occur. The detected level of MTBE (0.31 ug/L) is thousands of times lower than ATSDR's comparison value of 3,000 ug/L and is therefore unlikely to cause adverse health effects.

Comment #6:
Private Irrigation wells, may be used as potable water
Summary, Fifth paragraph, first sentence
Please consider that the private irrigation wells onsite may have been used for drinking water purposes.

Once a private well is in place there is no practical way to control, or even be aware of how this domestic water source is actually used. An outdoor spigot or hose could be used to supply drinking water to people or pets. A private well could be used for water in an outdoor shower, or in a greenhouse. An uninformed future property owner could convert it to a drinking water source.

In its handbook, the Massachusetts Association of Health Boards states:

"Boards of Health may be very correct in assuming that there is no such thing as a "non-potable" well serving a residence. Even if the intention is to provide water for car washing and lawns, there is always a risk that children will drink from a hose, that it will be used to fill a swimming pool, or at a future date, it may be hooked up to the house plumbing."

ATSDR Response:
Homes connected to a municipal drinking water supply generally do not use private irrigation wells as a drinking water source. Irrigation wells are used for watering yards and gardens, filling swimming pools, washing cars, etc. Where applicable, ATSDR considered these types of VOC exposures in its risk calculations. ATSDR considered incidental ingestion and dermal contact in

its evaluation of exposure to vinyl chloride from private irrigation wells in the public health assessment and in its evaluation of vinyl chloride, benzene and VDC (from the Lisa Lane and Bellantoni Wells) in comment 4 above. ATSDR's exposure scenario considered that a person might be exposed through incidental ingestion and dermal contact by wading or swimming in pools filled with water from these irrigation wells 1.5 hours per day for 90 days per year. For vinyl chloride ATSDR estimated 30 year and 8 year maximum exposures. For VDC and benzene, ATSDR estimated an 8 year exposure (maximum length of time people may have been exposed to contaminants in the Lisa Lane and Bellantoni Wells). Based on these conservative assumptions, all of ATSDR's calculated VOC exposure doses are well below established health guidelines for non-carcinogenic risk and the calculations for theoretical excess cancer risk are well below the generally acceptable excess lifetime cancer risk of 1 in 1 million (1.00E-06).

In summary, based on ATSDR's evaluation, it is unlikely that intermittent exposure to VOCs found in private irrigation wells near the W.R. Grace would cause adverse health effects in people.

Comment #7:
Surface water, consider past concentrations/exposures
Summary, Sixth Paragraph
In addition to current concentrations of contaminants found in surface water, please consider past conditions. Were contaminant concentrations higher in surface water in the past? Were there additional contaminants to those found currently? Are surface water data available in pre-1997 OU-1 reports? In the 1997 Initial Site Characterization Report for OU-3? Please consider possible exposures to surface water contaminants over the past 27 years, in addition to current exposures.

ATSDR Response:
ATSDR cannot calculate doses for past exposure to surface water, because there is not sufficient data available.

Comment #8:
Fish: indeterminate risk
Summary, Eighth paragraph
This paragraph concludes that fish do not pose an apparent health hazard because edible sized fish were not caught. Since these conditions could change, please end the last sentence in this paragraph with the phrase, "at this time.", and add "Future reassessment will be needed if conditions change and edible sized fish are present in the pond."

(As noted later on in the report, (in the section: "Pathways Considered and Eliminated *Fish*"): "If future conditions at this pond change, due to stocking programs, or people report collecting fish of edible size, then we recommend that suitable samples be collected, analyzed and evaluated.")

ATSDR Response:
ATSDR edited the last two sentences in Summary paragraph eight to read as follows:

Therefore, ATSDR presently considers fish consumption from Sinking Pond to be a no apparent public health hazard. However, if future conditions change at Sinking Pond, and fish of edible size can be caught and consumed by anglers then a reassessment of this pathway may be warranted.

Comment #9:
Purpose: evaluate past and present exposures
Purpose and Health Issues, First paragraph
As already stated in previous comments, please cumulatively assess past exposures as well as present ones.

Please change the last sentence in this paragraph to say: "The purpose of this public health assessment (PHA) is to evaluate and present information pertaining to whether exposure to site-related contaminants **could have occurred in the past or could be occurring presently**, and whether health effects **could have resulted/could result** from these exposures. (Suggested changes are highlighted in bold.)

ATSDR Response:
ATSDR edited the first paragraph under the Purpose and Health Issues section to read as follows:
The purpose of this public health assessment (PHA) is to evaluate and present information pertaining to whether exposures to site-related contaminants could have occurred in the past, are presently occurring, or may occur in the future and whether health effects could result from these exposures, based on available data.

Comment #10:
Soil remediation
Purpose and Health Issues, Background, Site Description and History.
Operable Unit-1 for the site, which included soil remediation, was completed in 1997.

ATSDR Response:
This sentence was added at the end of the section on Site Description and History.

Comment #11:
Recreational uses of Fort Pond Brook
Purpose and Health Issues, Background, Land Use and Natural Resources, Second paragraph
Recreational uses of Fort Pond Brook include fishing, canoeing, and kayaking. The MA Department of Fish and Game (aka MA Dept. of Fisheries and Wildlife), stocks Fort Pond Brook with trout every spring. A farm located across the stream from the WR Grace Site uses Fort Pond Brook water for irrigation purposes.

ATSDR Response:
The following was added to the Purpose and Health Issues, Background, Land Use and Natural Resources section:
It has been reported by the community, that recreational uses of Fort Pond Brook include fishing, canoeing, and kayaking. The Massachusetts Department of Fish and Game stocks Fort Pond Brook with trout every spring.

The following sentence was deleted: The extent of recreational use of Fort Pond Brook could not be determined.

Comment #12:
Private wells at site
Purpose and Health Issues, Background, Land Use and Natural Resources, Third paragraph
Please change the last sentence in this paragraph to say:
"There are no private drinking water wells onsite; however, six private irrigation wells have been identified as being on the site, or within 500 feet of the mapped plume."

ATSDR Response:
The last sentence in the third paragraph under the Purpose and Health Issues, Background, Land Use and Natural Resources section was modified as follows:

There are no private wells onsite, however six private irrigation wells have been identified in the vicinity of the plume.

Comment #13:
Wells/Wellfields
Discussion of Environmental Contamination, *Public Water Supply, Private Well, and Groundwater Sampling*, First paragraph
Scribner is actually a wellfield, rather than a single well. Several of the relevant public wells have been reconfigured over the years---so, the easiest/most accurate way to refer to them, individually or collectively, is to use the term: "well/wellfield".

ATSDR Response:
Thank you for this clarification.

Comment #14:
Irrigation wells
Discussion of Environmental Contamination, Public Water Supply, Private Well, and Groundwater Sampling, Second paragraph
As discussed in comments 4 and 5, above, additional data are available for the Lisa Lane, Bellantoni Drive and Powder Mill Plaza irrigation wells. Also see Attachment A, and July 2005 RI; p. 2-7.

ATSDR Response:
Please see ATSDR responses to comments 4 and 5, above.

Comment #15:
Details are available for groundwater data
Discussion of Environmental Contamination, Public Water Supply, Private Well, and Groundwater Sampling, Third paragraph

Re: Groundwater Monitoring
Details regarding well locations, number of samples collected, and target analytes are available in the July 2005 Public Review Draft Remedial Investigation Report, (See Table 3-3, Figures 4-1, 4-2, etc., Appendix B, Tables B-1 and B-2), as well as in several previous reports on the WR Grace Site, including:

- Phase I RI Data Report, Appendix E, April 30, 2001,
- Phase I. RI Data Report Addendum, Attachment F, August 16, 2002, and
- Draft RI, August 30, 2002

ATSDR Response:
The following sentence was deleted: Details regarding the sampling event and target analytes are unavailable.

Comment #16:
Details are available for surface water and sediment data
Discussion of Environmental Contamination, Surface Water and Sediment Sampling, Second and Third paragraphs

Re: Surface water samples and samples for Ecological Risk Assessment (and human health risk assessment)
Details regarding the sampling events and target analytes are available. See July 2005 Draft PHRA and BERA, as well as:

- Data Report for Ecological Risk Assessment Vol. 1 and 2, April 25, 2003
- Baseline Ecological Risk Assessment, July 30, 2004

ATSDR Response:
See response to previous comment.

Comment #17:
Arsenic and cancer
Discussion of Environmental Contamination, Completed Exposure Pathways, Public Water Supply Wells, Arsenic, Second paragraph

The first sentence of this paragraph states:
Several studies have shown that inorganic arsenic can increase the risk of lung cancer, skin cancer, bladder cancer, liver cancer, and prostate cancer."
Since arsenic is a contaminant of concern at the site, please include all of these cancers in the 2005 PHA assessment of cancer incidence in the area. Prostate cancer and skin cancer are not included in this assessment in the current draft PHA. (Please also see comment 35 below.)

ATSDR/ MDPH Response:
To evaluate possible health effects associated with potential exposures to contaminants of concern such as arsenic and vinyl chloride at the W.R. Grace site, ATSDR and MDPH selected six cancer types for evaluation: cancers of the bladder, brain and central nervous system (CNS), kidney, liver, and lung and bronchus as well as leukemia. These cancer types are evaluated in the draft MDPH Health Consultation and results of the analysis are summarized in the draft PHA.

The primary risk factor associated with development of skin cancer is sun exposure (ACS 2005a, 2006). While a number of studies in the scientific literature indicate that ingestion of arsenic can also increase the risk of developing some types of nonmelanoma skin cancer, it was not possible to include this cancer type. Specifically, the primary type of skin cancer observed to occur as a result of chronic arsenic ingestion is squamous cell carcinoma, and multiple basal cell carcinomas have been observed as well (ATSDR 2006). However, diagnoses of nonmelanoma skin cancer are not required to be reported to the Massachusetts Cancer Registry (MCR). While the MCR collects information on diagnoses of melanoma, this type of skin cancer has not been found to be associated with arsenic exposure.

While exposure to arsenic has been shown in the scientific literature to be associated with development of a number of internal tumors including prostate cancer, arsenic exposure is not a primary risk factor for the disease; therefore, this cancer type was not selected to evaluate possible health effects due to arsenic exposure at the W.R. Grace site. Known or suspected risk factors for prostate cancer include advanced age, family history of the disease, race, diet, and possibly a history of vasectomy (ACS 2005b). However, to address community concerns about this cancer type, rates for prostate cancer are provided below for males in Acton CT 3631.01 where the W.R. Grace site is located. Fewer males were diagnosed with prostate cancer than expected during the overall time period 1982-2000 and for two of the three smaller time periods. During the middle time period 1988-1993 prostate cancer occurred as expected.

Prostate Cancer Incidence

Census Tract 3631.01, Acton, MA

	Observed	**Expected**	**SIR**	**95% CI**
1982-1987	6	8.9	67	25 - 126
1988-1993	18	18.6	97	57 - 153
1994-2000	33	40.2	82	57 - 115
1982-2000	**57**	**65.7**	**87**	**66 - 112**

Source: Massachusetts Cancer Registry, Massachusetts Department of Public Health

Comment #18:
EPA and ATSDR calculated different risks due to arsenic
Discussion of Environmental Contamination, Completed Exposure Pathways, Public Water Supply Wells, Arsenic, Second paragraph

What accounts for the difference in cancer risk due to arsenic, when calculated by ATSDR versus EPA? The ATSDR estimate is an excess lifetime theoretical cancer risk of 2.23E-05; while the figure in the Public Health Risk Assessment, overseen by EPA, is 1E-04.

This is a reminder that risk assessments, by their nature, rely on assumptions (re: exposure frequency, etc.), They also rely on the availability of sampling data, and of relevant toxicological studies, etc. "Indeterminate public health hazard" (an ATSDR term), and "no unacceptable risk" (an EPA term), are not the same as "no risk".

ATSDR Response:
ATSDR and EPA use similar methods for calculating theoretical excess lifetime cancer risk, however, our exposure assumptions for the calculations sometimes differ slightly. The differences in the assumptions result in differences in the estimated risk. However, both ATSDR's and EPA's calculated theoretical excess cancer risk are in the range of 1E- 04 to 1E-06. There are varying suggestions among the scientific community regarding acceptable excess lifetime cancer risk, due to uncertainties regarding the mechanism of cancer. The recommendations of many scientists and EPA have been in the risk range of 1 in 1 million to 1 in 10,000 (as referred to as 1E -04 to 1E -06) excess cancer cases. An increased lifetime cancer risk of one in a million or less is generally considered an insignificant increase in cancer risk.

Comment #19:
VOCs in Private wells
Discussion of Environmental Contamination, Potential Exposure Pathways, Private wells

a. VOCs were found in at least three private irrigation wells. VOCs detected in one or more of these wells included: Acetone, benzene, MTBE, TCE, VDC (1,1-Dichloroethene), and vinyl chloride. See previous comments 4, 5, and 14 for details.

b. Please develop an exposure scenario for each of the VOCs detected in private irrigation wells.

c. Please evaluate inhalation exposures, as well as ingestion, and dermal contact.

d. Please consider past exposures, as well as current ones. The Lisa Lane well was installed in 1995. The Powder Mill Plaza well was installed in?

ATSDR Response:
Please refer to ATSDR responses to comments 4 and 5, above.

Comment #20:
Arsenic in Surface Water
Discussion of Environmental Contamination, Potential Exposure Pathways, Surface Water, Arsenic

ATSDR calculated an excess lifetime risk for an adult of 7.21E-04 for incidental ingestion and dermal contact using the maximum concentration of arsenic in surface water. The PHRA, done under EPA guidance, stated that there were not any risks above 1E-04 in surface water.

Again, this is a heads up to the public that risk assessments involve assumptions and judgement calls, in their calculations. The public is best protected when conservative assumptions are made and there is a policy to act on the side of safety. In this instance, ATSDR's assessment is more conservative than that overseen by EPA. (See also comment 18, above).

ATSDR Response:
It is true that risk assessment requires that assumptions be made regarding the parameters used in the risk assessment calculations and that results may differ slightly due to these assumptions. It is important to note that while ATSDR's and EPA's theoretical excess cancer risk estimates differ slightly they are both in the 1E -04 risk range. It is reassuring from a public health perspective that even though slightly different assumptions or methods may have been used by ATSDR and EPA that the theoretical excess cancer risk estimates were in the same range.

Comment #21:
Arsenic
Discussion Section, Public Health Implications, Arsenic, second paragraph

The text states that "A few studies found no harmful effects in persons in the United States who throughout their lifetimes drank water containing arsenic at levels of 50 ppb to 100 ppb [3]." Is this statement misleading, or at least not a complete characterization of the health hazards, including cancer risk posed by arsenic at these concentrations? Is there a shortage of studies in the U.S. of arsenic consumption at these concentrations? (Hopefully, no one is consuming water with arsenic at these concentrations!) Are there other studies that did find harmful effects from exposures at these levels?

The toxicity value used in the Public Health Risk Assessment is 0.045 ppb. The PHRA calculated a theoretical cancer risk of 1E-04, given the 5.2 ppb of arsenic detected in the School Street wells.

ATSDR Response:
The levels of arsenic detected in the Assabet and School Street public water supply wells are well below those discussed in the study cited from the ATSDR Toxicological Profile. Even at the higher levels cited in the study harmful effects were not found, therefore it is unlikely harmful effects would occur from the much lower concentrations found in the Assabet/ School Street wells. ATSDR used the maximum concentration of 5.2 ppb found in the School Street Wells for its estimated exposure dose calculations related to drinking water ingestion. The difference

between EPA's estimated carcinogenic risk and ATSDR's is likely due to slightly different exposure parameters in the calculations.

Comment #22:
Child exposure to arsenic
Discussion Section, Public Health Implications, Arsenic, third paragraph
The last sentence in this paragraph ends: "…it is not likely that a one to six year old child would ingest or play in sediment with the highest concentrations as often as ATSDR has estimated."

Comment: Human behavior is unpredictable, and cannot be relied upon as a safety measure. Remediation is needed, including the removal of contaminated sediments, so that a child can 'safely' contact the sediment as often and as long as desired.

ATSDR Response:
It is true that human behavior is not easily predictable; however, ATSDR believes that its exposure assumptions used to calculate risk in this public health assessment are conservative, but realistic. It is unlikely that a one to six year old child would trespass on the site and have contact with soil or sediment as frequently as ATSDR estimated.

Comment #23:
Cumulative risk from Arsenic
Discussion Section, Public Health Implications, Arsenic, fourth paragraph

What concentrations were used for arsenic when calculating cancer risk due to ingestion of private well water? Please use the site wide groundwater data for this calculation, rather than the site specific data from the six known irrigation wells. The six irrigation wells were only sampled for VOCs, not for inorganics, so the arsenic levels in these wells are unknown.

ATSDR Response:
ATSDR did not calculate estimated exposure doses for arsenic in private well water, because people in the vicinity of the W.R. Grace site are connected to the municipal drinking water supply and because there was no data for arsenic available from these wells. Because people in the vicinity of the W.R. Grace site are connected to the municipal water supply it is unlikely they would ingest arsenic from these private wells.

There is no completed exposure pathway for persons near the W.R. Grace to groundwater concentrations of arsenic; therefore, using the site wide groundwater data to calculate an estimated exposure dose would not be prudent.

Comment #24:
Cumulative risk from site contaminants
Discussion Section, Public Health Implications, Arsenic, fourth paragraph

As was done with arsenic, please also calculate cumulative risk from multiple pathways for other site contaminants. Please consider past and present exposures, (including to soils, sludge, etc.) Please also consider synergistic effects when individuals are exposed to multiple chemicals.

ATSDR Response:
For contaminants exceeding comparison values and with available information ATSDR did calculate carcinogenic risk from multiple pathways (see Table 10, which includes arsenic, Bis(2-ethylhexyl)phthalate, Polycyclic Aromatic Hydrocarbons, Polychlorinated Biphenyl's and vinyl chloride).

ATSDR reviewed the limited data available for VOCs that was provided in the 1992 Initial Release Public Health Assessment, prepared by the Massachusetts Department of Health. As previously discussed, ATSDR believes that this data of limited value for determining public health conclusions for past exposure, because in most cases there is only one data point per year for the years 1978 through 1992 and in the case of benzene there is only data point for the years 1978 through 1992. However, in an effort to answer ACES question regarding past exposures to VOCs, based on this very limited data, ATSDR did evaluate the historical data in the Public Health Assessment. Please refer to the section entitled: Public Water Supply Wells, Historical Data, VOCs. ATSDR concludes that past levels of VOCs in the Assabet wells posed no apparent public health hazard; however, levels of TCE may have exceeded current health guidelines, but because of the short duration of exposure (maximum 9 years) and the relatively low levels compared to potential effects in health studies, it is unlikely that adverse health effects have occurred. In addition, because the estimated exposure doses were below a CV or established health guideline for all of the VOCs, except TCE, it is unlikely that that there would have been synergistic effects to individuals exposed to these VOCs between 1978 and 1992.

As discussed previously, since the early 1980's, the AWD has been treating the groundwater through an air stripping process to remove VOC contamination from its active water supply wells. Therefore, there is no current or expected future exposure to VOCs in the municipal drinking water supply.

Comment #25:
Concord census tracts
Health Outcome Data, Second paragraph
Part of the WR Grace Superfund Site, is located in Concord, and Concord residents could have been exposed to onsite contamination over the past 27 plus years. These exposures could include exposures to contaminated soils, sludge, surface water, sediments, and airborne contaminants including those released by the ARS. Please evaluate cancer incidence in Concord as well as in Acton, especially for any Concord census tracts that include the WR Grace Site. The 1992 PHA looked at census data from Census Tract 3612.

ATSDR/ MDPH Response:
The MDPH will evaluate the six cancer types previously mentioned for Concord CT 3612 and incorporate the results into the ATSDR PHA and the Health Consultation report. It is also important to note that the MDPH will include an evaluation of cancer incidence for some of these cancer types (e.g. lung cancer, brain cancer, leukemia) in the town of Concord as part of a PHA currently being conducted for the Starmet site located in Concord.

Comment #26:
Comprehensive cancer review requested
Health Outcome Data, Second paragraph
Please provide information on all cancer data for the census tracts, rather than for just six preselected cancers. (The 1992 PHA took this more comprehensive approach.) In particular please include data on: colorectal cancer, Hodgkins disease, and non-Hodgkins lymphoma, prostate cancer, skin cancer, pancreatic cancer, breast cancer, and ovarian cancer or cancer of the uterus.

ATSDR/ MDPH Response:
The MDPH selected the six cancer types for evaluation based on available environmental data at the W.R. Grace site and information in the scientific literature on known or suspected associations with contaminants of concern (e.g. arsenic, vinyl chloride). Much of this information was not available at the time of the 1992 assessment. Community specific cancer data for most cancer types are available for review on the MCR's website at http://www.mass.gov/dph/bhsre/mcr/canreg.htm.

Comment #27:
Bladder Cancer
Health Outcome Data, Fifth paragraph; also Appendix G.
The text states that bladder cancer occurred less often than expected, but Tables 1a, 1b, and 1c in the current report show more bladder cancer cases than expected in Acton females in 1982-2000; and in 1982-1987 and 1988-1993. There was also increased incidence of bladder cancer in certain census tracks for specific time intervals.

ATSDR/ MDPH Response:
As described in the Draft MDPH Health Consultation, some elevations in bladder cancer incidence were observed for females in the town of Acton as a whole and for males and females combined in CT 3631.02 during certain time periods. However, none of the elevations were statistically significant and there were no consistent trends in these elevations over time. In addition, when the geographic distribution of individuals diagnosed with bladder cancer was examined in relation to the W.R. Grace site, no unusual patterns were observed that would suggest the existence of a common factor.

Specifically, as stated in the results section of the Draft MDPH Health Consultation report:

> "Bladder cancer occurred less often than expected among males and females combined in the town of Acton as a whole during 1982–2000, primarily due to a lower-than-expected rate among males in the town (24 diagnoses observed vs. 30.2 expected, SIR = 79). Females were diagnosed more often than expected during 1982–2000 (15 diagnoses observed vs. 11.3 expected, SIR = 133). This elevation was not statistically significant. Males in Acton experienced fewer diagnoses of bladder cancer than expected during each of the smaller time periods evaluated, while females were diagnosed slightly more often than expected during 1982–1987 and 1988–1993 and less than expected during 1994–2000 (see Tables 1a–1d). Each of the elevations among females represented an excess of about three cases and neither was statistically significant.

While bladder cancer occurred less often than expected in three census tracts in Acton during 1982–2000 (i.e., CTs 3631.01, 3632.01, and 3632.02), this cancer type was diagnosed more often than expected among males and females combined in CT 3631.02 (13 diagnoses observed vs. 8.2 expected, SIR = 159). This elevation was not statistically significant (see Tables 3a–3d)."

Comment #28:
ACES Comments/Questions, Oct. 28, 2003
Community Health Concerns
ACES submitted a list of comments/questions to ATSDR at the October 28, 2003 public meeting held at Acton Town Hall. These comments are also available online at www.actonaces.org; and are in hard copy as Attachment E to this letter. Please respond to these comments/questions in the 2005 PHA.

ATSDR Response:
There were 12 comments/ questions on this list and they are included as comments 38 through 50 of this section.

Comment #29:
Acrylonitrile questions
Community Health Concerns
In the second set of questions about acrylonitrile, the points beginning: "Given: that VOC testing…" would be clearer if left as bullet points, (or separated by semicolons), since they are hard to follow in the current format. Also, please include the concluding comment that came after these bullet points in the original ACES comments (See attachment F):

"It seems appropriate that ATSDR consider that individuals drinking Acton public water from the contaminated wells, between 1970 and 1978, may have been exposed to acrylonitrile and that the dose may have been at a high enough level to have caused health effects. (Exposure routes could have included ingestion, inhalation, and dermal exposure.)"

These comments were written in response to discussion about acrylonitrile on pages 35 to 36 of the 1992 ATSDR "Draft: Public Comment" PHA. (See Attachment B to these comments.)

ATSDR Response:
Suggested formatting changes and the additional text were added to the Community Health Concerns section, as requested. ATSDR reiterates that it concurs that persons who received water from the Assabet wells between 1970 and 1978 may have been exposed to acrylonitrile; however, ATSDR has no data that indicates there was acrylonitrile contamination in the wells during that period. Because there is no data from the drinking water wells, ATSDR cannot calculate an estimated exposure dose.

Comment #30:
Cancer cluster?
Community Health Concerns

In answer to a question about cancer clusters, the PHA quotes the MDPH assessment as saying that there were no apparent spatial patterns at the neighborhood level; but a few pages earlier the PHA discussed a spatial distribution of brain and CNS cancer diagnoses. "…there were a few locations in Acton where two or three individuals with this cancer type were located in relative close proximity to each other, with some located in the southern area of town near the W.R. Grace site." The text then discusses a lack of temporal trends in diagnoses, and a variety of cell types of brain and CNS cancer among these individuals. Please include this information in the answer to the question about clusters, and/or refer the reader back to this part of the report.

ATSDR/ MDPH Response:
The Final PHA report language will be revised to include additional information about the geographic pattern of cancer in neighborhoods surrounding the W.R. Grace site, consistent with what is presented in the draft MDPH Health Consultation.

Comment #31:
AWD stripping towers at Assabet wells not in use until 1983 to 1984.
Conclusions, First bullet point.
The text states: "Since 1980, the AWD has been treating the groundwater through an air stripping process to remove VOC contamination from the active water supply wells."
Air strippers were not used on the Acton Water District wells until 1983-1984. Both Assabet 1 and Assabet 2 were taken offline in 1978. According to the AWD, Assabet 1 was brought back online with carbon filtration, for a few months in 1982. When testing showed that low levels of TCA were "breaking through" the carbon filters, they took this well offline again. In 1983 Assabet 1 was brought back online with both airstripping and carbon filtration technology in place. By March of 1984, Assabet 2 had also been brought back online with this same treatment. At some later date the AWD stopped using carbon filtration at these wells, but it continues to use an airstripper to remove VOCs from the water.

ATSDR Response:
Thank you for this clarification. The text has been modified to reflect this information.

Comment #32:
Irrigation well data
Conclusions, Third bullet point.
Please revise this bullet point based on the additional VOC data that are available for the irrigation wells. See previous comments 4, 5, etc.

ATSDR Response:
Please see ATSDR responses to comments 4 and 5, above.

Comment #33:
Evaluation of soil?
Conclusions, Third bullet point.
The third bullet point refers to an evaluation of potential health effects from exposure to contaminants in soil. Was an evaluation of soil done as part of this PHA? If not please conduct such an evaluation, especially of past contamination of soil in site disposal areas.

Also see references to soil in the fourth bullet point under Conclusions and the second bullet point under Recommendations.

ATSDR Response:
A separate evaluation of soil data was not completed, because soil data was insufficient in the reference for making a health determination related to past exposures. If additional soil data becomes available a separate evaluation could be conducted.

Comment #34:
Demographic Map needs revision
Appendix A. Figure 1
The demographic map only shows the portion of the WR Grace site that is south of the MBTA line. A substantial portion of the site is also north of the MBTA line, and should be included on this figure. The one mile buffer should be redrawn accordingly.

ATSDR Response:
ATSDR has modified the demographic map to include the area north of the MBTA line and the one mile buffer has been redrawn accordingly.

Comment #35:
Comprehensive cancer review requested
Main ATSDR Report, Health Outcome Data, Second paragraph
As stated in comment 26 above, please provide information on all cancer data for the census tracts, rather than for just six preselected cancers. (The 1992 PHA took this more comprehensive approach.) In particular, please include data on: colorectal cancer, Hodgkins disease, and non-Hodgkins lymphoma, prostate cancer, skin cancer, pancreatic cancer, breast cancer, and ovarian cancer or cancer of the uterus.

Skin cancer and prostate cancer are associated with arsenic, one of the contaminants of concern at the site. Incidences of colorectal cancer in Acton males were found to be statistically significant in a 1991 review of available data. (See Attachment D.) There are community concerns about the other cancers listed above.

ATSDR/ MDPH Response:
Refer to responses to Comments # 17 and # 26 above.

Comment #36:
Concord census tracts
Health Outcome Data, Second paragraph
As already stated in comment 25: Part of the WR Grace Superfund Site, is located in Concord, and Concord residents could have been exposed to onsite contamination over the past 27 plus years. Please evaluate cancer incidence in Concord as well as in Acton, especially for any Concord census tracts that include the WR Grace Site. The 1992 PHA looked at census data from Census Tract 3612.

ATSDR/ MDPH Response:
Refer to response to Comment # 25 above.

Comment #37:
Brain and CNS cancer, and bladder cancer
Both Brain and CNS cancer, and female bladder cancer incidence were observed more than expected in several different time periods and/or census tracts. (See Tables 1a to 1c; 2a to 2d; and 3a to 3d.)

a. Please provide further discussion of brain and CNS cancer in the Discussion section (VII) of the MDPH assessment, including a discussion of the spatial distribution of this cancer type near the WR Grace Site.

b. Please provide some discussion of increased bladder cancer observations in females in the Discussion section (VII) of the assessment.

c. Please note these two cancers in the Conclusion section (VIII) of the cancer assessment.

ATSDR/ MDPH Response:
The MDPH will revise the Discussion and Conclusions sections of its Health Consultation to include additional information about statistically significant and non-statistically significant elevations observed among males and females diagnosed with brain/CNS cancer and among females diagnosed with bladder cancer for certain time periods and census tracts. It is important to note, however, that although these elevations were observed, based on all information reviewed (i.e. incidence rates, evaluation of geographic and temporal trends, and analysis of risk factor information), it does not appear that a common factor (environmental or nonenvironmental) played a primary role in the incidence of cancer in Acton as a whole or in relation to the W. R. Grace site.

Comment #38:
As part of the planned ATSDR Public Health Assessment of the WR Grace Site, please assess disease rates at both the census tract level in Acton and West Concord, as well as town-wide in Acton.

ATSDR Response:
Please see the attached Health Consultation: Assessment of Cancer Incidence in Acton and Concord Census Tract 3612: 1982-2000 prepared by the Massachusetts Department of Public Health under cooperative Agreement with ATSDR.

Comment #39:
Please include in the assessment all cancers tracked by the MA Cancer registry, paying special attention to the cancers addressed by the John Snow Institute (leukemias, bladder cancer, colorectal cancers, liver cancers, non Hodgkins lymphoma, Hodgkins disease, and all cancers combined.)

a. Please assess both cancer incidence and cancer death rates.

b. Please include all data from the earliest possible date through the present. (JSI looked at cancer mortality data in five groupings: 1969-1973, 1974-1978, 1979-1983, 1984-1986, and 1987-1988; and at cancer incidence rates from 1982-1988.)
c. Please present data in a form so that rates from different time periods can be directly compared. (The 1995-1999 data cautions about comparing different data sets from different years.)
d. Please indicate any data limitations when assessing cancer data or trends. For example the MA Department of Public Health annual report on "Cancer Incidence and Mortality in MA 1996-2000" warns that some cancers may be under-reported due to how and where they are diagnosed –ie in a hospital or not, (leukemia, multiple myeloma, etc.) Also the actual incidence rates for some cancers with shorter survival times, (including liver and pancreatic cancer), may be 10% higher than initially reported due to delay and error. Please recheck all data, (including historical data), so that any corrections for under-reporting, error, or delayed reporting are made.

ATSDR/ MDPH Response:

a. MDPH/BEH typically evaluates cancer incidence because this is a more accurate and complete picture of cancer in a community than cancer mortality. Furthermore, many cancers are treatable, and while they may cause long term morbidity, they do not necessarily contribute to an individual's death. The cancer experience of the community may be underestimated if only cancer mortality is examined; the number of people affected by cancer will likely exceed the number who died from cancer. Also, cancer mortality rates are based on information recorded on death certificates, which depending on who completes the death certificate, who is present at the time of death, and what is know about the decedent's underlying health conditions, may contain information on an underlying cancer diagnosis.

   Because cancer incidence data provides a more complete picture of cancer in a community, the MDPH examined the pattern of cancer diagnoses in Acton and Concord using data collected by the MCR. An analysis of cancer incidence data can detect trends faster than an analysis of cancer mortality data as we are receiving reports of most cancer diagnoses within a shorter time period. The MCR collects information on all Massachusetts residents diagnosed with cancer, and state law requires that all new cancer diagnoses be reported to the MCR within 6 months of diagnosis, regardless of where the diagnoses occur. According to state regulations, all health care facilities and health care providers that diagnose, evaluate or provide cancer treatment to cancer patients shall report to the MCR (105 CMR 301). The MCR is considered by the North American Association of Central Cancer Registries to have achieved the gold standard for certification in recent years (MDPH 2006a).

   MDPH/BEH selects cancer types for evaluation based on knowledge of community concerns or potential associations with contaminants of concern at a particular site. In the case of the W.R. Grace site, six cancer types were evaluated in this investigation, including cancers of the bladder, brain and central nervous system (CNS), kidney, liver, and lung and bronchus as well as leukemia. Colorectal cancer, non-Hodgkin's lymphoma, and Hodgkin's disease were not evaluated in relation to the W.R. Grace site because these cancer types either have no known environmental risk factors (e.g. colon and rectum cancer) or are not thought to be associated with the primary contaminants of concern at the site (e.g., arsenic and vinyl chloride).

b. Cancer data for this report was provided by the Massachusetts Cancer Registry (MCR). The MCR is a division in the MDPH Bureau of Health Information, Statistics, Research, and Evaluation. It is a population-based surveillance system that has been monitoring cancer incidence in the Commonwealth since 1982. All new diagnoses of invasive cancer, as well as certain in situ (localized) cancers, among Massachusetts residents are required by law to be reported to the MCR within 6 months of the date of diagnosis (M.G.L. c.111. s 111b). The MCR also gathers additional information (e.g., gender, age, address at diagnosis) on each individual reported. This information is kept in a confidential database. Data are collected daily and reviewed for accuracy and completeness on an annual basis. Due to the high volume of data collected and the 6-month period between diagnosis and required reporting, the most current registry data that are complete will inherently be a minimum of 2 years prior to the current date. This data is the most accurate and complete data available to the CAP.

   As previously stated, the MCR was created by the state legislature and began collecting cancer incidence data in 1982. Data available prior to 1982 are limited to cancer mortality data gained through a search of the cause of death as recorded on death certificates. As discussed above in the response to Section A of this comment, an analysis of cancer mortality data may underestimate actual incidence as the number of people diagnosed with cancer will likely exceed the number who died from cancer. A more accurate assessment of cancer in a community can be obtained by evaluating cancer incidence rather than cancer mortality.

c. In the Health Consultation, cancer incidence was examined over a 19-year period (1982-2000) as well as over three smaller time periods (1982-1987, 1988-1993, and 1994-2000). For each time period, the cancer incidence of Acton or its census tract was compared to that of the state of Massachusetts as a whole. The use of standardized incidence ratios (SIRs), as were calculated in the Health Consultation, allows for a comparison of a community's cancer experience to that of the state over time. Because the age distribution of a community changes over time, it is most appropriate to compare the community's cancer experience for a given time period to that of the state for that same time period. Time trends can be evaluated, therefore, by determining whether the community's cancer experience is, across time periods, above, below, or consistent with the statewide experience of cancer.

d. The health consultation conducted by the MDPH/BEH is an investigation that analyzes readily-available descriptive health outcome data for cancer to determine whether the pattern or occurrence of selected cancers appears unusual. Information from descriptive analyses, which may suggest that a common etiology (or cause) is possible, can serve to identify areas where further analyses or public health intervention are needed.

   As mentioned earlier, the MDPH/BEH uses cancer incidence data collected by the MCR. The MCR is a population-based surveillance system that collects information on all Massachusetts residents diagnosed with cancer. According to state regulations , all health care facilities, including public and private hospitals and health care providers, health care facilities, oncology centers, nursing homes, hospices, laboratories, health maintenance organizations, and other outpatient facilities that diagnose, evaluate or provide cancer treatment to cancer patients must report diagnosis or treatment of cancer (105 CMR 301).

Estimates of MCR completeness in reporting have increased steadily since the registry was established in 1982. In its early years, the MCR was estimated to include 90-95% of all reportable cancer cases in Massachusetts. More recently, efforts to improve case ascertainment have increased completeness to more than 95%, and the MCR is considered by the North American Association of Central Cancer Registries to have achieved the gold standard for certification in recent years (MDPH 2006a).

Thus, MDPH/BEH is confident that the MCR data reflect all but a small percentage of all invasive cancers among Massachusetts residents. Our reports evaluate cancer incidence data and environmental contamination, and contain discussions on applicable limitations of the available data, the W.R. Grace Acton Health consultation is no exception.

Comment #40:
Please extend the assessments of infant mortality and low birth weights, up to the present, and provide and analyze all of the data from 1969 to present.

ATSDR/ MDPH Response:
The original scope of the MDPH's work did not include either of these two health outcomes in this report. To address the comment above, MDPH reviewed the contaminants of concern and completed exposure pathways identified by ATSDR in the public health assessment. As discussed in ATSDR's PHA, two contaminants, arsenic and manganese, were measured at levels above their comparison values in public water supply wells. According to ATSDR's toxicity profiles on these two contaminants, there is some scientific evidence that consumption of high levels of arsenic and manganese in drinking water may result in adverse reproductive effects in humans or animals.

Based on comparisons to health guidelines, drinking water standards, and calculations of site-specific exposure doses using maximum detected concentrations, ATSDR concluded in the PHA that no adverse non-cancerous health effects would be expected from exposure to the maximum detected concentrations of either of these compounds in the drinking water. Nonetheless, to address concerns about low birthweight births and infant mortality, MDPH conducted two evaluations: the first involved identifying in the ATSDR Toxicological Profilesfor arsenic the lowest dose at which an adverse reproductive outcome has been reported, to compare to the estimated maximum dose from ingestion of the contaminants in the Acton public water supply, and the second involved a review of readily-available data on infant mortality and low birth weight for Acton, to compare to statewide data on these same health outcome measures. (MDPH focused on arsenic, instead of manganese, because of arsenic's greater relative toxicity compared to that of manganese; this allowed for a worst-case evaluation of the potential for adverse reproductive outcomes.)

MDPH calculated the estimated exposure dose for adults exposed to the maximum detected concentration of arsenic in drinking water in the Acton public water supply for 365 days per year for a lifetime to be 0.00015 mg/kg/day. This estimated exposure dose is 40 times lower than the lowest adverse effect level observed in scientific studies of humans consuming doses of arsenic (0.006 mg/kg/day) that increased the incidence of adverse reproductive health outcomes (ATSDR 2007)[20]. This indicates that residents are unlikely to have an unusually increased risk of adverse reproductive health outcomes as a result of their opportunities for exposure.

MDPH also reviewed rates of infant mortality and low birthweight births in Acton and the state as a whole for the years 1989 through 2006.

Low birthweight is considered to be the live birth of a full-term infant weighing less than 2,500 grams (approximately 5.5 pounds). Babies born with a low birth weight are alternatively referred to as "small for gestational age," and the terms are used interchangeably. There are many risk factors for low birthweight, including insufficient placental growth; maternal risk factors (e.g., poor nutrition, smoking, drug or alcohol abuse); infections (e.g., rubella, cytomegalovirus, toxoplasmosis, syphilis); chronic renal failure; and other conditions (e.g., sickle cell anemia, phenylketonuria, thrombophilia, preeclampsia). Research is beginning to emerge on environmental risk factors for low birthweight. A recent British study found that increased maternal exposure to air pollution, particularly sulfur dioxide, was associated with low birthweight prevalence (Bobak 2000).

Low birthweight data are collected by the MDPH Bureau for Health Information, Statistics, Research, and Evaluation (BHISRE). The number of low birthweight births for Acton and the state as a whole from 1989–2006 were obtained through the Massachusetts Community Health Information Profile (MassCHIP). The year 1989 is the first year for which these data are available on MassCHIP. For this analysis, rates were calculated by comparing the number of low birthweight babies to the number of total births for the community within three time periods: 1989–1994, 1995–2000, and 2001–2006. A rate per 10,000 live births was then calculated to allow for easier comparison to the state.

To determine if the number of low birthweight births observed in Acton was statistically significantly different from the number of low birthweight births observed in the state or if the difference may be due solely to chance or natural variability, a 95% confidence interval (CI) was calculated for each rate. A 95% CI assesses the magnitude and stability of a rate. By definition, a 95% CI is the range of estimated values that has a 95% probability of including the true rate of low birthweight births for the population. A confidence interval also indicates the precision of a rate; the wider the interval, the less certain the rate. Statistically, the width of the interval reflects the size of the population and the number of events; smaller populations yield less precise estimates which have wider confidence intervals.

If the 95% confidence intervals for the community do not overlap with (i.e. fall within the range of) the state's confidence intervals, then the prevalence of low birthweight births in the community is considered to be statistically significantly different from the prevalence of low birthweight births in the state as a whole. For example, for the time period 2001-2006, a rate of

20 Margin of Safety (Adult) = $\frac{0.006 \text{ mg/kg/day}}{0.00015 \text{ mg/kg/day}} = 40$

507 low birthweight births per 10,000 live births was observed in Acton, with confidence intervals of 391–622. In the state as a whole for this time period, a rate of 765 low birthweight births per 10,000 live births was observed, with confidence intervals of 757–773. Because the confidence intervals for Acton (391–622) do not fall within the range of the state's confidence intervals (757–773), and because the confidence intervals in Acton are lower than the state's confidence intervals, the rate of low birthweight births in Acton is considered to be statistically significantly lower than the rate of low birthweight births in Massachusetts. The results of the analysis of low birthweight data can be seen in Tables 1 (Acton) and 2 (State).

Table 1: Low Birthweight* Prevalence Estimates for Acton, Massachusetts, 1989-2006					
Time Period	Number of Births with Low Birthweight	Total Births	Rate per 10,000 Live Births	Confidence Intervals	
1989-1994	41	1456	282	197	367
1995-2000	54	1540	351	259	443
2001-2006	70	1382	507	391	622

*Low Birthweight is considered to be below 2500 grams (~ 5.5 lbs.) when carried to full term

Table 2: Low Birthweight* Prevalence Estimates for Massachusetts, 1989-2006					
Time Period	Number of Births with Low Birthweight	Total Births	Rate per 10,000 Live Births	Confidence Intervals	
1989-1994	31632	527545	600	593	606
1995-2000	32974	485900	679	672	686
2001-2006	36319	474759	765	757	773

*Low Birthweight is considered to be below 2500 grams (~ 5.5 lbs.) when carried to full term

As illustrated in the tables, Acton had prevalence estimates for low birthweight births that were statistically significantly lower than the state of Massachusetts as a whole for each of the three time periods. In the three time periods analyzed, between 41 and 70 infants were born in Acton that were considered to be of low birthweight. Because these numbers are relatively small, the calculated prevalence estimates produced wide confidence intervals, illustrating their statistical instability. However, for each time period, the 95% CIs for Acton are below those for the state as a whole. *Because the estimates are consistently lower than that of the state, it can reasonably be concluded that low birthweight prevalence has not been elevated in the town of Acton during the 16-year period evaluated, compared to the state as a whole.*

MDPH also reviewed rates of infant mortality in Acton and the state as a whole for the years 1989 through 2006, again using data from MassCHIP. Infant mortality is defined as the death of a child less than one year of age. For this analysis, rates were calculated by comparing the number of infant deaths to the number of total births for the community within the time period of 1989–2006. As with low birthweight data, a rate per 10,000 live births and 95% confidence intervals (CI) were then calculated. The results of the analysis of infant mortality can be seen in Tables 3 (Acton) and 4 (State).

Table 3: Infant Mortality Prevalence Estimates for Acton, Massachusetts, 1989-2006					
Time Period	**Number of Infant Deaths**	**Total Births**	**Rate per 10,000 Live Births**	**Confidence Intervals**	
1989-2006	11	4,378	25	10	40

Table 4: Infant Mortality Prevalence Estimates for Massachusetts, 1989-2006					
Time Period	**Number of Infant Deaths**	**Total Births**	**Rate per 10,000 Live Births**	**Confidence Intervals**	
1989-2006	8,292	1,488,204	56	55	57

As illustrated in the tables, Acton had an infant mortality rate that was statistically significantly lower than the state of Massachusetts as a whole. Further analysis of infant deaths in each year indicates that the number of infant deaths appears to be stable and low over time, with between 0 and 2 infant deaths reported each year. No temporal trends are evident from the data and the deaths were not clustered in any one year or group of years.

Based on a review of low birthweight and infant mortality data for the town of Acton, no apparent concentrations or trends of infant deaths or low birthweight births were observed in any one year or time period in Acton. The rates of low birthweight births and infant deaths for the town of Acton were statistically significantly lower than the rates observed for the state as a whole.

Comment #41:
One limitation that has been anecdotally related about previous assessments was that Acton's population was too small and too mobile to fully analyze the effects of the WR Grace contaminants on public health. Are there any new statistical or other analytical tools available that can now be used to overcome previous limitations? Could the remaining population of long-time residents be identified, surveyed, and assessed for health effects? If so, please help with the planning for these assessments.

ATSDR/ MDPH Response:
The issue of small numbers is common in any cluster evaluation. For that reason, MDPH/BEH developed a peer-review protocol for conducting such small-scale investigations and maximizes the use of readily-available health data (e.g., by reviewing trends; readily available risk factor information; histologies; residential history information). We believe that our approach best addresses community concerns and can be (and has been) the basis of recommending additional research when unusual patterns are observed. MDPH/BEH is one of the few health departments in the country that uses health outcome data to address community concerns.

ATSDR evaluated environmental data for the W.R. Grace site available through August 2004. A large portion of the data reviewed came from the 2002-2004 Remedial Investigation and Ecological and Public Risk Assessment documents produced under the guidance of EPA. ATSDR also reviewed the limited historical data that was available from the Draft 1992 Public

Health Assessment written by MDPH under cooperative agreement with ATSDR. A full review of all historical environmental data related to the W.R. Grace was beyond the scope and ATSDR resources available for the 2008 Public Health Assessment. This assessment included estimated potential exposure opportunities using worst-case assumptions (e.g. maximum concentration detected in drinking water) and concluded that exposure to groundwater from non-municipal wells for non-drinking water purposes poses no apparent public health hazard; that exposure to levels of VOCs in the Assabet wells poses an indeterminate public health hazard; that exposure to the highest levels of arsenic and manganese in sediment and surface water poses a public health hazard to trespassers; and past exposure to arsenic and manganese in the municipal water supply poses an indeterminate public health hazard.

While the lack of access to information about in- and out-migration (or mobility) can also be a data limitation, it is important to note that the MCR is a high quality cancer registry that captures more than 95% of all diagnosed cancers among Massachusetts residents and records their address at the time of diagnosis. The MCR is rated by the North American Association of Central Cancer Registries as having achieved gold standard status, the highest rating for state cancer registries (MDPH 2006a). Although clearly some individuals who may have lived much of their lives in Acton or Concord moved away before their diagnoses, it is also true that some individuals lived elsewhere and then moved to Acton or Concord, where they were diagnosed with cancer. Thus, we generally assume that there is some off-setting of both in- and out-migration for any given community.

Comment #42:
People exposed to contaminated drinking water were exposed to several chemical contaminants together. Please assess the possible synergistic and cumulative effects of human exposure to multiple chemicals in the body.

ATSDR Response:
ATSDR reviewed the limited data available for VOCs that was provided in the 1992 Initial Release Public Health Assessment, prepared by the Massachusetts Department of Health. As previously discussed, ATSDR believes that this historical data is of limited value for determining public health conclusions for past exposure, because in most cases there is only one data point per year for the years 1978 through 1992 and in the case of benzene there is only data point for the years 1978 through 1992. However, in an effort to answer ACES question regarding past exposures to VOCs, based on this very limited data, ATSDR did review and calculate non-carcinogenic and carcinogenic risk, where possible (see Comment 2 response). Based on this assessment, the maximum concentrations of ethylbenzene, 1,1 dichloroethylene and methylene chloride were below ATSDR CVs and were therefore not evaluated further. Based on the maximum concentrations and reasonable exposure parameters (see Comment 2 response), estimated exposure doses for benzene, TCE, and 1,1, dichloroethane were below established EPA or ATSDR health guidelines. Because the estimated doses for these contaminants are either below a Comparison Value or below ATSDR or EPA health guidelines it is unlikely that a person would have experienced harmful effects. In addition, because the estimated exposure doses were below a CV or established health guideline it is unlikely that that there would have been synergistic effects to individuals exposed to these VOCs between 1978 and 1992.

As discussed previously, since the early 1980's, the AWD has been treating the groundwater through an air stripping process to remove VOC contamination from its active water supply wells. Therefore, there is no current or expected future exposure to VOCs in the municipal drinking water supply.

Comment #43:
The 1992 ATSDR report concentrates on the potential relationship between chemical exposure and cancer rates. Please also assess other health-related outcomes that may be related to chemical exposure. These could include: chromosomal disorders, other birth defects, multiple sclerosis, Lou Gehrig's disease, asthma, infertility, learning disabilities, autism, rates of ADD and ADHD, other Special Education needs, etc. Can Acton's rates of these or similar health issues be compared over time to state rates? Are there any clusters of these conditions within Acton? Could any of these health issues be related to the chemical contaminants at the WR Grace Site?

ATSDR/ MDPH Response:
Similar to other state health departments throughout the country, Massachusetts does not have a statewide registry to track diagnoses of most of the other diseases or conditions that are mentioned in this comment (e.g., multiple sclerosis, infertility). However, MDPH was recently mandated to establish a statewide ALS (Lou Gehrig's Disease) Registry, which is currently being implemented. Birth defects data are collected by the Massachusetts Center for Birth Defects Research and Prevention within the MDPH Bureau of Family and Community Health and Nutrition, BEH will request these data and will make them available as part of the final report.

Also, through our environmental public health tracking activities, MDPH/BEH has pediatric asthma data for grades K through 8. Statewide pediatric asthma surveillance has been conducted by the MDPH/BEH for school years 2003-2004, 2004-2005, 2005-2006, and 2006-2007 (MDPH 2005a, 2006b, 2007). As part of a cooperative agreement with the U.S. Centers for Disease Control (CDC), MDPH's BEH established a statewide tracking system for pediatric asthma. All public and private schools in Massachusetts with any grade kindergarten through 8 report the number of enrolled students with a diagnosis of asthma. This information is generally provided by school nurses through a standardized report form, however for private schools, administrative staff complete reporting forms. School enrollment data were collected from the Massachusetts Department of Education (MDOE) or from a school's administrative staff. Data available from the tracking program indicate that the statewide prevalence of asthma among children in grades K through 8 is approximately 10%.

Table 5 contains prevalence estimates for all of the Acton K-8 schools that have participated in the MDPH pediatric asthma surveillance program. The prevalence of asthma among Acton schools for all years reported was either similar to the state as a whole (meaning that any differences in prevalence may reflect natural or random variability) or statistically significantly below the state prevalence of asthma.

Table 5: Pediatric Asthma Prevalence by School, Acton, Massachusetts				
	2003-2004	**2004-2005**	**2005-2006**	**2006-2007**
Acton Schools				
Douglas	10.7 (8.0-13.5)	8.5 (6.0-10.9)	9.4 (6.8-11.9)	10.0 (7.4-12.7)
Gates	11.3 (8.5-14.1)	9.8 (7.1-12.4)	10.8 (8.0-13.5)	10.4 (7.7-13.1)
Luther Conant	9.1 (6.6-11.7)	10.0 (7.3-12.7)	8.3 (5.9-10.8)	6.5 (4.3-8.7)*
McCarthy-Towne	6.7 (4.5-8.9)*	11.0 (8.3-13.8)	9.3 (6.7-11.8)	10.4 (7.7-13.1)
Merriam	8.1 (5.7-10.4)	8.4 (6.1-10.7)	7.3 (5.1-9.4)*	6.9 (4.8-9.0)*
Raymond J Grey JH	11.4 (9.4-13.4)	11.1 (9.1-13.2)	NR	8.1 (6.4-9.8)*
The Victor School	---^	---^	0.0 (0.0-0.0)*	0.0 (0.0-0.0)*
Statewide Prevalence	9.5 (9.4-9.6)	10.0 (9.9-10.1)	10.6 (10.5-10.7)	10.8 (10.7-10.8)

* Indicates a statistically significant difference from the state rate for that school year
^ Schools with K-8 enrollment < 15, data not shown to protect student confidentiality
NR - not reported

Finally, although no statewide registry for autism exists, MDPH/BEH completed a report examining prevalence estimates of autism and autism spectrum disorders (ASD) in Massachusetts (MDPH 2005b). The report evaluated three years of disability and school enrollment data in 43 Massachusetts school districts for the school years 2002-2003, 2003-2004, and 2004-2005. School district prevalence was estimated as the number of children (ages 3-22) with autism or ASD. The range of prevalence estimates for autism in Massachusetts, based on three years of data, is 26 to 55 per 10,000 children. For ASD, the range of prevalence estimates is 71 to 81 per 10,000 children.

Table 6 contains prevalence estimates for the Acton school district and the state of Massachusetts. The prevalence estimates of autism among children enrolled in Acton schools for all years reported was either similar to the state as a whole or below the state prevalence estimates of autism.

Table 6: Autism Prevalence Estimates in Acton, Massachusetts								
	Acton				Massachusetts			
	Autism Count	Total Enrollment	Rate*	95% CI	Autism Count	Total Enrollment	Rate*	95% CI
2002-2003	11	2,571	43	(18, 68)	4,080	991,641	41	(40, 42)
2003-2004	13	2,544	51	(23, 79)	4,876	991,478	49	(48, 51)
2004-2005	13	2,594	50	(23, 77)	5,467	986,662	55	(54, 57)

*Prevalence per 10,000 students based on IEP data and enrollment

Comment #44:
A 1984 ATSDR memo stated that an epidemiological study was being conducted in Battle Creek, Michigan, that could be relevant to conditions in Acton since three of the contaminants

being assessed were the same as the ones from the Acton site. What were the results of that study? Please provide the Acton Board of Health, ACES and the Acton Memorial Library with hard copies of that and any other relevant studies from Battle Creek or elsewhere, including any ATSDR studies of the Superfund Site in Woburn, MA

ATSDR Response:
Hard copies of the Final Public Health Assessments for the Verona Well Field, Battle Creek, Calhoun County, Michigan (December 20, 1995) and the Final Public Health Assessment for the Wells G and H, Woburn, Middlesex County, Massachusetts (November 29, 2000) can be obtained by contacting the ATSDR Records Center. You may contact ATSDR toll free at 1-888-42ATSDR. These documents are also available for review on the ATSDR web site. The results are summarized below.

Summary of the Verona Well Field PHA
The Verona Well Field site was placed on the U.S. Environmental Protection Agency's National Priority List in September 1983. In 1981, some of the wells in the Verona Well Field, the primary source for the municipal water system of the City of Battle Creek, Michigan, and many private wells in the same area were found to be contaminated with volatile organic chemicals. The most contaminated municipal wells were taken out of service, and other appropriate steps were taken to reduce the contaminant levels in the municipal system to acceptable levels. Beginning the following year, residents with contaminated private wells were provided with bottled water and, by 1984, their homes and businesses were connected to the municipal water supply. New municipal wells were drilled in uncontaminated areas. Several of the abandoned municipal wells were put in service as purge or blocking wells to intercept contamination before it would reach the wells currently in use. There has been no detectable contamination in the municipal water system since 1984. The contamination has been traced to three sources near the well field: the Thomas Solvent Raymond Road Facility, the Thomas Solvent Annex, and the Grand Trunk Western Railroad marshalling yard.

Remediation of the Thomas Solvent Raymond Road facility began in 1987. Construction of the remediation system at the Thomas Solvent Annex began in mid-1993. From 1984 to 1988, the Michigan Department of Health (MDPH) and the Centers for Disease Control (CDC) conducted a health study of individuals having used contaminated private wells in the Verona area and a representative sample of individuals using Battle Creek municipal water. The study attempted to correlate health effects with exposure to the contaminated drinking water. No health effects were found that could be associated with the contamination. The individuals studied have been included in the Agency for Toxic Substances and Disease Registry (ATSDR) National Exposure Registry, Trichloroethylene (TCE) Subregistry.

The site poses a public health hazard, due to past history of exposure via groundwater and the potential for future exposure. Future exposures could occur if the remedial measures that have been taken to capture the contaminated groundwater plume were interrupted or if residents used contaminated water from private wells for drinking, cooking, or other household uses contrary to public health advisories. The extent of surface soil contamination in the source areas should be evaluated. Health concerns at the site have been largely addressed by the MDPH/CDC health study and the ATSDR Exposure Registry. Participants in the Exposure Registry will continue to benefit from registry follow-up and updates as new information becomes available. Community health education is recommended to remind those who have private wells of the risks associated with using contaminated groundwater.

Summary of the Wells G and H, Woburn PHA

The Wells G and H site encompasses two municipal wells located in Woburn, Massachusetts. The water drawn from these wells was used as a municipal water supply for the city of Woburn from 1964 to 1979. A Health Assessment was completed in 1989. This public health assessment addendum focuses on the indoor air monitoring studies conducted at the Wells G and H site since the completion of the Health Assessment in 1989. Three residences and a day care center were sampled to determine the extent of indoor air contamination due to volatilization of contaminants from the groundwater plume into the basements of the residences and the day care center. The sampling was conducted in July 1989, and in April and October 1991. The primary contaminants detected in indoor air were carbon tetrachloride, benzene, 1,2-dichloroethane, trichloroethylene, 1,1-dichloroehtylene, methylene chloride, and chloroform.

Populations potentially exposed to indoor air contaminants from the study area include residents and workers in the area and workers and children at the day care center. The exposure pathway of potential concern is the inhalation of indoor air. Although individuals have been exposed to and are exposed to contaminants in the indoor air in the residences and day care center, adverse health effects are unlikely due to the low concentrations detected.

It is unlikely that the chemicals detected during these sampling investigations are site related. The concentrations measured were typical of concentrations seen in many studies of ambient or indoor air. The majority of the samples taken at three Woburn residences and the Puddle Duck Day Care center resulted in either non-detectable levels of contaminants or low levels of contaminants. The highest levels were detected consistently at the 6 Dewey Avenue residence, which stored a considerable amount of household products. Such products contain a variety of the compounds of concern associated with this investigation; therefore suggesting another potential source of contamination. The proximity of various industrial companies, including a printing press, may be a source of contamination for the indoor air of the Puddle Duck Day Care Center. Therefore, identifying the contaminated groundwater as the only source contributing to air concentrations in the basements, cannot be made with any certainty.

Based on the available information, the indoor air in the site vicinity represents no apparent public health hazard. However, the conclusions of this public health addendum do not change the original conclusions of the 1989 Public health Assessment, which said that the Wells G and H site represents a public health hazard because of the risk to human health resulting from current and past exposure to hazardous substances, in the soil and municipal drinking water respectively, at concentrations that may result in adverse health effects.

The contaminants of concern for both of these Public Health Assessments are VOCs. The Verona Well Field/ Battle Creek PHA focused mostly on the ingestion of contaminated well water and the Summary of the Wells G and H, Woburn PHA focused primarily on exposure to

VOC contaminants due to vapor intrusion or the volatilization of contaminants into indoor air from a contaminated groundwater plume.
Both of these pathways of exposure have been addressed in this W.R. Grace PHA. Based on the very limited historical data available, ATSDR has concluded that past exposure to VOCs in the Assabet wells posed no apparent public health hazard; however, levels of TCE may have exceeded current health guidelines, but because of the short duration of exposures (maximum 9 years) and the relatively low levels compared to potential health effects in other studies, it is unlikely that adverse health effects have occurred. To address vapor intrusion, ATSDR applied the USEPAs Johnson and Ettinger (1991) model to estimate possible indoor air concentrations for homes or buildings that may overly the groundwater plume. ATSDR used a very health protective model and the highest values found in groundwater to create a worst-case evaluation. As a result, ATSDR concludes that homes or buildings above the W.R. Grace site groundwater plume should not accumulate indoor air concentrations of VOCs to levels that could pose harm to residents in the vicinity of the plume.

Comment #45:
Please avoid generalizations and be as precise as possible, especially when describing potential health risks. Please use statistical means to explain risk rather than undefined terms such as "significant health risk", "significantly increased risk of cancer", "appreciable health effect", or "excess cancer risk", etc.

ATSDR Response:
ATSDR and MDPH have used statistical means to explain potential health impacts, where possible, but the use of some general or descriptive language is necessary to help convey findings in this report.

Comment #46:
Please address the question of odors and possible health effects associated with airborne contaminants from the site.

ATSDR Response:
ATSDR reviewed the information in the September, 1992 DRAFT Public Health Assessment pertaining to airborne site related contaminants.

No ambient air data for VOCs was collected during plant operations, so it is not possible for ATSDR to evaluate ambient air exposure from that time period. Site workers and trespassers may have been exposed to some VOC contaminated air during plant operations, but the levels are unknown. In addition, it is possible for VOC emissions to have migrated off-site in ambient air, however it is likely that those levels would have been much lower than those on-site. Because there is no ambient air data, it is not possible for ATSDR to evaluate past exposure to residents near the site. *Past exposure for residents near the W.R. Grace site to VOCs from plant operations in ambient air is considered an indeterminate public health hazard.*

After the air stripping towers for the Aquifer Restoration System (ARS) became fully operational in March 1985 to remove VOCs from groundwater there were some complaints of odor and concern about potential releases of VOCs into the atmosphere from the towers. After these complaints two pilot studies were conducted. One study conducted by VFL Technologies evaluated the levels of contaminants in air which could be released during the excavation of sludge from the waste areas. The data collected indicated that VOCs did not appreciably migrate from the area of excavation and that exposure to airborne contaminants would occur only in the work area or directly downwind of the work area, but still within site boundaries. The other study determined that granular activated carbon was effective in removing benzene, ethylbenzene and toluene from the air stripping tower emissions, however it was not as effective in removing vinyl chloride and DCE. The study recommended replacing the granular carbon filtration filters with activated carbon filters. This recommendation was carried out in the form of an odor control system, which was installed in September 1992 and has been in continuous service since. The odor control system consists of a booster air blower and three carbon canisters to treat the air stream prior to being discharged to the atmosphere. Due to the installation of the filters and the odor control system it is unlikely that there would be significant off-site VOC emissions from the air stripping towers. However, there could be some limited on-site exposure to VOCs for workers or trespassers who are in close proximity to the air stripping towers. An odor study was conducted by Odor Science & Engineering, Inc. in June, 2000. The analytical results confirmed that the carbon treatment system was effectively keeping VOCs at concentrations less than their odor thresholds (with the possible exception of isobutene). This report noted that the probable source of odor complaints was the stripper column effluent. The odor of the stripper column effluent was not due to elevated concentrations of any single odorant, rather it appeared to be a mixture of several compounds near their odor threshold concentration levels. It is unlikely that odors from the stripper column effluent would migrate off-site. ATSDR has no new data for further evaluation of the ambient air pathway at the site.

Comment #47:
Since no treatment technology is 100 percent effective 100 percent of the time, please assess the health impacts of the contaminants from the northeast plume to drinking water customers, assuming no treatment of the water. What are the worst-case potential health impacts due to exposure via ingestion, dermal exposure, and inhalation?

ATSDR Response:
ATSDR believes that this is an unlikely scenario and that a speculative worst-case analysis would not be meaningful. It is highly unlikely that public drinking water customers in the Acton Water District would be exposed to untreated drinking water. The Acton Water District routinely monitors its public drinking water supply wells and if levels of contaminants are detected, in excess of health guidelines set forth in the Safe Drinking Water Act, immediate action will be taken.

Comment #48:
Private irrigation wells in the plume to the northeast may have brought contamination to the surface in the past. Please assess any possible health effects this past exposure may lead to. Please also assess any potential synergistic effects that may have occurred if residents were exposed to WR Grace contaminants in conjunction with lawn chemicals.

ATSDR Response:
ATSDR has addressed the issue of contaminants in private irrigation wells in this Public Health Assessment. Please refer to the Section: *Potential Exposure Pathways, Private Wells.* This section evaluates the most likely potential exposures pathways from private wells; dermal contact and incidental ingestion.

ATSDR has no data regarding the types or quantities of lawn chemicals used by private well owners in the vicinity of the W.R. Grace site. Therefore, it is not possible to conduct this type of analysis.

Comment #49:
Please do an analogous health assessment to that done for the previous question, assuming that in the future an irrigation well were to bring the most concentrated level of contaminants to the surface, both with and without accompanying human exposure to lawn chemicals.

ATSDR Response:
ATSDR believes that this is an unlikely scenario and that a speculative worst-case analysis would not be meaningful. In addition, ATSDR has no data regarding the types or quantities of lawn chemicals used by private well owners in the vicinity of the W.R. Grace site. Therefore, it is not possible to conduct this type of analysis.

Comment #50:
Page iv, Summary, Fourth Paragraph

The paragraph opens with reference to a time period of 1970-1978 and leads one to infer that it is with respect to this time period and a conclusion regarding past exposures to municipal drinking water supply is offered. The paragraph ends with a second conclusion regarding current and future exposures to the municipal drinking water supply. However, what conclusion is relevant for exposures that occurred between 1982 and 2005 when the two wells in question were brought back on-line? It may be beneficial to clarify exactly what water the conclusions relate to as at present, the term “municipal water supply” could mean a) water in the ground prior to any treatment, b) water extracted from wells Assabet One and Assabet Two post treatment, or c) blended water from all municipal water supplies post treatment. (Data included in the following sections on the extent of chemical contamination seem to suggest that the first definition (a) seems to be closest to the author’s intent of a “municipal water supply”. However the statement that recent sampling has indicated that there is “no VOC contamination (due to the treatment process)” suggests the author’s intent may be closer to definition (b) or (c). This clarification would also be helpful in the last paragraph of the section summarizing the Public Water, Supply, Private Well, and Groundwater Sampling that appears on page 4 and in the section beginning on the top of page 6 dealing with Completed Exposure Pathways for Public Water Supply Wells.

ATSDR Response:
In paragraph four, sentence four, ATSDR changed the word “Presently” to “Since 1982” to be more specific. In general, ATSDR’s reference to the “municipal water supply” refers to water from the public water supply after treatment or water that is provided to residents at the tap.

However, not all of the data provided to or reviewed by ATSDR is post treatment or at the tap, so ATSDR has had to generalize some of its conclusions based on assumptions of what residents may actually be receiving at the tap.

Comment #51:
Page iv. Fifth Paragraph.

It is suggested that the word “existing” be inserted into the conclusion statement in reference to the private well summary.

ATSDR Response:
This change has been made.

Comment #52:
Page 3, paragraph entitled: *Public Water Supply, Private Well, and Groundwater Sampling*.

This paragraph states that there are five private wells and six public water supply wells. Section 1.1.1 of the 2002 Draft Remedial Investigation identified six existing private wells from a private well survey (1 Lisa Lane in the northern portion of the Site, 5 Bellantoni Drive in the northern portion of the Site, Powder Mill Plaza located between Route 62, High Street, and Knox Trail, Valley Sports Arena on the Acton/Concord town line just south of the Assabet River and two at the Starmet property located south of the Assabet River). There are five public supply wells located near the W.R. Grace site: Christofferson, Scribner and Lawsbrook (the School Street well field) are located northeast of the Grace property and Assabet 1 & 2 is located southwest of the Grace property.

ATSDR Response:
This change has been made.

Comment #53:
Page 7, paragraph entitled: *Potential Exposure Pathways, Private Wells.*

There is a reference to sampling of "the remaining well". Please consult the Public Review Draft Remedial Investigation Report dated July 1, 2005. The property owner on Bellantoni Drive would not allow the private well to be sampled again and requested that W.R. Grace properly abandoned and close the well.

Also as a point of clarification, throughout the document instead of stating "private wells" please use the phrase "private irrigation wells" as these private wells are only permitted for irrigation purposes and residences receive potable public water supply from the Acton Water District.

ATSDR Response:
These suggested changes have been incorporated into the document.

Comment #54:
Page 7, second paragraph entitled: *Vinyl Chloride*

The sentence that begins with "ATSDR calculated a lifetime cancer risk of 9.63E-08......." for consistency throughout the document, the word "excess" should be added before the word lifetime.

ATSDR Response:
This change has been made.

Comment #55:
Page 8, first paragraph entitled: *Arsenic*

In the first paragraph ATSDR states that it "calculated incidental ingestion exposure doses using the maximum concentration of arsenic, 0.02705 mg/L, found in surface water. " However the second paragraph states that "ATSDR calculated a lifetime cancer risk for an adult of 3.81E-07 using the maximum concentration (0.00052 mg/l) of arsenic in surface water." There appears to be an inconsistent reference to the maximum surface water concentration noted for arsenic.

ATSDR Response:
The maximum concentration has been corrected.

Comment #56:
Page 10

In summarizing the significance of the bis (2-ethylhexyl) phthalate findings, it should be noted that EPA Region III does not issue RfDs or unit risk factors but that these are terms developed by EPA's Washington Office for use by all Regional Offices. It would therefore be better to claim that the RfD represents the value currently on EPA's IRIS database. A similar comment applies to mention of the Region III value for carcinogenic effects.

ATSDR Response:
This suggested change has been incorporated into the document.

Comment #57:
Page 11, *Chromium*

It should be clarified that for evaluating oral exposures to chromium (hexavalent), EPA's statement on the IRIS database is as follows, "Carcinogenicity by the oral route of exposure cannot be determined and is classified as Group D."

ATSDR Response:
These suggested changes have been incorporated into the document.

Comment #58:
<u>Page 12, *Manganese*</u>

Please refer to discussions noted previously on manganese. Additionally, in this section, it refers to EPA's RfD for this compound as being 0.02 mg/kg/day which is not consistent with EPA's IRIS database.

ATSDR Response:
This discrepancy has been corrected.

Comment #59:
<u>Page 12, first paragraph entitled: *Manganese*</u>

The first sentence states "an incidental ingestion dose for adolescents and children"; however the second sentence says "the estimated exposure dose for adults and children. Please address this discrepancy.

ATSDR Response:
This discrepancy has been corrected.

Comment #60:
<u>Page 13, *PCB'S in Sediments, and Sediment Concentrations*</u>

From the database of sediment samples which comprised of samples from the Assabet River, Fort Pond Brook, Gravel Pit Wetlands, Former North Lagoon, North Lagoon Wetland, and Sinking Pond which were considered by EPA in our Baseline Human Health Risk Assessment, we were unable to confirm any reported detections of PCBs. Additionally, we were unable to confirm both the maximum value for manganese (80,000 mg/kg) and the maximum value for arsenic (3,900 mg/kg). Concentrations used by EPA in the Baseline Human Health Risk Assessment for assessing risk to humans via exposure to arsenic and manganese in sediment were less than the concentrations reported in this Health Assessment. Several sediment samples obtained from Sinking Pond were obtained from locations having significant depths of water above them and thus were excluded from EPA's Baseline Human Health Risk Assessment and thus may account for the discrepancies in concentration noted. Perhaps the authors of the Health Assessment Report could expand on the locations of the maximum detected sediment samples used in the Health Assessment and the relevance of these locations to human exposure potential.

ATSDR Response:
ATSDR has reviewed additional data from the Baseline Human Health Risk Assessment and modified its exposure dose calculations by using the maximum sediment concentrations for arsenic and manganese for Sinking Pond (arsenic 1300 mg/kg and manganese 20,000 mg/kg). However, the substitution of these values for arsenic and manganese did not significantly alter ATSDR's conclusions regarding these contaminants.

Comment #61:
Page 16, *Arsenic Summary*

The first two paragraphs summarizing drinking water studies and arsenic does not seem to be intuitively relevant to the significant medium (sediments) identified in the Health Assessment. It would be difficult for the average reader to be able to make any connection between the apparent lack of health effects noted in people exposed to 50 ppb arsenic in water and potential exposure to 3,900 mg/kg arsenic in sediments. Furthermore, the choice of ppb (vs. ug/l) is not in keeping with the remainder of the report and would seem likely to lead to confusion of the reader.

In the arsenic paragraph on this page which mentions the exposure dose for a child exceeding the RfD and LOAEL, the text inappropriately calls attention to adverse carcinogenic effects rather than to examples of non-cancerous effects that have been attributed to exposure to arsenic.

ATSDR Response:
Modifications were made in an attempt to address these comments.

Comment #62:
Page 22, *Conclusions*

In the first bullet, it is not apparent whether it was the case that the town's wells Assabet One and Assabet Two were analyzed for anything other than VOCs during the period of 1970-1978 as the conclusions on past exposures have been restricted to VOCs alone. Given that arsenic and manganese levels in the water supply are of interest to conclusions regarding current and future exposures and risks, are there any conclusions to offer regarding past exposures to arsenic, manganese or other metals (inorganics) in the municipal drinking water supply based on historical data? Again, clarification is sought on exactly what is meant by the term "municipal drinking supply".

In the second bullet, given that data was never obtained from one of the six private wells, it may be warranted to exclude the well from which data was lacking when summarizing conclusions on private wells. Also, it may be helpful to clarify that the summary applies to existing private wells included in the analysis. As mentioned in comment # 4, the property owner on Bellantoni Drive would not allow the private well to be sampled again and requested that W.R. Grace properly abandoned the well.

ATSDR Response:
ATSDR added clarification on page 22 regarding the municipal drinking supply.

Comment #63:
Page 41- 50, ATSDR's *Evaluation Process*

It is helpful that ATSDR has included this section to describe the steps that went into their quantitative evaluation. Much of their process appears to be heavily dependent on EPA risk assessment practices. As such we have noted some discrepancies on these pages from the risk process typically used by the EPA CERCLA Program which are offered for ATSDR to consider. Also, given the information on exposure parameters, exposure point concentrations, exposure equations, and sometimes but not always toxicity values, we were not always able to verify the risk or hazard estimates, as noted in this report, as being accurate.

- Page 48 indicates that the cancer risk estimation process was calculated by multiplying the adult exposure dose "with slight modification" by EPA's chemical specific cancer slope factors. It was never made apparent exactly what the "slight modification" might be.
- Body weights for a child (0-6 yrs) for drinking water ingestion are noted as 10 kg yet for incidental ingestion of a private well, the body weight for the same aged receptor is noted as 16 kg.
- EPA RAGS Part E contains the exposure equations and default parameters for dermal contact with contaminants in water and soil presently advocated by the CERCLA Program which differ from those provided.
- Page 46 indicates incorrect units for chemical concentration in sediments and the sediment ingestion rate.

ATSDR Response:
Modifications were made in an attempt to address these comments.

Comment #64:
Page 50-52, Appendix D, *Vapor Intrusion and Johnson and Ettinger Indoor Air Model*

Documentation on the J & E model is non-existent as are the exposure assumptions used for inhalation risk estimation. As a result, we were not able to verify any of the risk calculations for the modeled indoor air concentrations.

ATSDR Response:
ATSDR used similar assumptions to those in EPA's Draft human Health Risk Assessment.

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Appendix I

Response to Comments from Public Comment Release

ATSDR received four sets of comments during the public comment period. This appendix includes all of the comments specific to this PHA together with the ATSDR responses to those comments. The comments have resulted in a number of revisions to the PHA and have improved the technical accuracy and readability of the document. If the PHA was revised, the ATSDR response will specify how the document was revised.

Page numbers mentioned in this response to comments section may not reflect the actual page numbers in the final version of the PHA. References used by MDPH are provided at the end of Appendix I.

Comment #1:
In evaluating the increased disease incidence, the general population was considered without consideration of exposure based on age. Since the contaminated wells were shut down in 1978, the incidence of cancer or other disease should be considered for the population born in 1978 or earlier. I asked this question during the public meeting in August, and based on discussion, it sounded like the population data includes age information so the incidence for only the target population (those born in 1978 or earlier) could be considered.

MDPH Response:
Because the incidence of many cancer types increases with age, the vast majority of the individuals diagnosed with cancer and evaluated in the Health Consultation were born before 1978. Of Acton residents diagnosed from 1982-2000 with one of the six cancer types evaluated, 97% (234/241) were born before 1978. Therefore, if MDPH were to eliminate individuals born after 1978 and run the analysis again, the results would be similar.

Comment #2:
Particularly in light of the underground "plume" discovered migrating north of the site in the past few years, was the potential for contaminated groundwater being pumped from wells to irrigate private and commercial farmland in the area considered? The report mentions 5 irrigation wells in the area. Are any of these over the contamination "plume"? Has water from these wells been tested for contaminants? Is the water from any of these wells being used for agricultural irrigation?

ATSDR Response:
Based on reports to ATSDR, private wells in the vicinity of the W.R. Grace site are not being used to irrigate farmland.

There are no private wells on the W.R. Grace property; however seven non-municipal wells have been identified within 500 feet of the plume. Three are used as private irrigation wells and one is a private commercial irrigation well. Another is a permitted non-community public water supply well which supplies drinking water, ice resurfacing, and bathing water for a sports arena. Two others serve as production wells for non contact cooling water on a commercial property. On May 6, 2002, W.R. Grace collected samples from five of these wells and analyzed each sample for VOCs. No contaminants were found in four of the wells during the May 6, 2002 sampling. However, one of the wells contained vinyl chloride (0.35 parts per billion [ppb]) above its CV of 0.03. This well was converted to a monitoring well by W.R. Grace. Another of the private irrigation wells was abandoned and properly sealed.

Based on concentrations reported for the VOC contaminated non-municipal well and toxicological evaluations, adverse health effects are not expected to occur. *Therefore, ATSDR concludes that exposure to groundwater from private wells for non-drinking water uses poses no apparent public health hazard.*

ATSDR recommends in its PHA that the remaining non-municipal wells used for non-drinking water purposes be monitored periodically by W.R. Grace or an appropriate public health agency to ensure that the wells continue to be used for non-drinking water purposes and/or that people are not exposed to contaminants at levels that would adversely affect public health.

ATSDR recommends that the TNC water supply well used for non-drinking water and drinking water purposes at the sports arena be periodically monitored to ensure protection of public health.

Comment #3:
VOCs, Analytical limitations: Additional contaminants and high detection limits?
There was no regular monitoring program for Volatile organic Chemicals (VOCs) in Acton's drinking water prior to the mid 1980's, and the laboratory analytical methods for VOCs were still being refined. It is possible that there may have been additional VOCs in the drinking water that went undetected due to analytical and other sampling limitations. Routine VOC testing of drinking water supplies by certified labs was not required until after 1985. It is not clear from the 1992 ATSDR report whether more than the seven listed VOCs were sampled for. This report also does not include information about detection limits, but it is likely that they were higher than those used now, so low level detections might have been missed.

ATSDR Response:
Thank you for your comment. ATSDR is aware that monitoring programs for VOCs in public drinking water systems were limited prior to the mid 1980's, if they existed at all. ATSDR also concurs that laboratory methods for VOCs were still being refined during this time period. ATSDR acknowledges in the Public Health Assessment (PHA) that there is very limited historical data for the Acton municipal wells and that there is no Quality Assurance or Quality Control (QA/QC) information available for the data. ATSDR estimated a nine year exposure period for VOCs in drinking water based on the time the Assabet wells were opened (1970) to the time the contamination was identified (1978) and the wells were taken off-line. It is possible that groundwater contamination levels could have been higher (or lower) prior to or during the 1970s, however people were not likely exposed to significant levels of VOCs in groundwater until the Assabet wells were brought on-line in 1970 as part of the public drinking water supply. Because there is no data prior to the 1970s it is not possible for ATSDR to estimate exposure prior to this time period.

Comment #4:
Arsenic, manganese, other inorganics
The 1992 ATSDR table did not include any data for inorganic contaminants in the municipal wells. Was such sampling performed? WR Grace has cited arsenic and other inorganic contaminant detections as being linked to increased VOC contamination in an area.

ATSDR Response:
ATSDR acknowledges this is a data gap. There was no data for arsenic, manganese or other inorganics in the 1992 Draft PHA for the Assabet wells. Therefore, ATSDR could not calculate past exposure doses for arsenic and manganese due to ingestion of drinking water during the period 1970 to 1978 similar to what was done for VOC data. However, ATSDR did use contaminant concentration data from later sampling to calculate potential non-carcinogenic and carcinogenic (where appropriate) exposure doses for arsenic and manganese. These exposure calculations and their impact on human health are discussed in the Completed Exposure Pathways, Potential Exposure Pathways and Discussion, Public Health Implications sections of the PHA. Explanation of exposure dose calculations, for these exposure pathways, are provided in Appendix C, ATSDR's Evaluation Process.

Comment #5:
Additional VOCs in past municipal well water
Additional Historical Data, Assabet Public Wells, 1982-1987
The Acton Water District located an old printout of data for the Assabet public drinking water wells. Detections in Assabet 2 between June 1984 and January 1987 include vinyl chloride, benzene, toluene, 1,2 dichloroethylene, chloroethane, ethyl benzene, isopropyl ether, and chloroform, etc. Additional data for 1982-1987 and later may exist. The 2008 PHA used data from a summary table for the municipal wells found in the 1992 ATSDR report. It is not clear whether or not the 1984-1987 data in the 1992 ATSDR report was compiled based on the data located by the Acton Water District, other data, or some combination of the two?

While the detection of these additional VOCs, (vinyl chloride, benzene, toluene, 1,2dichlorotheylene, chloroethane, ethyl benzene, isopropyl ether, and chloroform) in Assabet 2 are relatively low levels, they indicate that additional VOCs were likely in the drinking water that was distributed to Acton Water District customers in the 1970's and possibly 1980's. As discussed in the comment above, sampling for VOCs was an inexact science through at least the mid 1980's. No QA/QC information is provided with the data recently located by the Acton Water District, nor is there a comprehensive list of which contaminants were tested for and when.

ATSDR Response:
ATSDR cannot answer the question about whether the data in the 1992 PHA was compiled based on the data recently located by the Acton Water District, as this is the first time ATSDR has been provided this data for review. The source of the data for the 1992 PHA completed under cooperative agreement by the Massachusetts Department of Health (MDPH) could not be located after numerous record searches by both ATSDR and the MDPH. In addition, no records for QA/QC were located.

ATSDR reviewed the additional data (24 pages) provided by the Acton Water District for Assabet I and Assabet II public water supply wells for the June 1982 through January 1987 time period. ATSDR concluded that the maximum concentrations in this data set for benzene, chloroethane, 1,1 dichloroethene, ethyl benzene, methylene chloride, 1,1,1 trichloroethane, trichloroethylene, toluene, and vinyl chloride were either (1) below their respective Comparison

Value or (2) below the maximum concentration from previous data already used in the PHA. Therefore, these contaminants required no additional evaluation. The maximum concentration for 1,1 dichloroethane (28 ppb) did exceed the value previously used in dose calculations in the PHA, so ATSDR changed this value in the PHA and recalculated exposure doses accordingly. This change did increase the estimated exposure dose slightly, however the increase was minimal and did not change ATSDR's conclusions or recommendations related 1,1, dichloroethane or VOCs overall.

Contaminant	Maximum Concentration (ppb)	Maximum Concentration (mg/L)	Comment
Benzene	1.2	0.0012	Below Comparison Value
Chloroethane	1.1	0.0011	Below Comparison Value
1,1 Dichloroethane	28	0.028	Above previous maximum concentration, appropriate adjustments made in the PHA
1,1, Dichloroethene (aka. Dichloroethylene)	45	0.045	Below previously used maximum concentration in PHA
Ethyl Benzene	5.0	0.005	Below Comparison Value
Methylene Chloride	31	0.031	Below previously used maximum concentration in PHA
1,1,1 Trichloroethane	150	0.15	Below Comparison Value
Trichloroethylene	7.3	0.0073	Below previously used maximum concentration in PHA
Toluene	8.5	0.0085	Below Comparison Value
Vinyl Chloride	3.4	0.0034	Below previously used maximum concentration in PHA

Comment #6:
1,4 Dioxane, newly identified at the site
Recent testing at the Acton WR Grace site has provided new data on the occurrence of 1,4 dioxane at the site. Sampling was not done for this contaminant until 2006. 1,4-dioxane is mobile, does not readily break down, and is not effectively removed by the air strippers used by the Acton Water District. The AWD has performed its own sampling in addition to that done by WR Grace. The AWD has reportedly detected low levels of this contaminant (around 0.2 ppb) in municipal well water. While there is not yet a federal MCL for this contaminant, the Massachusetts DEP has set a guideline of 3.0 ppb. In 2007, there was a detection of 4.4 ppb of 1,4 dioxane in a WR Grace monitoring well that is directly adjacent to the AWD public drinking water well known as the Christofferson Well, (one of the school street wells). These new data should be mentioned in the Public health Assessment.

ATSDR Response:
This PHA evaluates data provided to ATSDR through August 5, 2004. Review and evaluation of data after that date will need to be completed in a separate evaluation. Requests for evaluation of new data should be directed to ATSDR's Division of Health Assessment and Consultation. ATSDR and the MDPH Cooperative Agreement Program will determine the best course of action for evaluation of additional data sets.

Comment #7:
Acton Water District, separate from the Town of Acton
The Acton Water District and Town of Acton are two separate political entities. The AWD was established as a separate entity by an Act of Legislature and is not part of the town government.

Acton Water District wells
Page iv. Summary, p. iv Second paragraph
In the first sentence in this paragraph, please change “the Town of Acton” to “the Acton Water District”. (The Acton Water District detected the contamination in its wells and then closed them.) Please also make any similarly appropriate changes to the language under “Site Description and History”, on page 1.

ATSDR Response:
This suggested change has been incorporated into the PHA.

Comment #8:
Assabet wells back online, correction to text
Page iv. Summary, Second paragraph on page iv,
The summary text states: “Use of the municipal wells, Assabet One and Two, was restarted in 1982 after the well water was treated with an activated carbon purification system (air stripping process) to remove the VOCs.” Assabet Two was not back in use in 1982, and Assabet One was only in use for a short while last year, and then was taken out of service again. Air stripping and carbon filtration are two separate and distinct technologies.

See page 49 of the ATSDR report for the correct information as follows:

Air strippers were not used on the Acton Water District Wells until 1983-1984. Both Assabet 1 and Assabet 2 were taken offline in 1978. According to the AWD, Assabet 1 was brought back online with carbon filtration for a few months in 1982. When testing showed that low levels of TCA were “breaking through” the carbon filters, they took this well offline again. In 1983 Assabet 1 was brought back online with both air stripping and carbon filtration technology in place. By March of 1984, Assabet 2 had also been brought back online with this same treatment. At some later date the AWD stopped using carbon filtration at these wells, but it continues to use an air stripper to remove VOCs from the water.

ATSDR Response:
This suggested change has been incorporated into the PHA.

Comment #9:
Page 1. Background Section; Site Description and History, near the end of this paragraph

a. The text currently states: The Town took precautionary action and closed the two wells. Please substitute the “Acton Water District” in place of the “Town” so that the sentence reads: “The Acton Water District took precautionary action and closed the two wells.”
b. Please add the word “currently” so that the text states: “The Acton Water District (AWD) currently operates and maintains air strippers…”

c. Given the distinction between site vs. property, and the fact that only three of the identified wells were used for irrigation, please change the text to read: "There are no private wells on **the WR Grace property**; however six private irrigations wells have been identified **within 500 feet** of the plume." (omits the word irrigation)

   (Change the number of wells to include the additional private irrigation well on School Street?)

ATSDR Response:
Thank you for your comments. Suggested changes have been incorporated into the PHA, as appropriate, to address these concerns.

Comment #10:
Municipal water exposure
Page 7. Public Water Supply Wells, Historical Data, VOCs
When referring to contamination in the municipal drinking water wells between 1970 and 1978, the text states: "However, most likely the exposure duration was less than nine years." We are concerned that this might be misleading. The WR Grace property was used for industrial purposes for decades before the contamination was discovered in the late 1970's in the public water supply wells. According to the August 30, 2002, RI Report, Volume I (p. 7-2):

"Dewey & Almy acquired the property in 1946 and manufactured synthetic rubber container sealant products. An organic chemical plant that produced latex products, plasticizers, and resins began operating in 1949, and a paper battery separator production facility was constructed in 1951. Grace acquired Dewey & Almy in 1954, and chemical operations were continued at the property."

Given the long history of industrial use at the site, it is quite possible that groundwater contamination existed prior to the time period when analytical techniques were available for detecting VOCs in groundwater. Unless ATSDR has clear evidence to the contrary, please delete the sentence stating that exposure duration was likely less than nine years.

ATSDR Response:
We appreciate your comment. ATSDR agrees that groundwater contamination may have existed for longer than nine years (there is no data available to prove this one way or the other). However, it is unlikely that there would have been a significant pathway for people to be exposed to contaminants in groundwater until 1970 when the municipal wells came on-line. ATSDR estimated the exposure period at nine years, because this is the period of time from when the wells were opened (1970) until the time the wells were closed (1978). Therefore, this is the potential exposure period for the ingestion of drinking water from the municipal wells (Assabet 1 and Assabet II).

Comment #11:
There are multiple sections of the ATSDR Public Health Assessment for W.R. Grace Superfund Site dated August 26, 2008 which include discussion regarding private wells in the vicinity of the W.R. Grace Site. The ATSDR report refers incorrectly to the number and type of private wells.

Many parts of the document reference private wells collectively as “private irrigation wells”, when not all of the private wells are used for irrigation. Please correct the report using the detailed information below.

From the Remedial Investigation (RI) Report, Operable Unit Three dated July 1, 2005 (GeoTrans, Inc.) section 2.4.2 page 2-7 and shown on Figure 2-9 (attached), there were seven private wells identified as part of a private well survey RI task in 2002. The seven wells included:

- Three private residential irrigation wells – 307 School Street, 1 Lisa Lane, 5 Bellantoni Drive in Acton, MA
- One private commercial irrigation well – Powder Mill Plaza, corner of Route 62 and High Street in Acton, MA
- One permitted non-community public water supply well – Valley Sports Arena, Route 62 in Concord, MA
- Two production wells for non contact cooling water at Starmet Property off Route 62 in Concord, MA

Subsequently as documented in the RI report, two of the private irrigation wells were either abandoned (5 Bellantoni Drive) or converted to monitoring wells (1 Lisa lane) by W.R. Grace.

ATSDR Response:
Thank you for this detailed information pertaining to private wells in the vicinity of the W.R. Grace Superfund Site.

The summary text was modified to read as follows:

Seven non-municipal wells have been have been identified in the vicinity of the W.R. Grace site; four private irrigation wells, two private production wells for contact cooling water and one non-community public water supply at a sports arena. Of the six non-municipal wells used for non-drinking water purposes; one well contained elevated levels of vinyl chloride and was converted to a monitoring well, four wells indicated no VOC contamination present, and one well was not sampled because it was sealed and properly closed at the request of the property owner. The non-community public water supply well at the sports arena is classified as a transient non-community (TNC) public water system by the MDPH.

The Public Water Supply, Private Well, and Groundwater Sampling text was modified to read as follows:

There are no private wells on the W.R. Grace property; however seven non-municipal wells have been identified within 500 feet of the plume. A non-community public water supply well supplies drinking water, ice resurfacing, and bathing water for an area sports arena. Three wells are used as private irrigation wells and one is a private commercial irrigation well. Two others serve as production wells for non contact cooling water on a commercial property. On May 6, 2002, W.R. Grace collected samples from five of these wells and analyzed each sample for VOCs. One non-municipal private well was abandoned and properly closed, as requested by the property owner. Four of the non-municipal wells are located south of the site and beyond the horizontal extent of groundwater contamination. No contaminants were found in these four wells during the May 6, 2002 sampling. Two of the non-municipal wells are located north of the W.R. Grace site, within the horizontal extent of the VOC groundwater contamination plume from the site. One of these wells contained vinyl chloride (0.35 parts per billion [ppb]) above its CV of 0.03. This well was converted to a monitoring well by W.R. Grace.

The Conclusion section was modified to read as follows:

- Six non-municipal wells have been identified in the vicinity of the W.R. Grace site groundwater plume that are used for non-drinking water purposes. One well contained vinyl chloride above the CV and was converted to a monitoring well by W.R. Grace. Four wells indicate no present VOC contamination, one well was not sampled, but at the request of the owner was properly sealed and permanently closed. Potential past exposure was limited to possible dermal contact from swimming in pools that were filled with well water or irrigation activities. Based on the concentrations reported and toxicological evaluations, adverse health effects are not expected to occur. Therefore, *ATSDR concludes that exposure to groundwater from non-municipal wells for non-drinking water uses poses no apparent public health hazard.*
- One non-municipal well was indentified in the vicinity of the W.R. Grace site groundwater plume that is used for drinking water purposes at a sports arena. This well is classified as a transient non-community (TNC) public water system by the Massachusetts Department of Public Health. This well was sampled in May 2002 and again in July 2006. No VOCs were detected. *Therefore, ATSDR concludes that the TNC water supply well at the sports arena poses no public health hazard.*

Comment #12:

Additionally, for location specific reasons, Grace believes ATSDR's recommendation for W.R. Grace to obtain and analyze samples from the remaining private wells on a periodic basis is unwarranted and unreasonable. On a case by case basis, these reasons are indicated below.

Regarding the one remaining active residential irrigation well at 307 School Street, this location is on the north side of Fort Pond Brook and upgradient of the contaminated groundwater plume within the School Street well field. With the exception of groundwater pulled under the brook by the Christofferson water supply well, groundwater locations north of Fort Pond Brook flows southerly toward Fort Pond Brook. This private irrigation well would operate seasonally and at a low flow rate so it is not anticipated that this location could be impacted by the contaminated groundwater plume from the W.R. Grace Superfund Site and this was substantiated by the 2002 sampling data for this irrigation well.

The commercial irrigation well at Powder Mill Plaza was sampled in May 2002 and the analysis indicated very low concentrations of trichloroethylene (TCE) at 1.2 ug/l and methyl-tert butyl ether (MTBE) at 0.31 ug/l. Neither of these contaminants is associated with the contaminated groundwater plume from the nearby W.R. Grace property. Based on the contaminants detected, location and use of this well, W.R. Grace should not be required to perform any additional sampling of water from this well.

The MassDEP-permitted non-community public water supply well at Valley Sports already has a monitoring program in place. In May 2006, the Concord Board of Health requested that MassDEP include volatile organic compounds (VOCs) in the required monitoring plan. MassDEP responded by indicating the agency would not change the monitoring requirements for Valley Sports based on the transient nature of the community served by the water supply but that MassDEP would sample the well in July 2006 and winter 2007 (correspondence attached). ATSDR's recommendation for continued monitoring of this well for VOCs by W.R. Grace appears to be inappropriate and already superseded by regulatory authority.

Two production wells for non-contact cooling water at Starmet property should not need to be sampled from a public health perspective as the water is not used for public consumption. The Starmet property is the subject of a separate Superfund investigation. Decisions regarding well sampling on the Starmet property should be based on that investigation.

ATSDR Response:
ATSDR revised the Recommendation as follows:

- ATSDR recommends that the non-municipal wells that are used for non-drinking water purposes in the vicinity of the W.R. Grace site be monitored periodically by W.R. Grace or an appropriate public health agency to ensure that the wells continue to be used for non-drinking water purposes and/ or that contaminant levels are not adversely affecting public health.
- Periodic monitoring of the TNC public water system at the sports arena should be conducted by the Massachusetts Department of Environmental Protection to ensure protection of public health.

Comment #13:
In summary, W.R. Grace has a network of monitoring wells on and off the Grace property which are part of an ongoing groundwater monitoring program approved by the United States Environmental Protection Agency (USEPA) and the Massachusetts Department of Environmental Protection (MassDEP). This network of wells is reviewed on a regular basis and any changes to the monitoring program are approved by USEPA and MassDEP. The periodic monitoring recommended in the ATSDR report for active private irrigation wells is not warranted based on the locations, uses and existing contaminant data.

ATSDR Response:
Thank you for your comment. ATSDR believes that periodic monitoring of the remaining active non-municipal wells in the vicinity of the W.R. Grace site by W.R. Grace or an appropriate public health agency is warranted to ensure that contaminants do not adversely affect public health presently or in the future.
(please see response to the comment above).

Comment #14:
Ideally, the Public Health Assessment (PHA) by the Agency for Toxic Substances and Disease Registry (ATSDR) would provide a complete evaluation of the risks and/or health outcomes

from all possible past, current, and future exposures to site contaminants. Unfortunately, there are constraints that limit the ability of the 2008 ATSDR PHA to meet this lofty goal.

Given that the subject is complex, with many variables and assumptions, it may be difficult for a layreader to understand the scope, details and limitations of the PHA. There may also be public confusion about the role that the 2008 ATSDR report plays, especially given that a separate Public Health Risk Assessment on the WR Grace Superfund Site was completed in 2005 under guidance of EPA. The next several comments concern these issues.

ATSDR Response:
Thank you for your comment. ATSDR concurs that the W.R. Grace PHA is lengthy and includes a lot of information, however the information has been summarized and presented in the standard PHA format. ATSDR has tried to clearly label each section, including attachments in a logical manner. In addition, a Summary section at the beginning of the document provides the highlights of the report for the lay-reader.

Comment #15:
Comparison of ATSDR Public Health Assessment to EPA Public Health Risk Assessment
Please include in the ATSDR 2008 PHA a copy of the side by side comparison of the roles, assumptions, analytical techniques, etc. in the ATSDR Public Health Assessment (PHA) and the EPA guided Public Health Risk Assessment (PHRA). See Attachment A of these comments for a copy of the handout provided by ATSDR at the October 28, 2003 public meeting in Acton, MA that was used for this purpose at the Acton meeting.

ATSDR Response:
ATSDR has provided a fact sheet that discusses the differences between the ATSDR Public Health Assessment and the EPA Public Health Risk Assessment as Appendix F.

Comment #16:
Discussion in text
Please also include in the 2008 PHA text some discussion about the different roles of the two evaluations. In particular please point out the different approaches to assessing risk via the municipal drinking water wells, private irrigation wells, and other private wells. Under the EPA process, the highest levels of contaminants in groundwater in the area, and not just found in the wells themselves, are used to assess the potential risk from exposure to that water. This is appropriate given that EPA focuses on current and future risk, and that the goal of the EPA guided cleanup is to return the aquifer to a “fully usable condition” as mandated by a federal court consent decree. By analyzing risk in the groundwater throughout the site, the EPA can then guide a cleanup whose goal is to allow a municipal drinking water well, private irrigation well, or other private well to be installed anywhere on the site without the need for additional treatment in order to protect public health.

According to the ATSDR handout in Attachment A, the ATSDR process focuses on present and past exposures. The 2008 PHA only considers contaminant detections from the wells themselves, not the surrounding groundwater that supplies the wells. Risks are assessed for “completed exposure pathways”. In the case of current exposures in municipal well water, ATSDR does not calculate risk from VOCs in the groundwater, or untreated well water, but instead assumes that treatment by the Acton Water District will keep any exposure to VOCs in drinking water to acceptable levels.

ATSDR Response:
ATSDR's Public Health Assessment (PHA) and EPA's Risk Assessment (RA) have some similarities, but they also differ in a number of aspects. ATSDR's PHA is mainly focused on completed and potential impacts to human health and is not used as a basis for regulatory decisions, however it is commonly used to support or recommend measures that would prevent or reduce site related contaminant exposures. The EPA RA considers human and ecological risks associated with a site, focuses on present and future exposures, is used to help establish clean-up goals and supports regulatory decision making (please see Appendix F). ATSDR considers the drinking water exposure pathway to be the primary route of completed exposure for VOCs in groundwater for people in the vicinity of the site. However, ATSDR did consider potential exposure pathways in its PHA for the W. R. Grace site, such as; exposure from private well water and the volatilization of VOCs from groundwater into buildings.

Comment #17:
Add Figure, Pre-1984 contaminant plume
New Figure, See Attachment B, and 2002 Monitoring Report Figures 3-7
Distribution of VDC in Groundwater, Pre-1984
Please include in the 2008 PHA, Figure 3-7 from the OU-3 Monitoring Program Report, 2002, WR Grace Superfund Site, Acton, MA by GeoTrans, dated March 28, 2003. (See Attachment B.) This figure shows the pre-1984 extent of the groundwater contamination from the WR Grace Site, as known at that time. (There are data gaps for the Northeast Area of the site). This figure is also available in all of the subsequent annual monitoring reports for the site to the present, and is shown as Figure 3 in the September 2005 EPA Record of Decision for the WR Grace Site. The pre-1984 figure clearly shows contamination at the two Assabet wells, which were shut down in 1978. Please note that the colored contours that show contamination concentrations up to 2900 ppb of VDC (1,1-dichloroethene).

ATSDR Response:
ATSDR has not re-printed this Figure from the OU-3 Monitoring Program Report by Geo Trans in its PHA. The figure is available via public record from EPA and similar maps depicting past or present VDC concentrations in groundwater can be found on EPA's internet site. Examples include the EPA Community Update, December 2002 found at:
http://www.epa.gov/region01/superfund/sites/graceacton/41530.pdf or the EPA Record of Decision, dated September 2005 at:
http://www.epa.gov/region01/superfund/sites/graceacton/237033.pdf

ATSDR concurs that there is evidence of VDC groundwater contamination as shown in these figures. However, as previously stated in the PHA, the Assabet wells were opened in 1970 and then taken offline in 1978 after contamination was discovered in the wells. The Assabet wells were brought back on-line only after installation of treatment for VOCs. Therefore, the time period for potential past exposure via ingestion of drinking water from the municipal wells is the nine year period (1970-1978). There is no current drinking water exposure pathway to VDC. Because there is no current ingestion exposure no public health impacts are expected.

Comment #18:
Retitle Figure 2.: "Extent of Groundwater contamination, 2002"
Page 83. Figure 2. Plume Map
Please retitle Figure 2 to say "Extent of groundwater contamination, 2002" since this plume outline appears identical to that shown in Figure 7-1 in the August 30, 2002 Remedial Investigation Report for the WR Grace Superfund Site, by GeoTrans. (Since at least 2002 a new VDC plume map has been generated each year based on annual monitoring. The contaminant concentration contours and aerial extent of the plume vary from year to year.)

ATSDR Response:
Thank you for your comment. The extent of the groundwater plume provided in Figure 2 has been provided to show the "general extent of the groundwater plume". The title of Figure 2 has been changed to reflect this.

Comment #19:
Add Figure of 2001-2002 contaminant plume
New Figure, See Attachment C and 2002 RI, Figure 3-3 Distribution of VDC in Groundwater, 2001-2002
Please also add to the PHA Figure 3-3 from the August 30, 2002 Remedial Investigation Report for the WR Grace Superfund Site, by GeoTrans, that shows the 2001-2002 VDC (1,1 dichloroethene), contaminant level contours. (See attachment C.) This figure was used as a frame of reference throughout the RIFS process that led up to the September 2005 EPA Record of Decision (ROD) for the WR Grace Superfund Site.

ATSDR Response:
Thank you for your comment. No additional figures were added to the PHA because they are already available from other sources.

Comment #20:
Add Figure of "Groundwater Exposure Areas" to the Figures Section of the PHA New Figure, See Attachment D. and October 31, 2003, PHRA Figure 3.
Please add to the PHA, Figure 3 from the October 31, 2003, Public Health Risk Assessment, Interim Deliverable I & II, for the WR Grace Site, by Menzie Cura & Associates. This figure shows the groundwater exposure areas at the WR Grace Superfund Site that were used throughout the Ecological and Public Health Risk Assessments done under the guidance of EPA, and completed in 2005. It also shows the distribution of VDC in groundwater, 2001-2002.

ATSDR Response:
Thank you for your comment. No additional figures were added to the PHA because they are already available from other sources.

Comment #21:
Property vs. site
Please make a distinction in the text between the property owned by the WR Grace Company

and the WR Grace Superfund Site. Please explain that the property consists of approximately 260 acres, the majority of which lies to the south of the MBTA rail line.
In contrast the "site" includes all of the areas that have been affected by contamination from the property and extends beyond the WR Grace property lines, to the northeast under private residences, property owned by a private business, and Acton Water District property, including the three Acton Water District (AWD) School Street public drinking water wells/wellfields. In the past the plume of contamination also extended to two other AWD public wells on Acton Water District property located to the southwest of the WR Grace property.

Please change the terminology used in the PHA accordingly.

ATSDR Response:
A footnote has been added on page 1 of the PHA to assist in making this distinction.

Comment #22:
Add discussion of changes in contaminant levels
Page 1. "Background" section, "Site Description and History"
In the "Background" section of the PHA, under "Site Description and History", please point out that contaminant levels at the site were much higher in the past, and covered a more extensive area on the southern part of the site. Refer the reader to the figure showing the pre- 1984 plume of groundwater contamination, (Attachment B.), as well as to the new figure in the PHA which shows the groundwater plume as of2001-2002 (Attachment C.). A comparison of these two figures, and the colored contours will help the reader visualize the extent of cleanup over the years. (Be aware that the contaminant levels represented by the contour intervals vary between the two figures.)

ATSDR Response:
ATSDR concurs that there have been changes in the VDC groundwater contaminant levels over the years. However, as indicated in previous responses depicting the changes in levels of the VDC plume over the years does not change ATSDR's recommendations or conclusions. No additional figures were added to the PHA because they are already available from other sources.

Comment #23:
Include "Limitations" section
Please include a section in the report that explicitly discusses the limitations of the PHA. This will enable the reader to easily reference this information. (A summary table or list may also be helpful.)

Limitations include:
a. Data analyzed
The PHA focused on data from approximately the 2001 -2003 time period, with additional analysis of one set of limited historical data from one summary table in a 1992 ATSDR Public Comment Release Public Health Assessment written under a cooperative agreement with the Massachusetts Department of Public Health-referred to hereafter as the 1992 ATSDR report.

For the purposes of these comments ACES will refer to the 2001-2003 data/time period as "current". The "current" data were collected in and around 2002 as part of the Remedial

Investigation and Ecological and Public Health Risk Assessment investigations conducted under the guidance of EPA.

The public repository at the Acton Memorial Library for the WR Grace Superfund Site contains hundreds of documents dating back to at least 1980, and extending to the present. These reports include countless data tables from analyses of well water, groundwater, soils, sludges, surface water, air, sediment, etc. It is now ACES understanding that it was beyond ATSDR's resources and the scope of the current PHA to review all of these historic data. Please include a statement in the PHA that acknowledges the existence of the reams of historic data, but then cites the financial, personnel, time resources etc. or other practical constraints that resulted in ATSDR using the 1992 ATSDR summary table as its only historic data source to evaluate past exposures.

b. Current exposures
Please point out that analyses and conclusions based on "current" data, and "current" contaminant levels, even when calculated for 30 year time periods, are only applicable to "current" conditions-not past exposures.

c. Past exposures
Please point out that past exposures can only be accurately assessed using historic data. Levels of contaminants at the site in groundwater, soils & sludges were considerably higher in the past. Given that groundwater discharges to surface water, contaminant levels in surface water were also likely higher in the past. Contaminant levels in ambient air were also likely elevated in the past when the WR Grace facility was actively in production and onsite waste disposal was occurring. Airborne contamination was also likely higher in the early years of the operation of the air stripper towers when groundwater levels were much higher, and higher contaminant levels were being transferred from water to air by the ARS treatment system.

(Please refer the reader to the discussion about airborne contaminants found on pages 63- 64 of the current report, in response to Comment #46.)

As you have done throughout the report, please describe in the proposed "Limitations" section, the problems with trying to assess risk from past exposures to contaminants using the very limited data set that was in the municipal well summary table from the 1992 ATSDR report. Please also discuss the issue of contaminants such as vinyl chloride, acrylonitrile, arsenic, manganese and others that may have been in the drinking water, but gone undetected due to sampling gaps and/ or technological limitations.

As further elaborated in comments below, ACES respectfully requests that ATSDR include an analysis of the limited historic data set from the municipal wells as an informational exercise, but that given the data limitations, ATSDR conclude that there is an indeterminate risk from past exposure to municipal well water. Accordingly, please discuss this issue in the proposed "Limitations" section of the text.

Response:
A Limitations and Uncertainty section has been added to the PHA. ATSDR did not search the repository of the Acton Memorial Library for historical documents, however ATSDR did request historical records from the Environmental Protection Agency, Massachusetts Department of Public Health and the Acton Water District. Each of these provided information to ATSDR for

the PHA. These agencies would likely have been the "source" for historical reports and data contained in the Acton Memorial Library.

Comment #24:
Past exposures-ACES request & ATSDR analysis
Thank you to ATSDR for calculating risk for the very limited data they had on past VOC contamination in the municipal drinking water wells as presented in the 1992 draft ATSDR public health study. As noted in comment 9 above and discussed more thoroughly below, ACES requests that the evaluation be amended and retained in the report as providing important insight into the issue, but that given the serious data limitations and gaps, ATSDR conclude that at this time that there is an indeterminate risk from past exposure to contaminants in municipal well water.

ATSDR Response:
Per your request, ATSDR reconsidered this conclusion category and based on the data limitations and, data gaps, has changed the conclusion category to reflect an indeterminate risk from past exposure.

Comment #25:
Background:
In our September 16, 2005 comments on the August 2005 draft of the ATSDR Public Health Assessment, ACES requested that ATSDR evaluate cumulative risk due to past, as well as present exposures to organic and inorganic contaminants at the WR Grace Site, taking into account the higher levels of contamination that people may have been exposed to in the past in drinking water, soils, sludge, groundwater, surface water and ambient air. We noted that there are historical data available dating back to 1978 and that <u>some</u> of the data had been summarized in the 1992 ATSDR documents.

We were concerned that past exposures would not be evaluated under the EPA risk assessment process, and that any ATSDR or EPA assessment based on <u>current</u> contaminant concentrations would <u>underestimate past exposures and risk,</u> even if long term exposure times were assumed for the current concentrations. Obviously site conditions, contaminant concentrations and exposure pathways have changed over the course of the 29 years since the contamination was identified. In the past, contaminant concentrations in groundwater and soils, were much higher; (Compare the groundwater contamination in the Pre-1984 figure [Attachment-B], to that in the 2001-2002 figure [Attachment C.]; approximately 200 workers were employed onsite, highly contaminated sludge and surface water in lagoons may have been readily accessible, and the site was unfenced, and thus even more vulnerable to trespassing than under current conditions. Past contaminant levels in surface water and ambient air were also likely much higher. See comment 9 above; and page 63, ATSDR's response to Comment #46.)

ACES September 16, 2005 request regarding ATSDR evaluation of past exposures was made under the assumption that ATSDR would have complete access to all of the historical site documents in the public repository, as well as the resources to review these documents and locate the data necessary, (in addition to the data in the 1992 report), to make the thorough evaluation requested. It is now ACES understanding that logistical and resource limitations have resulted in ATSDR using the draft 1992 ATSDR Public Health Study as its sole source of historical data for the site. ATSDR only evaluated one pathway for past exposures using historical data: municipal well water, using 1978-1987, & 1992 data from a summary table in the 1992 ATSDR report, and assuming that these were representative of the concentrations found in well water between 1970 and 1978.

ATSDR Response:
Thank you for your comment. This has been addressed in the added section entitled "Limitations and Uncertainty".

Comments #26:
Exposure assumptions may be incorrect
See p. 23 of 1992 ATSDR Initial Public Release PHA; VOCs in drinking water from 1982-1987?

a. Number of years of exposure: Nine? Fifteen? Unknown?
ACES appreciates that ATSDR evaluated the data contained in the 1992 table. However, ACES shares ATSDR's repeated reservations about the advisability of making any definitive public health determination based on such a limited data set. Also ATSDR's assumption that there were no VOCs in municipal drinking water after 1978 may be incorrect. The text on page 23 of the 1992 ATSDR Report, second paragraph from the bottom of the page states:
(See Attachment L.)

> "Assabet Wells One and Two were reopened in 1982 after the installment of a carbon purification system. Since 1982, the level of VOCs distributed from the wells (after treatment by the carbon purification system) to the tap water has significantly reduced. According to Acton Water Department monitoring reports, no VOCs have been detected in the wells since 1987."[1]

Page 24 of the same report states:

"Currently water is treated prior to withdrawal for public use. Exposure to well water contaminants has been reduced as a result of treatment processes. Assuming the effectiveness of the carbon filtration and the ARS continues, future exposure to site contaminants via groundwater will be substantially reduced."

Table C-12 of the 1992 report lists detections of seven different VOC contaminants in the municipal wells between 1978 and 1987, with only two of these limited to the years before 1982. Given that there were detections of 1, 1-Dichloroethylene, 1,1,1 Trichloroethane, Trichloroethylene, Methylene Chloride, and 1,1-Dichloroethane between 1982 to 1987, and the statement in the text of the 1992 ATSDR report referring to detections in treated water, ATSDR should not limit the exposure assumption to a 9 year time period, but should assume at least an additional six years of exposure, (1982- 1987?). Please also state in the text that the treatment system did not completely remove all contaminants from the drinking water, and so there was some exposure via this pathway even after the wells were brought back online in the 1980s.

[1] This text is from the "Public Comment Release" version of the 1992 Public Health Assessment, rather than the "Initial Release" version of the same report. ACES mailed Robert Knowles at the ATSDR a copy of the "Public Release" version of this report on September 16, 2005. See also comments 96 and 97 below.

b. VOCs, Technological limitations: Additional contaminants? (Vinyl Chloride, Acrylonitrile, etc.); High detection limits?

There may have been additional VOCs in the drinking water that went undetected due to technological and other sampling limitations. It is ACES understanding that routine VOC testing of drinking water supplies by certified labs was not required until after 1985. It is not clear from the 1992 ATSDR report whether more than the seven listed VOCs were sampled for. This report also does not include information about detection limits which may have been high in the 1970s and early 1980s. The Acton Water District, Massachusetts DEP, (formerly the DEQE), and the public repository for the WR Grace Site may all be sources of additional information.

As ATSDR acknowledged on pages 25-26 in the PHA, (under "Community Health Concerns"), Acton residents may also have been exposed to vinyl chloride and acrylonitrile in drinking water in the past. Vinyl chloride is a major contaminant at the WR Grace Superfund Site. It is ACES understanding that vinyl chloride was regulated differently than other VOCs, due in part to the difficulty in obtaining accurate sampling results. Drinking water sampling for vinyl chloride, "a known human carcinogen of high potency" was not required for all systems, and sampling errors for vinyl chloride in drinking water, before 1987 could be plus or minus 40 percent. (See Federal Register, Vol. 50. No. 219 Nov. 13, 1985/ Proposed Rules and Federal Register Vol. 52, No. 130 July 8, 1987/ Rules and Regulations.)

Acrylonitrile was detected at 1700 ppb in groundwater onsite under the Secondary Lagoon, but may not have been included in sampling in the Assabet wells since it is not routinely sampled in VOC sampling rounds. USEPA has a limit of O.058 ppb for surface water because of public health concerns about the ingestion of acrylonitrile. The 1992 ATSDR report states that "Acrylonitrile exposure occurred via ingestion, inhalation and dermal contact for residents who received water from Assabet One and Two."

There are data on toluene and chlorobenzene in the municipal drinking water wells, that ATSDR may be unaware of (See comment 12. below). In 1988, on behalf of the Acton Board of Health three epidemiologists, Drs. Wartenberg, Ozonoff, and Lagakos submitted a proposal to the Massachusetts Department of Environmental Quality Engineering. The proposed study, entitled "A Surveillance and Investigation Program to Assess the Health Status of Residents of Acton, MA" included development of a computer model to "reconstruct flows from the contaminated wells over time to evaluate which residences got the contaminated water and how much they got." Unfortunately budget problems at the state level prevented funding of this project. The study proposal listed toluene and chlorobenzene as being amongst the contaminants in the municipal well water.

c. Arsenic, manganese, other inorganics

The 1992 ATSDR table did not include any data for inorganic contaminants in the municipal wells. Was such sampling performed? WR Grace cites arsenic detections as being linked to increased VOC contamination in an area. As can be seen from a comparison of the Pre-1984 plume (Attachment B) to the 2001-2002 plume (Attachment C), there were higher levels of VOC contamination at the Assabet wells in the past than present, (and the possibility of accompanying higher levels of arsenic, manganese, etc.?).

ATSDR Response:
ATSDR concurs that the actual length of past exposure to VOCs in the municipal drinking water system is unknown. This is stated in the PHA in several places. However, in order to evaluate the very limited data set for past municipal drinking water exposures it was necessary for ATSDR to develop a "reasonable" exposure scenario that included the concentration of the contaminants in the municipal drinking water and a plausible duration of exposure. ATSDR believes the exposure assumptions it used are as realistic as possible and are a conservative estimate of exposure. Changing the duration of exposure assumption up or down by a few years will not likely make significant changes in the estimated dose for an individual and would not likely change ATSDR's final conclusion regarding past exposure to municipal drinking water, which is that the exposure is in an indeterminate public hazard.

ATSDR also acknowledges that VOC treatment processes in the Assabet wells may not have completely stopped all exposure to VOCs. However, since treatment for the Assabet was implemented and the wells were brought back on-line they have been continually monitored for VOC contamination in accordance with the Safe Drinking Water Act (SDWA) and the contaminant levels have remained below Maximum Contaminant Levels (MCLs), according to the Acton Water District. In addition, water from the Assabet wells was/is blended with water from other uncontaminated municipal wells prior to distribution to homes further reducing levels via dilution. As long as VOC levels remain below the MCL and meet the guidelines of the SDWA health effects from exposure are unlikely.

There was no data on arsenic or manganese in the data tables in the 1992 Public Health Assessment and ATSDR has no way to determine if that sampling was conducted. Without sampling data, ATSDR cannot make any assumptions or determinations regarding past exposure to arsenic and manganese in the municipal drinking water supply.

Comment #27:
Additional VOCs in past municipal well water
See Attachment E, Additional Historical Data, Assabet Public Wells, 1982-1987

a. The Acton Water District recently located an old computer printout of data for the Assabet public drinking water wells. Copies of the pages related to the Assabet wells are provided in Attachment E of these comments. Detections in Assabet 2 between June 1984 and January 1987 include <u>vinyl chloride, benzene, toluene, 1,2 dichloroethylene, chloroethane, ethyl benzene, isopropyl ether and chloroform,</u> etc. Most of these VOC contaminants were not included in the 1992 summary table that ATSDR considered.

b. Additional data for 1982-1987 and later may exist. The 2008 PHA used data from a summary table for the municipal wells found in the 1992 ATSDR report. It is not clear whether or not the 1982-1987 data in the 1992 ATSDR report was compiled based on the data recently located by the Acton Water District, other data, or some combination of the two.

c. While the detection of these additional VOCs, (vinyl chloride, benzene, toluene, 1,2 dichloroethylene, chloroethane, ethyl benzene, isopropyl ether, and chloroform) in Assabet 2 are at relatively low levels, they indicate that additional VOCs were likely in the drinking water that was distributed to Acton Water District customers in the 1970s and possibly into the 1980s. As discussed in comment 11 above, sampling for VOCs was an inexact science through at least the mid 1980's. No QA/QC information is provided with the data recently located by the Acton Water District, nor is there a comprehensive list of which contaminants were tested for and when. The data for Assabet 1 on pages 12-19 and Assabet 2 on pages 20-23 in Attachment E are not labeled as to whether they are for treated or untreated water.

ATSDR Response:
ATSDR cannot answer the question about whether the data in the 1992 PHA was compiled based on the data recently located by the Acton Water District, as this is the first time ATSDR has been provided this data for review. The source of the data for the 1992 PHA completed under cooperative agreement by the Massachusetts Department of Health (MDPH) could not be located after numerous record searches by both ATSDR and the MDPH. In addition, no records for QA/QC were located. ATSDR worked with the Environmental Protection Agency, Massachusetts Department of Health and the Acton Water District to collect data and information pertinent to the PHA. All three of these agencies conducted records searches and provided information to ATSDR. These agencies are the primary resources for both current and historical data.

ATSDR reviewed the additional data (24 pages) provided by the Acton Water District for Assabet I and Assabet II public water supply wells for the June 1982 through January 1987 time period. ATSDR concluded that the maximum concentrations in this data set for benzene, chloroethane, 1,1 dichloroethene, ethyl benzene, methylene chloride, 1,1,1 trichloroethane, trichloroethylene, toluene, and vinyl chloride were either (1) below their respective Comparison Value or (2) below the maximum concentration from previous data already used in the PHA. Therefore, these contaminants required no additional evaluation. The maximum concentration for 1,1 dichloroethane (28 ppb) did exceed the value previously used in dose calculations in the PHA, so ATSDR changed this value in the PHA and recalculated exposure doses accordingly. This change did increase the estimated exposure dose slightly, however the increase was minimal and did not change ATSDR's conclusions or recommendations related to 1,1, dichloroethane or VOCs overall.

Contaminant	Maximum Concentration (ppb)	Maximum Concentration (mg/L)	Comment
Benzene	1.2	0.0012	Below Comparison Value
Chloroethane	1.1	0.0011	Below Comparison Value
1,1 Dichloroethane	28	0.028	Above previous maximum concentration, appropriate adjustments made in the PHA
1,1, Dichloroethene (aka Dichloroethylene)	45	0.045	Below previously used maximum concentration in PHA
Ethyl Benzene	5.0	0.005	Below Comparison Value
Methylene Chloride	31	0.031	Below previously used maximum concentration in PHA
1,1,1 Trichloroethane	150	0.15	Below Comparison Value
Trichloroethylene	7.3	0.0073	Below previously used maximum concentration in PHA
Toluene	8.5	0.0085	Below Comparison Value
Vinyl Chloride	3.4	0.0034	Below previously used maximum concentration in PHA

ATSDR is aware that monitoring programs for VOCs in public drinking water systems were limited prior to the mid 1980's, if they existed at all. ATSDR also concurs that laboratory methods for VOCs were still being refined during this time period. ATSDR acknowledges in the Public Health Assessment (PHA) that there is very limited historical data for the Acton municipal wells and that there is no Quality Assurance or Quality Control (QA/QC) information available for the data. ATSDR estimated a nine year exposure period for VOCs in drinking water based on the time the Assabet wells were opened (1970) to the time the contamination was identified (1978) and the wells were taken off-line. It is possible that groundwater contamination levels could have been higher (or lower) prior to or during the 1970s, however people were not likely exposed to significant levels of VOCs in groundwater until the Assabet wells were brought on-line in 1970 as part of the public drinking water supply. Because there is no data prior to the 1970s it is not possible for ATSDR to estimate exposure prior to this time period.

Comment #28:
Note that additional data for the earlier time period, 1970-May 1982 may also exist. Please consider such data if/when they are located and provided to ATSDR. Any additional earlier data are likely to include higher contaminant levels, as evidenced by the comparison of the 1978-1979 Assabet well data, in the ATSDR 1992 report to data from later years in the same summary table.

ATSDR Response:
This PHA evaluates data provided to ATSDR through August 5, 2004. Review and evaluation of data after that date will need to be completed in a separate evaluation. Requests for evaluation of new data should be directed to ATSDR's Division of Health Assessment and Consultation. ATSDR and the MDPH Cooperative Agreement Program will determine the best course of action for evaluation of additional data sets.

Comment #29:
Discussion/Analysis of historical data
Given the factors discussed in the comments above, please retain a revised analysis of historical data and discussion of exposures, based on a longer exposure time, (I970-1978 and 1982-1987) and consideration of any additional information obtained from the Acton Water District, MA DEP, the site repository or any other source. The evaluation, risk calculations, and the existing discussion, in the current report, especially regarding TCE, provide useful information, and a minimum exposure scenario, and should be included in the PHA. In the discussion, please note that exposure and risk could have been higher given the technological and sampling limitations discussed in the comments above.

ATSDR Response:
Thank you for your comment. ATSDR has reviewed and analyzed the additional historical data provided by the Acton Water District and has provided comments regarding the technological and sampling limitations.

Comment #30:
Historic municipal well water --- Conclusion:
Given all of the uncertainty about the data for past exposures to municipal well water as discussed in the comments above, ACES respectfully requests that ATSDR conclude there to be

an indeterminate risk from past exposure to municipal well water.
Please consider revising this conclusion in the future if additional information and data to address the above concerns becomes available.

ATSDR Response:
After careful consideration, ATSDR has agreed to change the conclusion category for past exposure to VOCs in the municipal drinking water supply to an indeterminate public health hazard.

Comment #31:
Limitations Section--Future exposures
In the proposed "Limitations" section of the PHA, please discuss the limitations on assessing future exposures to site contaminants. ATSDR has stated that its focus is on past and current exposures rather than future ones. (Attachment ***A).***

ATSDR's public health assessment is dependent on the availability of data for the relevant time period and also knowledge of the relevant site conditions and exposure pathways. There is insufficient information about future data, changing site conditions, and future exposure pathways. While it would be appropriate and serves a useful purpose for ATSDR to suggest reasons and ways to reduce future risk, (by limiting exposure pathways or recommending cleanup), it is beyond the scope of the PHA to assess these risks in the same way that it assesses current risks. Please make this PHA limitation on assessing future risks clear throughout the text and in the summaries and conclusions.

ATSDR Response
ATSDR has added a Limitations and Uncertainty section in the PHA. While the majority of the PHA discusses past and current exposure, future exposures have been addressed, where appropriate. ATSDR's focus is the potential impact on human health associated with site related exposure. ATSDR discusses potential on-site exposure to soil and sediment for trespassers in the PHA. ATSDR also considered the potential for future exposure to VOCs in the municipal drinking water supply. Because the AWD treats the Assabet wells through an air stripping process to remove VOC contamination and periodically monitors VOC levels in the wells, in accordance with SDWA, it is unlikely that people would be exposed in the future to VOCs at levels that would cause adverse health effects.

Comment #32:
Limitations Section---Media/time periods not analyzed
Please include information about which media (exposure pathways) and time periods are not analyzed by the PHA. While this information may be in the current 2008 PHA, it is scattered throughout the text. Please increase the accessibility to this information by including an explicit discussion and/ or table or list summarizing the information. Please also include this information in any summaries or conclusions of the report.

Proposed summary of media and time periods analyzed/not analyzed:
"The PHA analyzed risk from current exposures to site contaminants in sediment, surface water, vapor intrusion from groundwater into homes, municipal drinking water, (inorganic contaminants only), and six private wells identified around 2001-2003. Risk was assessed using current contaminant levels, and assuming a 7 to 70 year exposure period, depending on the

particular circumstance. The PHA did not consider past exposures to soils, surface water, sediment, or airborne contaminants. An analysis was done of limited data on VOC contaminants in public drinking water in the past, but due to data limitations, definitive conclusions about past risk could not be reached."

Please use the above summary, (or something comparable), as part of any summary or conclusions section in the PHA, and in any summary handouts or press releases.

Relevant information that could be used in a table, or presented as bullet points:

Analyzed:

- Municipal Drinking Water (current) As and Mn only (adult & child)
- Surface Water (current)

Limited analysis (provides information, but cannot make definitive conclusions)

- Municipal Drinking water (past-VOCs only, insufficient data)
- Fish (current, unable to catch fish of edible size, but that means people are not likely eating them and therefore are not currently at risk!)
- Sediment (current), adolescent
- Private wells 9 current; 6 identified wells, VOCs only, 3 wells used for irrigation, one well used for drinking water, showers, and ice resurfacing)
- Vapor Intrusion (current; not clear if this was done sitewide in all areas of the plume --- or only in areas with current structures)

Not analyzed: (beyond scope of current study and/or limited data/limited access to data or ATSDR assumes AWD treatment)

- Soils (past, current)
- Sludge (past)
- Sediment (past)
- Surface water (past)
- Ambient Air (past, current, See discussion on page #63 of current report; response to comment #46)
- Municipal wells (current, VOCs-instead ATSDR assumes that AWD treatment is effective in minimizing risk from VOCs)
- Private wells, including irrigation wells (past, current, Inorganics, also did not analyze any locations for VOCs other than 6 identified private wells)
- Consumption of fish (past)
- Future exposures --- calculations not possible for any media exposure pathway

ATSDR Response:
Thank you for your comment. ATSDR has added a Limitations and Uncertainty section to the PHA, as requested (see response to previous comment). For information about the pathways evaluated please refer to the Pathways of Human Exposure section of the PHA, which discusses in detail the Completed Exposure Pathways, Potential Exposure Pathways and the Pathways of Exposure Considered and Eliminated.

Comment #33:
Index to information about select community concerns:
It may be difficult for the layreader to quickly and easily find the answers to specific questions in the current report. To make this process easier, please provide an index to information that ATSDR and/or the Massachusetts Department of Public Health (MDPH) have provided to answer specific community concerns. Please consider placing the following or similar information after the Table of Contents at the beginning of the report. It is presented below alphabetically in Table format, but could be reformatted, etc. as needed.

Concern	Page of current	Response to comment
Acrylonitrile exposure	p. 25-26 & p. 48	Response to unnumbered comment and response to comment # 29
Airborne contaminants	pp.63-64	Response to comment # 46
ALS (Lou Gehrig's Disease)	p.59	Response to comment # 43
Asthma	p.59	Response to comment # 43
Autism	pp.59-60	Response to comment # 43
Birth Defects	p.27 & p.59	Response to unnumbered comment & response to comment # 43
Cancer cluster	p.48; & Appendix G	Response to comment # 30
Cancer incidence vs. cancer mortality	p.52	Response to comment # 39
Infant mortality & low birth weight	p.54-57	Response to comment # 40
Prostate Cancer	p.42	Response to comment # 17
Skin cancer & arsenic	p.41	Response to comment # 17
Squamous cell carcinoma of the throat	p.26-27	Response to unnumbered comment
Vinyl chloride contamination	p.24-25	Response to unnumbered comment

ATSDR Response:
ATSDR believes that the section of the PHA addressing Community Health Concerns is short enough (approximately 4 pages) that it does not require a separate Table for the layreader. Based on this comment, ATSDR did move all the Responses to Comments to the PHA Appendices (Appendix H and I). Moving the comments and responses to the Appendices should improve readability of the document. A modified version of the proposed table was added as a quick reference guide to Appendix H.

Comment #34:
Mention Brain & CNS cancer and leukemia in ATSDR summary, conclusions and flyer
The statement that "In general, the six cancer types evaluated in this report… occurred approximately at or near the expected rates for Acton, its individual census tracts, and the Concord CT 3612 during the 19 year time period 1982-2000", is misleading when it is taken out of context and used in isolation, without mention of the statistically significant incidences of brain and CNS cancer in Acton, and leukemia in Concord.

ATSDR summary flyer
At a minimum, please add the words, "with only a few exceptions" after "In general" in the ATSDR flyer that was handed out at the August 26, 2008 public meeting and/or follow the statement up with the second bullet point from the conclusions section of the MDPH report, page 33 in Appendix G. (Adding the statement is preferable.) Please do likewise within the PHA report, as appropriate.

Please add the following or similar wording after the "In general" statement: (from Appendix G; p.33; second bullet point)

"Statistically significant elevations were observed for brain and CNS cancer in the town of Acton as a whole during the first time period, 1982-1987, and for leukemia in Concord CT 3612 during the middle time period, 1988-1993."

The "neighborhood level" investigation conclusions are already included in the ATSDR flyer and would follow the suggested inserted text.

ATSDR/MDPH Response:
ATSDR and MDPH will ensure that the following language is included in future flyers and conclusions sections where appropriate:

- In general, the six cancer types evaluated in this report (leukemia and cancers of the bladder, brain and central nervous system, kidney, liver, lung and bronchus) occurred approximately at or near the expected rates for Acton, its individual census tracts, and Concord CT 3612 during the 19-year time period 1982-2000. However, statistically significant elevations were observed for brain and CNS cancer in the town of Acton as a whole during the first time period, 1988-1993. While females in Acton were diagnosed with bladder cancer slightly more often than expected during 1982-2000, the elevation was not statistically significant and there were no consistent trends over time.

Comment #35:
Table showing exposure assumptions & data source
To make the assumptions in the PHA more transparent, accessible and user friendly:
Please include one or more tables that include columns that indicate the following for the data being used in dose calculations for a given exposure pathway or contaminant:

- Sampling dates (year: 2002-2003; 1979-1987 ...)

- exposure time per year (365 days, 350 days, 24 days ...)
- exposure time frame (# of years and/or particular years:" 6 years, 12 years, 30 years, 70 years, 1970-1978 ...)
- age category (children, adolescents, adults)

Or use some other appropriate method to display information in table format that clearly relates for example -- the application of 1978-1987 municipal well data to the 1970-1978 timeframe; or that the exposure scenario for sediment exposure was from 2002 data, and assumes 24 days of exposure for 1 hour/day, for an adolescent, for 12 years.

Please explicitly state that ATSDR did not have any municipal well data for the years 1970-1977, but that contaminants were most likely in the water during that time period.

ATSDR Response:
ATSDR has clearly indicated the exposure assumptions (exposure duration, body weight (child, adolescent or adult), exposure frequency, etc.) for its estimated dose calculations in Appendix C – ATSDR's Evaluation Process. For conservatism, ATSDR used maximum concentrations of contaminants from specific media regardless of the year it was reported in the sampling date.

As previously indicated, ATSDR used the historical data from the Draft 1992 Public Health Assessment and the additional data (24 pages) provided by the Acton Water District for Assabet I and Assabet II public water supply wells for the June 1982 through January 1987 time period for its assessment of historical exposure. The source of the data for the 1992 PHA completed under cooperative agreement by the Massachusetts Department of Health (MDPH) could not be located after numerous record searches by both ATSDR and the MDPH. It appears that no data from the Draft PHA precedes 1978, but that is difficult to verify without QA/QC information. ATSDR cannot determine whether or not contaminants were in the water between 1970 and 1977, because there is no data. However, ATSDR used conservative assumptions in its estimation of historical exposure doses to try and account for this data limitation.

Comment #36:
Conservative assumptions; Indiscriminate use of qualitative dismissive statement
Throughout the report, ATSDR repeatedly uses a dismissive statement about the use of conservative assumptions, so that even when there is increased risk-it is downplayed with a qualitative blanket statement, such as the one in the third paragraph on page 20. Throughout the PHA, the qualitative reference to conservative assumptions seems to be used as a one-size fits all way to brush off potential concerns.

In the case of exposure to arsenic at the site, the risks are serious and should not be marginalized or dismissed. (Cumulative risk due to arsenic exposure = 1.37E-03; See p.20 and Table 10.)

ATSDR Response:
The language used in this PHA to describe risk and the assumptions used in determining risk is similar to language used in other ATSDR PHA's and Consultations. The language is not meant to be dismissive; it is used to give perspective to the reader about the assumptions used and the estimated risk for different exposure pathways in the PHA.

Comment #37:
Lack of data does not equal lack of risk
Please state in the report that a lack of sampling data does not necessarily equal a lack of contamination, exposure or risk, but rather an unknown exposure/risk. A comparison of the pre-1984 contaminant plume to the 2001-2002 contaminant plume illustrates this point. Both figures show the extent of VDC contamination (1,1 dichloroethene), as known at that time. The pre-1984 figure is in Attachment B of these comments. The 2001-2002 Figure is in Attachment C. There was likely a considerable plume of contamination in the northeast area before 1984, but there was insufficient sampling until after 1999 to fully delineate it.

Another example is the recent sampling for 1,4 dioxane at the site that found up to 36 ppb of this contaminant in groundwater. A lack of previous monitoring for this contaminant did not mean that it was not there, just that there had been no sampling for it. (See additional comment about 1,4 dioxane below.)

There may be an analogous situation for past exposures to contaminants in municipal drinking water, or other media where there are data gaps.

A lack of data not being equivalent to a lack of exposure/risk is an important consideration throughout the PHA, but especially in the assessment of municipal well water and private well water exposures. As ATSDR has noted throughout the report they had very little historic data for the municipal wells, and as the PHA notes on pages 25 and 26 of this report, Acton Water District customers may have been exposed to vinyl chloride and acrylonitrile, (as well as other additional VOCs), in drinking water that were not detected either due to technological limitations or sampling gaps. Also, the 1992 data summary table used by ATSDR did not include any data for inorganic contaminants in past municipal well water. ATSDR is therefore currently unable to determine whether or not past drinking water customers were exposed to arsenic, manganese or other inorganic contaminants, and what risks these may have posed in past drinking water exposures. Likewise, no inorganic sampling data have been identified for private wells near the plume. We therefore do not know whether or not people may have been exposed to arsenic, manganese, or other inorganics via current or past private well water and what risks any such exposures would pose.

Also, as already stated in previous comments, the current PHA does not assess past exposures to contaminants in soils, sludge, and ambient air. Please ensure that the text makes it clear that although these analyses may have been beyond the scope of the current PHA by ATSDR, past exposures and risks via these pathways could have occurred.

ATSDR Response:
ATSDR concurs that a lack of sampling data does not necessarily indicate there was no contamination. Contamination was likely present at the W.R. Grace site prior to the time it was actually discovered and then sampled for. However, the presence of contamination in soil, water or air does not mean people would automatically be exposed. There must be a completed pathway of exposure (ingestion, inhalation or dermal contact) to a contaminant, it must be at sufficient levels and there must be exposure for a sufficient duration in order for a potential health effect to occur. ATSDR explains this process in the Pathways of Human Exposure section of the PHA. ATSDR has clearly indicated throughout the PHA where data gaps exist and the limitations and uncertainties of the data utilized for the report.

Comment #38:
Irrigation info = incorrect/ incomplete
Please change the text on appropriate pages throughout the report to state that VOCs were detected in-at least three private wells within 500 feet of the mapped plume at the WR Grace Superfund Site. The text on several pages incorrectly states that VOCs were only found in one private irrigation well. In several places the text also states that a homeowner has not granted permission to have his private irrigation well tested. That well, located on Bellantoni Drive, was tested, VOCs were detected, and the well was subsequently properly decommissioned. Please change the text of the PHA accordingly. Also please note in the text that no sampling was done for inorganics in these wells and so risk from arsenic, manganese, or any other inorganic in private wells cannot be determined. (For this and other related comments about private wells and irrigation wells see PHA report pages v, 2, 4, 11, 28, etc.)

Please see attachments F, G and H for private well data and information.

ATSDR Response:
ATSDR has consulted with EPA, Remedium, Inc. and the AWD to verify private well information presented in the PHA. Modifications were made where appropriate.

Comment #39:
Private wells vs. Irrigation wells
In the text, please be careful to distinguish between private wells, and private irrigation wells, the latter being a subset of the former at the WR Grace Superfund Site.

Please also be clear throughout the report and especially in any conclusions or summaries, that ATSDR's calculations and conclusions were based on 2002 data from the six known existing private wells, three of which were irrigation wells. Especially in summary sections, please be careful not to imply that an evaluation was done based on site wide data, if that was not the case.

It is ACES understanding that, as of 2002, six wells were identified within 500 feet of the mapped plume. Two of these were private irrigation wells on residential properties, overlying some of the most contaminated portions of the "northeast plume". (Lisa Lane & Bellantoni Drive). One was an irrigation well on a commercial property, (Powder Mill Plaza). The other three were not irrigation wells. One was a private well at a local Ice skating rink that supplies water for ice resurfacing, drinking water and bathing. (Valley Sports Arena). [Was TCE detected in this well at an earlier sampling date?-Please check with WR Grace and its consultant GeoTrans, EPA, and/or the MA Department of Environmental Protection, DEP, for more information] The other two private wells are located on the Starmet industrial property and provided process water (non-contact cooling water?) for that facility. (Starmet) The Starmet Property has been designated as a Superfund Site.

The July 1, 2005 Public Review Draft Remedial Investigation Report states that the Bellantoni Drive well was decommissioned in June 2003; the Lisa Lane well-was converted to monitoring wells in August 2003; and an additional private, residential irrigation well in the Northeast Area was identified on School Street and then tested in June 2003. (This private well should not be confused with the nearby Acton Water District wells that are commonly referred to as the School Street wells and that supply public drinking water.) According to the 2005 RI Report, chloroform was the only VOC detected in this private residential irrigation well on School Street. Please adjust the PHA text accordingly to reflect this new information.

Does ATSDR have information about any additional private wells? If so, please include it in the analysis. The 2008 ATSDR report made reference to a 7th well in the first complete paragraph on page 4 of the PHA report, when it states that five wells, (rather than four), are located to the south and two to the north.

ATSDR Response:
ATSDR has modified information on private wells in the PHA in accordance with information provided by Remedium, Inc. (a subsidiary of W.R. Grace) and the AWD. ATSDR did verify that there were seven wells not six in the vicinity of the W.R. Grace plume.

The text now reads as follows:

There are no private wells on the W.R. Grace property; however seven non-municipal wells have been identified within 500 feet of the plume. A non-community public water supply well supplies drinking water, ice resurfacing, and bathing water for an area sports arena. Three wells are used as private irrigation wells and one is a private commercial irrigation well. Two others serve as production wells for non contact cooling water on a commercial property. On May 6, 2002, W.R. Grace collected samples from five of these wells and analyzed each sample for VOCs. Four of the non-municipal wells are located south of the site and beyond the horizontal extent of groundwater contamination. No contaminants were found in these four wells during the May 6, 2002 sampling. Two of the non-municipal wells are located north of the W.R. Grace site, within the horizontal extent of the VOC groundwater contamination plume from the site. One non-municipal private well was abandoned and properly closed, as requested by the property owner. The other of these wells contained vinyl chloride (0.35 parts per billion [ppb]) above its CV of 0.03. This well was converted to a monitoring well by W.R. Grace.

Comment #40:
1, 4 Dioxane, newly identified at the site
As discussed in the Town of Acton comments submitted by their consultant, O'Reilly Talbot & Okun Associates, there are new data available for the WR Grace Site, for 1,4- dioxane. Sampling was not done for this contaminant until 2006. 1,4-dioxane is mobile, does not breakdown easily, and is not effectively removed by the air stripper treatment used by the Acton Water District (AWD). The AWD has performed its own sampling in addition to that done by WR Grace. The AWD has reportedly detected low levels of this contaminant (around 0.2 ppb) in municipal well water. While there is not yet a federal MCL for this contaminant, the Massachusetts DEP has set a guideline of 3.0 ppb for 1,4- dioxane in drinking water. In 2007, there was a detection of 4.4 ppb of 1,4 dioxane in a monitoring well that is directly adjacent to the AWD public drinking water well known as the Christofferson Well, (one of the AWD School Street wells).

ATSDR Response:
This PHA evaluated data provided to ATSDR through August 5, 2004. Review and evaluation of data after that date will need to be completed in a separate evaluation. Requests for evaluation of new data should be directed to ATSDR's Division of Health Assessment and Consultation. ATSDR and the MDPH Cooperative Agreement Program will determine the best course of action for evaluation of additional data sets.

Comment #41:
Proposed new public drinking water well WRG-3, (aka Assabet 3)

The Acton Water District is in the process of going through the permitting process for a new public drinking water well on property it acquired from WR Grace as part of a settlement of a court case concerning contamination from the WR Grace Site. This well, WRG-3 is located north and slightly east of the existing public wells Assabet 1 and Assabet 2/2A. It can be seen on the pre-1984 plume map in Attachment B, located in the most contaminated contour of the plume at that time. The current VDC plume does not extend to WRG-3. (WRG-3 was used by WR Grace for processing water when the industrial facility was in operation. The AWD refers to this well, WRG-3, as "Assabet 3". As part of the permitting process for WRG-3 a pump test was performed in 2007 or 2008 and water quality samples were taken. 0.56 ppb of 1,4 dioxane was detected at the proposed municipal well. As stated in the comment above, existing treatment for the AWD Assabet public water supply wells is ineffective at removing 1,4-dioxane from drinking water.

Please include information about WRG-3 in the ATSDR report, as this is a potential future exposure pathway.

ATSDR Response:
This request is beyond the scope of the current PHA. Please submit requests for review and analysis of new or additional data to ATSDR's Division of Health Assessment and Consultation. ATSDR and the MDPH Cooperative Agreement Program will determine the best course of action for evaluation of additional data sets.

Comment #42:
Acton Water District, separate from Town of Acton
The Acton Water District and Town of Acton are two separate political entities. The AWD was established by an Act of the Legislature and is not part of the municipal government.

ATSDR Response:
Thank you for your comment. This distinction has been made where appropriate.

Comment #43:
Manganese; Comparison Value in Table 4. lists 500 ppb; instead of EPA health advisory level of 300 ppb; EPA screening value is 50 ppb
EPA's lifetime health advisory level for manganese is 0.3 mg/L, (equivalent to 300 ppb), to protect against potential neurological effects. Based on staining and taste considerations the 2004 EPA health advisory document recommends reducing manganese levels to or below 0.05mg/L which is equivalent to 50 ppb, the EPA's secondary maximum contaminant level for manganese.) See: "Drinking Water Health Advisory for Manganese", U.S. Environmental Protection Agency, Office of Water (4304T), Health and Ecological Criteria Division, January 2004 at: http://www.epa.gov/ogwdw000/ccl/pdfs/reg_determine1/support_cc1_magnese_dwreport.pdf

In Table 4 of the 2008 PHA, ATSDR lists 500 ppb as a comparison value for manganese. Please consider using 300 ppb instead, since this is the EPA Health Advisory level. Under the EPA process, WR Grace used 50 ppb as a screening value and ARAR (applicable, reasonable and appropriate requirement) for manganese. (See Table 3-1 in August 30, 2002 Remedial

Investigation Report).

If ATSDR chooses to use a value other than 50 ppb or 300 ppb as a comparison value, please include an explanation and justification for this choice in the text.

ATSDR Response:
ATSDR used 500 ppb as a screening level. It is the Remedial Evaluation Guide (RMEG) level for a child found in ATSDR's Drinking Water Comparison Value Tables. This screening value was used to determine if additional evaluation for manganese was necessary in the PHA. Because the actual maximum concentration (520 ppb) exceeded this value (and the EPA value) it was evaluated further. ATSDR actually performed estimated dose calculations for adults and children to manganese in the public water supply wells. The estimated dose for adults and children was below the established health guideline of 0.05 mg/kg/day. The health guideline is the USEPA's RfD, which is based on a human study. *Because the calculated exposure doses are below the health guideline and because conservative assumptions were made in calculating these doses, it is unlikely that adverse health effects would occur.*

Comment #44:
Concord Library
The WR Grace Site is located partially in Concord, and Concord residents may have had past or current contact with site contaminants. Please provide a copy of the current draft ATSDR PHA to the Concord public libraries, especially the Fowler Library in West Concord, located closest to the site. Please also provide these libraries with final copies of the PHA, and any subsequent ATSDR studies related to the WR Grace Superfund Site located in Acton and Concord.

ATSDR Response:
Thank you for your comment. ATSDR will provide a copy of the Final version of the PHA to the local libraries, including the Fowler Library in West Concord.

Comment #45:
PR for release of final ATSDR report
When the final ATSDR PHA is available, please provide public notification of that fact with a press release to the Concord Journal, the Beacon (Acton's local newspaper) and other media, mailings to residents, Town officials, local libraries, and any other appropriate means.

ATSDR Response:
Thank you for your comment. ATSDR will provide a copy of the press release for the Final version of the PHA to the media outlets designated.

Comment #46:
B. General Comments MDPH (& ATSDR)

Synergistic effects
It is a valid concern that individuals may have been exposed to a mixture of chemicals via municipal well water or and/or exposures via other media at the site, and that the risks posed by a mixture may be greater than the sum of the risks posed by each individual chemical in isolation. Even at low concentrations of individual chemicals, these synergistic effects are a concern.

As is stated in Appendix C of the PHA, exposure to a cancer-causing compound, even at low concentrations, is assumed to be associated with some increased risk (page 96). ACES understands that ATSDR does not have an established means of evaluating synergistic effects, (Attachment A). Would the MDPH be willing to address the question of synergistic effects from exposure to a mixture of contaminants found in past municipal well water as shown in the 1992 ATSDR data summary table, as well as the additional VOC data for the Assabet-public wells from 1982-1987 that were recently located by the AWD - See Attachment E (Note that concentrations may have been higher between 1970 and 1978 when the wells were taken off line, and that the data ATSDR considered from 1978-1979 shows higher concentrations of contaminants than were detected in subsequent years.) Is there another authority that has experience with evaluating synergistic effects of exposure to a mixture of chemicals?

ATSDR Response:
The levels of VOCs in the historical data for the municipal drinking water supply are relatively low. In addition, the estimated exposure doses for VOCs in the municipal drinking water supply were all below a Comparison Value or established health guideline with the exception of TCE. Based on the very limited amount of data and lack of QA/QC information for the historical data set ATSDR has determined that past exposure to VOCs in the municipal drinking water supply poses an Indeterminate Public Health Hazard. Assessing synergistic effects of VOCs when there is reliable data is a complex and difficult process. Because of the lack of reliable historical data for VOCs at the W.R. Grace site there would be little value in attempting this type of complex analysis and it would not likely change the indeterminate conclusion category for past exposure to VOCs in municipal drinking water.

Comment #47:
Temporal pattern of increased Brain and CNS Cancer in Acton
A statistically significant increase in brain cancer was found by MDPH in Acton town-wide in the earliest time period examined-1982-1987; it was elevated in the next time period-1988-1993, and was slightly lower than expected in 1994-2000.

Question for MDPH: Is the temporal trend in observed brain and CNS cancer in Acton consistent with an environmental exposure between 1970 and 1978, and then the removal of that source as of the end of 1978? (people may have been exposed to contaminated drinking water from 1970, when the wells were opened, through 1978, when the wells were taken offline. Both wells were back in operation with stripping towers in place to remove VOCs by 1984. Contaminant levels in well water when they were put back online were most likely much lower and/or non-detect due to treatment. Soils and sludge remediation was completed in 1997 and groundwater has been undergoing treatment by W.R. Grace since about 1985. It is unclear how important/extensive airborne exposure may have been in the past. (See discussion of airborne contamination from the WR Grace Site on page 63-64 of the 2008 PHA in response to comment # 46.) There were odor complaints from neighbors beginning in 1973. With all the cleanup at the site, and an odor control system on the groundwater treatment system, offsite odors are not considered to be an issue now.)

Given that there may be a latency period of a decade or more between exposure and diseases- if exposure via drinking water began in 1970 and were at their peak from 1970- 1978, and then ceased or dropped off significantly after that--- would we expect an increased rate of brain & CNS cancer in the early years but then a drop off in incidence by 1994-2000? Is this temporal pattern of disease consistent with exposures beginning in 1970, manifesting itself as disease (brain and CNS cancer), 15 years later in the mid 1980s? (Airborne contaminants may have followed a similar pattern of high levels in the 1970's, and much lower neighborhood exposure later.)

Or should we still expect higher incidence in 1994-2000 (and later?) if there were a link with environmental/drinking water exposures? By 1994-2000, twenty four or more years would have passed since the onset of exposure, and sixteen or more since exposures ceased or were significantly reduced, (at least via drinking water).

Please include discussion of this issue in the main text of the final MDPH report. (Please do likewise for the related issues in the next two comments.)

MDPH Response:
While this comment is very relevant to understanding whether the Assabet well contamination is associated with an increased risk of cancer in Acton or Concord, it is important to stress that information and data gaps exist with respect to what is known about the latency period of brain and CNS cancers as well as the levels of VOCs, particularly vinyl chloride, in the Assabet wells between 1970 (when the wells were opened) and 1978 (when the wells were closed).

According to the medical literature, the latency period for brain and CNS cancers could range anywhere between 10 and 40 or 50 years. If the latency period is 10 years, then the relevant period to review cancer incidence ranges from 1980 (1970 plus 10) to 1988 (1978 plus 10). If the latency period is 40 years, then the relevant period to review cancer incidence ranges from 2010 to 2018. Because of this wide range in time, between 1980 and 2018 or later, it is not possible to predict when the incidence of brain and CNS cancer incidence could have been affected if exposure to contamination from the Assabet wells did in fact contribute to an increased incidence. For this reason, MDPH considered other factors as well in evaluating the incidence of brain and CNS cancer, such as residential history and histology type, in evaluating the overall pattern of brain and CNS cancers.

Volatile organic compounds (VOCs) were detected in Acton water between 1970 and 1978. VOCs including ethylbenzene, 1,1-dichloroethene, benzene, 1,1,1-trichloroethane, trichloroethylene (TCE), methylene chloride, and 1,1-dichloroethane were detected in the Assabet Wells, and vinyl chloride was detected in one private irrigation well in the vicinity of W.R. Grace. The maximum concentrations of ethylbenzene and 1,1,1-trichloroethane were below ATSDR comparison values and were not evaluated further. Although vinyl chloride was detected in the private irrigation well, it is not known whether vinyl chloride was present in the Assabet wells during the period that residents were consuming the water because of the lack of sampling data.

Ionizing radiation is the best established environmental risk factor for brain and CNS cancer (ACS 2009, NIH 2009). Researchers are studying whether other environmental factors such as exposure to vinyl chloride or other specific chemicals are important risk factors. The scientific literature indicates that workers who have breathed high levels of vinyl chloride for many years have an increased risk of liver cancer. In addition, studies indicate that lab animals fed vinyl chloride for a lifetime had an increased risk of liver cancer. The evidence also indicates that brain cancer, lung cancer, and some cancers of the blood may be connected with breathing vinyl chloride over time. Brain and CNS cancer was analyzed in the health consultation primarily because elevated levels of vinyl chloride were measured in one private irrigation well in the vicinity of the site.

Given what is known about vinyl chloride, it is also informative to consider the incidence of liver cancer (in addition to brain and CNS cancer). The human epidemiology data demonstrate a clear association between vinyl chloride exposure and liver cancer (ATSDR 2006). However, the association between vinyl chloride exposure and brain or CNS cancers is much less clear, with some scientific studies reporting a potential association and many other studies reporting no apparent association. The studies reporting a potential association were based on individuals exposed to vinyl chloride in an occupational setting (Cooper 1981, Waxweiler et al., 1976, and Wong et al., 1991). Occupational exposures are generally many times higher than the level detected in the private irrigation well. It is most likely that, if vinyl chloride exposure opportunities had an impact on cancer among residents of Acton or Concord, then an unusual temporal trend should have been observed in the incidence of liver cancer. In Acton, liver cancer occurred as expected during 1982–2000 (7 diagnoses observed vs. 7.0 expected) (See Table 1a). Diagnoses among residents of each census tract within Acton also occurred near expected rates and did not demonstrate an unusual temporal trend (See Tables 2a–5d). In West Concord CT 3612, liver cancer occurred slightly less often than expected (1 observed diagnosis vs. 2.3 expected) during 1982–2000. Because there is no temporal trend in liver cancer and liver cancer is more strongly associated with vinyl chloride exposure than brain and CNS cancer, we do not expect that the statistically significant elevation in brain and CNS cancer during 1982-1987 is likely to be related to vinyl chloride exposure.

Additionally, of the 4 children diagnosed with brain and CNS cancer in Acton, all were born several years after the closure of the wells and therefore did not have an opportunity for exposure to VOCs present in wells from 1970 through 1978.

We have continued to monitor cancer incidence in Acton because we know from the medical literature that some cancer types have a long latency period, as long as several decades. The latency period is defined as the time between exposure to a cancer-causing agent and the development of the disease. Individuals exposed to potential cancer-causing agents in the 1970s could develop cancer many decades later, well into the 2000s. Specifically, the latency period for occupational exposures to vinyl chloride and development of cancers of the liver has been shown to range from 12-47 years (ATSDR 2006). Due to environmental data gaps and the wide range of latency periods for certain cancers, the MDPH/BEH will continue to monitor the incidence of all cancer types evaluated in this health consultation in the communities of Acton and Concord through city/town cancer incidence reports published by the Massachusetts Cancer Registry.

Comment #48:
Spatial pattern, CNS and brain cancer
The 2008 MDPH cancer incidence report for Acton and Concord states:

"During the 19-year time period 1982-2000, brain and CNS cancer occurred approximately at expected rates in three of the census tracts in Acton (ie., CTs 3631.02, 3632.01, and 3632.02).

Residents of 3631.01, however experienced an elevation in the incidence of this cancer type (18 diagnoses observed vs. 10.9 expected, SIR = 165). This observed increase was again of borderline significance (95% CI = 98-261). Increased incidence within this census tract during each of the smaller time periods was not statistically significant." (MDPH report, page 11 of the 2008 ATSDR Public Health Assessment.)

The census tract with the elevated risk is the one that includes the WR Grace Superfund Site. The MDPH report states on page 29-"there were a few locations in Acton where two or three individuals with brain and CNS cancer were located in relative close proximity to each other, with some located in the southern area of town near the W.R. Grace site."

Given that there was a statistically significant increase in incidence of brain and CNS in the Town as a whole for the years 1982-1987, and that the only census tract with elevated risk for this cancer for this time period included the WR Grace Site, it still seems reasonable to conclude that the WR Grace Site may have played some role in the increased incidence of brain and CNS cancer in this part of town.

MDPH Response:
The basis for reporting that no common factor (environmental or non-environmental) was noted among the individuals diagnosed with brain & CNS cancers was based upon factors consistent with what is reported in the medical/epidemiological literature about brain & CNS cancer, including gender distribution, age at diagnosis, histology/subtype distribution, percent brain cancer and percent CNS cancer, and age at diagnosis by subtype. Among the adults diagnosed with brain & CNS cancer, the pattern of the above variables was consistent with what would be expected. The four children diagnosed with brain cancer were born several years after the Assabet wells were closed in 1978 and therefore would not have had the opportunity to consume water from the wells.

To address areas of town where two or three individuals with brain and CNS cancer were located in relative close proximity to each other, the MDPH/BEH reviewed information available on each diagnosis through the Massachusetts Cancer Registry and information on the amount of time that the individual diagnosed with brain or CNS cancer resided in Acton prior to diagnosis. An evaluation of the dates of diagnosis did not suggest a temporal trend among the individuals diagnosed with brain and CNS cancer. An evaluation of each histology type (i.e., the specific tissue or cell type) showed that a variety of different histology types were represented among individuals located in close proximity to each other, indicating that a common factor among individuals in these locations was unlikely. An evaluation of residential history was constructed for each individual diagnosed with brain and CNS cancer in Acton between 1982 and 2000 to help determine the importance that their location might have in terms of exposure to a potential environmental source. A range in the length of residence was observed among residents diagnosed with brain and CNS cancer who were located in close proximity to each other.

The above information, together with the MDPH response to the previous comment, in which the incidence of liver cancer is discussed with respect to vinyl chloride exposure, form the basis for the conclusion that a common factor among individuals with brain & CNS cancer was not found.

Also, it is important to note (as reported in the PHA) that the historical data from the public water supply wells do not indicate the presence of vinyl chloride. The PHA also reports that water from the Assabet wells was mixed with water from other wells prior to distribution to homes, so it is highly unlikely that any home would receive the maximum reported contaminant concentrations at the well from their tap.

As noted, however, because of environmental data gaps and the wide range of latency periods for some cancers, MDPH/BEH will continue to monitor the incidence of all cancer types review in this health consultation in Acton and Concord through the Massachusetts Cancer Registry.

Comment #49:
Brain and CNS cancer, histology types
The discussion on page 29 of the MDPH cancer incidence study about the census area in Acton that includes the WR Grace site, states:

"An evaluation of the dates of diagnosis did not suggest any temporal trends among individuals diagnosed with brain and CNS cancer, and a variety of histology types were represented among individuals located near to each other indicating that a common factor among individuals in these locations was unlikely."

Question: Even with a common trigger, such as exposure to chemical contamination, wouldn't we expect there to be some variety in the manifestation of disease? Different people would have different immunological statuses, or other risk factors-so that in some it would take longer for cancer to develop than in others. Likewise, isn't it reasonable to expect some variety as to the histology type of brain and CNS cancer that occurred, without eliminating the possible role of a common factor?

MDPH Response:
It is common for risk factors or combinations of risk factors to result in some variety in the manifestation of cancer. A risk factor is anything that increases a person's chance of developing cancer. For example, variations in gender and race can result in different manifestations of brain and CNS cancers. Men are generally more likely to develop gliomas than women, while women are more likely to develop meningiomas. Furthermore, the incidence of gliomas is highest among white individuals, whereas the incidence of meningiomas is highest among African Americans. In addition to these main subtypes, there are a number of rare brain and CNS tumors.

Despite numerous scientific and medical studies, the causes of brain and CNS cancers are still largely unknown. Most brain and CNS cancers develop for no apparent reason and are not associated with anything that the person did or didn't do, or with any known exposures in the environment. The brain is relatively protected from cigarette smoke and other cancer-causing chemicals that we breathe or eat, so these factors are unlikely to play a major role in these cancers. The most established risk factor for brain and CNS tumors (either non-malignant or malignant) is high-dose exposure to ionizing radiation (i.e., x-rays and gamma rays). Most radiation-induced brain and CNS tumors are caused by radiation to the head from the treatment of other cancers. These brain tumors usually develop around 10 to 15 years after therapeutic radiation. Meningiomas are the most common type of tumors that result from high-dose exposure to ionizing radiation, but tumors of other types have also occurred, including gliomas.

In order to determine if brain and CNS cancers were manifesting in unusual patterns in Acton, the distribution of these cancers by histology type was examined against established state and national trends in disease. Of the 35 individuals diagnosed with brain and CNS cancer in Acton during 1982–2000, 83% (n = 29) had brain cancer and 17% (n = 6) had CNS cancer. This distribution was very similar to the statewide distribution of brain and CNS cancer. Among individuals diagnosed with brain and CNS cancer in Massachusetts during this time period, 81% had brain cancer and 19% had CNS cancer. Recent information reported by the American Cancer Society (ACS), indicates that 80% of malignant brain tumors in adults are gliomas, a general category that includes glioblastomas, astrocytomas, oligodendrogliomas, and ependymomas (ACS 2009).

While tools available to environmental epidemiologists are somewhat crude and some variation is expected, review of histology types, temporal patterns and spatial patterns did not reveal any atypical patterns that would suggest that an environmental factor played a primary role in the incidence of brain and CNS cancer among individuals in Acton.

Comment #50:
2001-2006 Cancer Data
Please include and analyze the 2001-2006 cancer data in the final ATSDR and MDPH reports. (Please especially look at brain & CNS cancer & leukemia.)

MDPH Response:
MDPH/BEH will evaluate updated cancer incidence as part of a future Health Consultation.

Comment #51:
Pancreatic Cancer
Would MDPH please also include pancreatic cancer in its cancer incidence study? According to an online source, exposure to chlorinated hydrocarbon solvents have been linked to pancreatic cancer. The 1992 ATSDR report looked at pancreatic cancer and found that for the 1982-1988 time period, in the census tract that includes the WR Grace Site, there were five observed cases of pancreatic cancer versus 2.8 expected.

MDPH Response:
Based on the evidence in the scientific literature, the relationship between chlorinated solvents and pancreatic cancer is uncertain. In addition, ATSDR has concluded that past levels of volatile organic compounds, including some chlorinated solvents, in the Assabet wells posed no apparent public health hazard; however, levels of TCE may have exceeded current health guidelines, but because of the relatively short duration of exposure (maximum 9 years) and the relatively low levels compared to potential effects in health studies, it is unlikely that adverse health effects have occurred. However, due to community concern about the incidence of pancreatic cancer in the census tract containing the W.R. Grace site, an evaluation of pancreatic cancer will be provided as part of a future Health Consultation.

Comment #52:
Benzene
Would MDPH please consider both cancer and non-cancer health effects from benzene in its study? MDPH states that its choice to concentrate on the six cancers in the report is based on the contaminants arsenic and vinyl chloride. Benzene is another major contaminant at the site, and is linked with blood disorders including leukemia, one of the cancers in the study. To address comments/questions in the ATSDR report would MDPH please include any information related to possible non-cancer health effects that may be related to benzene exposure?

MDPH Response:
MDPH was asked by ATSDR to provide a descriptive evaluation of the occurrence of cancer in Acton (and one census tract in Concord) for the years 1982-2000 for this health consultation. Unfortunately, readily available data do not exist for other non-cancer health outcomes such as the blood disorder aplastic anemia. The evaluation of leukemia showed that, in general, leukemia occurred at or near the rates expected in Acton and its census tracts during 1982-2000. In Concord CT 3612, a statistically significant elevation among males and females diagnosed with leukemia was observed in the census tract during the middle time period, 1988–1993 (6 diagnoses observed vs. 2.2 expected, SIR = 278, 95% CI = 102–606), while leukemia diagnoses occurred less than or as expected during the other two time periods.

Comment #53:
Immunological disorders and other health related issues.
In addition to cancers, would MDPH and ATSDR please also assess non-cancer immunological disorders or other health effects that may be related to chemical exposures? Please provide information about such health conditions. Can Acton and Concord's rates of these or similar health issues be compared over time to state rates? Please especially examine rates for the areas near the WR Grace Site, as there are anecdotal reports of unusual incidences of immunological related health issues in that area in the past. Could any of these health issues be related to the contaminants at the WR Grace Site?

Thank you to MDPH and ATSDR for addressing similar questions in the response to comments section of the 2008 PHA. Those questions did not explicitly ask about immunological disorders, hence the current request.

ATSDR/MDPH Response:
Similar to other state health departments throughout the country, Massachusetts has no surveillance systems available to track diagnoses of immune disorders. MDPH was recently mandated by the legislature to establish a statewide Amyotrophic Lateral Sclerosis (ALS or Lou Gehrig's Disease) Registry, which is currently being implemented. The cause of ALS is not known, however scientists are researching several possible causes, including the role of free radicals, autoimmune responses, genetic predisposition, environmental factors such as toxic or infectious agents, and dietary deficiency (NIH 2008).

While there is some evidence that exposure to arsenic, vinyl chloride, or benzene can result in immune responses including both enhanced immune response and immunosuppression depending on the chemical form of the contaminant and the level of exposure (Klaassen 1999, ATSDR 2006), ATSDR concluded in the PHA that adverse non-cancer health effects, such as immune responses, are unlikely based on the doses calculated using conservative exposure assumptions. The exposure doses calculated for benzene and vinyl chloride were well below health guidelines and would not be expected to cause adverse health effects. The exposure dose calculated for arsenic using the maximum concentration found in public water supply wells was below the established health guideline for adults, but slightly exceeded the established health guideline for children. While the estimated dose for a child slightly exceeded the ATSDR health guideline, it is well below the dose that would result from ingesting water with an arsenic level at the USEPA MCL, therefore adverse immunological health effects are unlikely.

Comment #54:
C. Tables & Figures. Additional comments:

Tables 1, 2 and 3 Exposure pathways for the W.R. Grace Site; Pages 72-74.
Is the intent of Tables 1, 2 and 3 to present a comprehensive list of the time periods and chemicals above comparison values that people may have been exposed to via select pathways? If so, then in Table 1, please add "present" for the "time of exposure" for the completed pathway for drinking water, as the Acton Water District has not historically and does not currently provide treatment for inorganics, and both arsenic and manganese have been found in current municipal well water. ATSDR has stated that it considers current exposure to arsenic and manganese in the public water supply wells to be a completed exposure pathway.

ATSDR Response:
Thank you for your comment. ATSDR has modified Table 1.

Comment #55:
Tables 1 through 3; add note clarifying scope of PHA; Pages 72-74.
Tables 1 through 3 are valuable in that they give the reader a sense of some of the multiple ways in which people may have been/may be exposed. However, in order to clarify the scope and accomplishments of the current PHA, please add a footnote to the tables that not all of these pathways/time periods were assessed in the PHA, and there may have been additional past exposure pathways that are not part of the 2008 PHA. Please refer the reader to additional tables or lists that clarify which exposure pathways were analyzed as part of this PHA, and which were not. See comment 17 above, which includes suggested content for such tables or lists. The inclusion of these tables or lists would add to the clarity and transparency of the report, by helping to summarize some of the various complex assumptions and constraints of the PHA.

Clarification of this comment:
As noted in the text and proposed tables in comment 17 above, ATSDR did not have historic or future data to calculate exposure risk for past or future exposures via surface water, sediment, inorganics in municipal well water, VOCs in private wells, vapor intrusion, and consumption of fish. Current data were used to assess current exposures for each of these pathways, and calculations assumed these levels were encountered over various periods of time from 7 years to 70 years. There have now been 25 years or more of cleanup efforts at the site. Given that historic contaminant levels are likely to have been higher for most of the contaminants and pathways, exposure calculations for past exposures would have likely resulted in higher risk than those using current levels. By definition future data are not available and therefore future exposure risk could not be calculated. The 2008 PHA did not address past, present or future contamination in soils, sludge, or ambient air, although pages 63 to 64 of the report provide

information on past studies regarding airborne contamination at the site. Data for inorganics in private well water were unavailable and so the PHA could not determine risk for exposure to arsenic or other inorganics via this pathway for any time period.

ATSDR Response:

The following comment was inserted after Table 3 for clarification:

Tables 1 through 3 include the completed, potential and incomplete pathways of exposure evaluated in this Public Health Assessment. There may be other pathways of exposure that were evaluated in previous reports (i.e., the Draft 1992 Public Health Assessment), but if they were not discussed in this PHA they were not included these Tables.

Comment #56:

a. Table 3. Pathways considered incomplete. Page 74.

Please add the word "currently" to the title of this table, so that it reads: "Pathways currently considered incomplete for the WR Grace Site." This distinction is important since both exposure pathways listed, (vapor intrusion and consumption of fish), may have been complete in the past.

b. Vapor intrusion, past worker exposure, Table 3.

For the pathway named "Volatilizing of VOCs from groundwater into buildings", please consider that when contamination was at its highest levels in groundwater, (much higher than current levels), there were multiple WR Grace buildings onsite with workers, (See Figure in Attachment B). It has been estimated that approximately 200 people worked at the site in the past. Given the higher levels of benzene, vinyl chloride, l,l-DCE (known locally as VDC) and other VOCs in groundwater at the time, workers may have been exposed to contamination via this pathway at levels that would have posed a health concern

c. Consumption of Fish:

ATSDR only had information on current efforts to catch fish in the pond. There may or may not be past information about fish in Sinking Pond, which may or may not have posed a health risk to those consuming them. Was the pond sampled for fish before it was selected to receive the discharge of treated effluent? Given that it is a kettle pond a main source of its water is from groundwater. The figure of pre-1984 contaminant levels shows Sinking Pond to be within the historic plume. Without further information, past exposure via this pathway should be considered to pose an indeterminate risk.

ATSDR Response:

a. The word “currently” was inserted into the title of Table 3.
b. It is possible that workers may have been exposed to VOCs while working in former buildings located on the W.R. Grace site. However, there is no data available to assess former worker exposures to VOCs in groundwater, therefore this pathway cannot be evaluated by ATSDR.
c. ATSDR evaluated the fish tissue data from minnows and other information available on fish consumption from Sinking Pond. Because there is no subsistence fish-consuming population identified and because edible size fish could not be caught for evaluation, it is unlikely that persons accessing the site have in the past or are presently catching and consuming fish from Sinking Pond on a regular basis. Therefore, ATSDR considers fish consumption from Sinking Pond to be a no apparent public health hazard for both the

past and present.

Comment #57:
Table 5. Historical municipal well data
Page 75. Table 5, Contaminants Detected Above Comparison Values in Assabet Wells between 1970 and 1978; Historical Data
a. Please retitle this table to something like: "Historical municipal well data; Contaminants detected above Comparison values in Assabet Wells between 1978-1987; assumed to have been present in wells from 1970 to ??"
(Please consider using a longer exposure time than just 1970-1978---see discussion in previous comments.)

b. On this table, please add a note that ATSDR did not have any VOC data for the years 1970-1977; and the maximum detections shown were for the very limited data from the public wells from] 1978-1979. Please note that the exception to this is that the maximum concentration for 1,1 dichloroethane was from 1985 (ATSDR did not have any VOC data for this contaminant for the years 1970-1984), and the minimum concentrations in Table 5 are from the years 1978-1987 & 1992. The maximum detections were analyzed as if these were the VOC concentrations in drinking water between 1970 and 1978.

c. Please ensure that analysis of these contaminants in public drinking water considers dermal and inhalation exposures as well as ingestion. (Also see next comment.)

ATSDR Response:
ATSDR changed the title of Table 5 and added the following footnote below the table for clarification: The maximum contaminant concentration detected in historical well data is provided in this table. ATSDR compiled data from several different sources covering the years 1978 to 1987.

ATSDR believes that the nine year exposure period (1970-1978) used in its estimated dose calculations (non-carcinogenic effects) for exposure to VOCs in municipal well water is both conservative and realistic. As previously indicated, this is the time period from when the Assabet municipal drinking water wells were opened until the time they were closed, due to the discovery of VOC contamination. All ATSDR's calculations in the PHA for Theoretical Cancer Risk for VOC exposure in municipal well water use the standard default assumption for a lifetime of exposure (70 years). ATSDR estimated exposure dose calculations in the PHA considered ingestion, inhalation and dermal exposure for this time period.

Comment #58:
Table 10. Arsenic-additional exposure pathways. Page 80.
For arsenic---the table lists "Ingestion of municipal and private well water" as a pathway. ATSDR did not have any arsenic data for private well water and therefore could not assess either ingestion or dermal exposure, although it may have occurred.

Please also assess dermal exposure for arsenic for the municipal well pathway and include this in the numeric cancer risk estimate. Please also add a footnote to the table that no data were available for ingestion and dermal exposure of arsenic for past municipal water, past and current private well water, past or current soils, past sediment, or past surface water.

ATSDR Response:
ATSDR changed the arsenic pathway statement to read: "Ingestion of municipal well water". Per request, ATSDR calculated a dermal exposure for the maximum concentration of arsenic in the municipal wells and added it to the numeric cancer risk estimate in Table 10. The numeric cancer risk for the dermal pathway in municipal well water was very low (6.07E-07). The total numeric cancer risk estimate for arsenic is (7.52E-03), which ATSDR considers to be a moderate cancer risk.

Comment #59:
Table 10. Arsenic cancer risk estimates in table different from those in text Page 80.
There are differences between the cancer risk estimates for arsenic in Table 10 versus those in the text as follows:

a. The text on page 20 states that the cumulative excess lifetime cancer risk is 1.37E-03. But Table 10 lists this total numeric risk estimate as 9.50E-04. (Any risk over 1.00E-03 or 1 in 1000, would be considered a moderate risk according to ATSDR criteria provided with Table 10. EPA considers cancer risk over 1 E-04 (1 in 10,000) to be significant enough to trigger remediation. The 2005 EPA Record of Decision requires sediment remediation (cleanup), in two areas of the WR Grace Superfund Site due to high contaminant levels of arsenic and other inorganics.

b. According to page 14 of the PHA, ATSDR calculated an excess lifetime cancer risk of 5.73E-04 for incidental ingestion and dermal exposure to arsenic in sediment. However Table 10 lists the risk from incidental ingestion as 1.83E-04 and from dermal contact as 2.31 E-05. The sum of these two exposures is less than that given in the text, 5.73E-04.

ATSDR Response:
a. The cumulative excess lifetime cancer risk for arsenic was recalculated and is 7.52E-03. Both the text on page 21 and Table 10 have been modified to accurately reflect this change.

b. The correct numeric risk from incidental ingestion and dermal absorption in sediment is 5.73E-04 (as provided in the text). The values in Table 10 have been corrected, so that they are consistent with the text on page 15.

Comment #60:
Table 10. Trichloroethylene-additional exposure pathways. Page 80.

a. Table 10 lists "Historical ingestion of municipal well water" as the only exposure pathway for Trichloroethylene, (TCE). Please also assess dermal and inhalation exposure for the past/ historical municipal well pathway and include this in the numeric cancer risk estimates.

b. TCE was also detected in private well water. Please assess incidental ingestion, dermal and inhalation exposures for the private well pathways for trichloroethylene and include this in the numeric cancer risk estimates for private wells in this table, and in any other appropriate part of the report.

ATSDR Response:

a. The exposure estimate for historical TCE exposure provided in Table 10 considered ingestion, inhalation and dermal exposure. Table 10 already indicated Ingestion, Inhalation and the word "Dermal" was added for clarification in the table.
b. TCE detection in private wells was below the ATSDR Comparison Value, therefore further evaluation was not deemed necessary.

Comment #61:

Table 10, Inhalation & dermal exposure to VOCs in past municipal well water Page 80.
For benzene, methylene chloride, and TCE please calculate and include cancer risk from inhalation and dermal exposure, as well as ingestion in past municipal well water, and include these risks in Table 10.

ATSDR Response:

The exposure estimate for historical exposures to benzene, methylene chloride and TCE already in Table 10 considered ingestion, inhalation and dermal exposure. Table 10 already indicated Ingestion, Inhalation and the word "Dermal" was added under each contaminant for clarification in the table.

Comment #62:

Table 10. Vinyl chloride, additional VOCs? Page 80.
As discussed in a previous comment above, the Acton Water District has recently located additional data for the Assabet Public Water supply Wells from 1982 to 1987. These data include a detection of 3.4 ppb of vinyl chloride in Assabet 2 on September 4, 1985. (See page 22 in Attachment E.) Please calculate a risk for vinyl chloride via historical municipal well water exposure using this concentration and add it to Table 10. Please also add a footnote to Table 10 that there could have been additional exposure to vinyl chloride through past municipal water, so the total numeric cancer risk might be higher. (See comment 11b above regarding vinyl chloride.)

ATSDR Response:

As requested, ATSDR calculated a theoretical cancer risk based on the detection of 3.4 ppb of vinyl chloride in the municipal well water and modified Table 10 accordingly. It is true that levels of vinyl chloride in the municipal well water could have been higher (but they may also have been lower at times). ATSDR added a note to Table 10 indicating that the theoretical cancer risk calculations in Table 10 are based on the default assumption for a lifetime exposure (70 years) for clarification.

Comment #63:

Table 10. Surface water & sediment exposures for arsenic-dermal vs. incidental ingestion; Page 80.
It's interesting that the elevated cancer risk from exposure to arsenic in surface water is higher from dermal exposure than from incidental ingestion, and the reverse is true for arsenic in sediment. What factors account for this?

ATSDR Response:
The difference is primarily due to the different assumptions used based on exposure pathway, difference in conversion factors for water versus sediment, and the low estimate for the ingestion rate for surface water.

Comment #64:
Figure 3 - Public Water Supply Wells; Page 84.
In addition to showing the private well locations, this figure also shows both the extent of the groundwater plume as of 2002, as well as the WR Grace property line. Especially since the legend on this figure is too small to read, please add this information to the figure title:

"Figure 3 - Public Water Supply wells (Assabet 1, Assabet 2, Lawsbrook, Scribner and Christofferson), along with WR Grace Property Boundary (red), and 2002 Groundwater Plume (blue)."

If possible, please also increase the size of the legend to make it legible.

ATSDR Response:
The Figure 3 title was modified.

Comment #65:
Acton Water District wells
Page iv. Summary, p. iv Second paragraph
In the first sentence in this paragraph, please change "the Town of Acton" to "the Acton Water District". (The Acton Water District detected the contamination in its wells and then closed them.)

Please make also make any similarly appropriate changes to the language under "Site Description and History", on page 1.

ATSDR Response:
A similar comment was received by the Acton Water District (AWD) and the PHA was modified in accordance.

Comment #66:
Assabet wells back online, correction to text Page iv. Summary, Second paragraph on page iv,
The summary text states: “Use of the municipal wells, Assabet One and Two, was restarted in 1982 after the well water was treated with an activated carbon purification system (air stripping process) to remove the VOCs.”

According to the Acton Water District, Assabet Two was not back in use in 1982, and Assabet One was only in use for a short while that year, and then was taken out of service again. Airstripping and carbon filtration are two separate and distinct technologies.

See page 49 of the ATSDR report for the correct information as follows:

Air strippers were not used on the Acton Water District wells until 1983-1984. Both Assabet 1 and Assabet 2 were taken offline in 1978. According to the AWD, Assabet 1 was brought back online with carbon filtration, for a few months in 1982. When testing showed low levels of TCA were "breaking through" the carbon filters, they took the well offline again. In 1983 Assabet 1 was brought back online with both airstripping and carbon filtration technology in place. By March of 1984, Assabet 2 had also been brought back online with this same treatment. At some later date the AWD stopped using carbon filtration at these wells, but it continues to use an airstripper to remove VOCs from the water.

If all of the above text is too detailed for the summary section, please consider stating:

"In 1983 Assabet 1 was brought back online with both airstripping and carbon filtration technology in place, to remove VOCs. By March of 1984, Assabet 2 had also been brought back online with this same treatment. At some later date the AWD stopped using carbon filtration at these wells, but it continues to use an airstripper to remove VOCs from the drinking water."

ATSDR Response:
Similar comment was received by the Acton Water District (AWD) and the PHA was modified in accordance.

Comment #67:
Private wells, Irrigation wells, need to correct info Page v.
Summary, first complete paragraph on page v.
The six wells identified were not all irrigation wells, (three were)-see previous comments above.

a. Please delete the word "irrigation" in the first sentence of this paragraph.

b. Please correct the information about the irrigation well on Bellantoni Drive. It was sampled, as were the irrigation wells on Lisa Lane and Powder Mill Plaza, the well at the skating rink (Valley Sports Arena), and the two wells on the Starmet property. (See comments above, as well as sampling data information on pages 35 through 37 of the 2008 ATSDR report.)

c. If ATSDR's conclusions are based solely on exposures at the Lisa Lane, Bellantoni Drive and Powder Mill Plaza irrigation wells, please change the conclusion statement to read:

Therefore, ATSDR concludes that exposure to groundwater from the three existing private irrigation wells...

If ATSDR's conclusions consider all six identified private wells, (as of 2002), within 500 feet of the plume, (used for irrigation or non-irrigation purposes) - please include discussion and analysis of all six wells in the PHA, and if appropriate state:
Therefore, ATSDR concludes that exposure to groundwater from the six existing private well ...

Make adjustments to the text as needed to account for the additional private irrigation well on School Street (See July I, 2005 Public Review RI Report, p. 2-7.)

ATSDR Response:
Similar comment was received by the Acton Water District (AWD) and the PHA was modified in accordance.

Comment #68:
Surface Water Exposure
Page v. Summary, Second paragraph on page v.
The text states: "ATSDR concludes that occasional exposure to surface water poses no apparent public health hazard."

a. What if the current exposure is more than occasional?

b. This paragraph mentions past exposures, but risks associated with past exposures are unknown, or at least not determined by the 2008 PHA. (Exposures via surface water may have been higher in the past, given the onsite lagoons and much higher contaminant concentrations in groundwater, with accompanying discharge to surface water.)

Therefore please add wording such as, "under current conditions and contaminant levels.. " or, "under current conditions and with assumed exposures", to the ATSDR conclusion, so that it reads:
"ATSDR concludes that occasional exposure to surface water under current conditions... "

ATSDR Response:
Thank you for your comment. ATSDR believes the exposure assumptions it used in its assessment of the surface water exposure pathway to be conservative, but realistic. It is true that exposure to contaminants in surface water by trespassers in the past could have been higher, but may also have been lower at times. This conclusion is based on the data reviewed and considers past, present and potential future exposure.

Comment #69:
Sediments, Exposures to adults vs. adolescents Page v.
Summary
a. Please note in the text that ATSDR's assumptions are for a person to be exposed for just 24 days per year for one hour/day.

b. What is the basis for the assumption that adolescents are more likely to access the site than adults? Anecdotally, there are reports of frequent and regular trespassing on the WR Grace Superfund Site. ACES is not aware of any data regarding the age of trespassers. The 2005 draft PHA included a sediment exposure assessment for children, and yet children are not assessed for the sediment pathway in the 2008 version of the PHA. Page 15 of the 2005 draft report estimated a dose of 0.00334 mg/kg/day for a child. This is more than ten times the health guideline of 0.0003 mg/kg/day (USEPA RID).

c. According to Appendix C., the figures/assumptions used for adults are different than those used for adolescents. These include a larger skin surface area for adults (6,074 sq cm; vs. 4,471 sq cm); higher exposure duration for adults (30 years, versus 12 years); higher body weight for adults (70 kg vs. 45 kg for adolescents); lower incidental ingestion rate for adults (100 mg/day vs. 150 mg/day for children); and a higher averaging time for non-cancer chemicals (10,500 days for adults vs. 4,200 days for adolescents). Given that there are not any identified data on the age of persons currently accessing the WR Grace Superfund Site, ACES requests that ATSDR base its "sediment" conclusions on the age group that shows the highest risk.

These comments apply to page 14, as well as page v. of the 2008 PHA.

ATSDR Response:
ATSDR did base its conclusions on the age group with highest estimated risk for sediment. Generally, (given the same concentration and duration of exposure) children are at highest risk, then adolescents and then adults. In this exposure scenario, ATSDR determined that 1 to 6 year old children are unlikely to trespass and be exposed to sediment, therefore the next most conservative population would be adolescents. ATSDR based its trespasser exposure assumptions on adolescents in this PHA, because that is more conservative than the adult exposure scenario. ATSDR actually calculated exposure doses for adults, adolescents and children for each exposure scenario. To reiterate, ATSDR considers it unlikely that 1 to 6 year old children would access the W.R. Grace site with any frequency. Based on observations during the site visit, adults and adolescents are likely to be the majority of trespassers at this site.

Comment #70:
Limitations: add section to report Page 1.
Purpose and Health Issues
As stated above in comment 9 and subsequent comments, please add information to the 2008 PHA about the limitations of the PHA, especially in regard to assessing past or future exposures. A new "Limitations" section could be logically placed on page 1 between the "Purpose and Health Issues" and "Background" sections of the report, or as part of the "Discussion of Environmental Contamination" section of the report that begins on page 2, or elsewhere as appropriate. If there is a mandated ATSDR report structure that does not allow the creation of a new section, please include the information in an existing discussion section, or elsewhere as appropriate.

ATSDR Response:
A Limitations and Uncertainty section has been added to the PHA.

Comment #71:
Site vs. property-
Page 1. Background Section; Site Description and History;
As stated above in comment # 7, please provide a discussion of the distinction between the "WR Grace property" vs. the "WR Grace Superfund Site" in the Site Description and History section on page 1. (The "site" includes all the areas affected by contamination from the WR Grace facilities and extends beyond the "property" owned by the WR Grace Company. See PHA Figure 3 and the figures in Attachment B and Attachment D to these comments. At a minimum, please change the word "site" to "property" in the first three sentences in the Site Description and History paragraph, and discuss the fact that the contamination has migrated beyond the property lines and underlies privately owned residential, industrial, and Acton Water District property and extends to the northeast to the AWD School Street municipal drinking water wells.

ATSDR Response:
As indicated in response to a previous comment, a footnote was added on the appropriate page of the PHA for clarification of the terms “site” and “property”.

Comment #72:
Acton Water District
Page 1. Background Section; Site Description and History, near the end of this paragraph

a. The text currently states: The Town took precautionary action and closed the two wells. Please substitute the "Acton Water District" in place of the "Town" so that the sentence reads: "The Acton Water District took precautionary action and closed the two wells."

b. Please add the word "currently" so that the text states: "The Acton Water District (AWD) currently operates and maintains air strippers... "

ATSDR Response:
Appropriate changes were made in the PHA text.

Comment #73:
Surface water bodies, site vs. property
Page 2. Land Use and Natural Resources, second paragraph

a. In the first sentence of this paragraph, please change the word "site" to "property", so that the text reads: "Sinking Pond, located on the center of the WR Grace property, is the only natural water body on the property."

Two additional natural water bodies, Fort Pond Brook and the Assabet River could be considered to be part of the site. WR Grace contamination discharges to both water bodies from groundwater, and in the Northeast Area groundwater contamination is now located on both sides of Fort Pond Brook. (pumping of one of the AWD public wells - the Christofferson well - has pulled contaminants underneath and to the other side of Fort Pond Brook.)

b. Please add a figure to the report that includes the locations of the relevant surface water bodies, at a reasonable scale. The scale on Figure 1 is too small and Figures 2 and 3 do not include the natural and manmade surface water bodies: Sinking Pond, Fort Pond Brook, the Assabet River, Muskrat Pond, Turtle Pond, etc.

ATSDR Response:
Thank you for your comment. Appropriate changes were made to the text in the PHA. No additional figures were added to the PHA. Figures and maps of additional water bodies near the W.R. Grace site are available in other resource materials.

Comment #74:
Proposed municipal well; onsite private wells
Page 2; Land Use and Natural Resources, third paragraph.

a. Please add information to third paragraph on page 2 about the proposed new AWD municipal well at the site. Suggested new/ changed text is below:

b. "The Acton Water District has six current wells/wellfields that draw water from the aquifer for the municipal water supply. *The Acton Water District has proposed the opening of a new municipal well at the site in the same location as an historic well, known as WRG-3, that the WR Grace Company used in its former industrial processes. The AWD is currently going through the DEP permitting process for this well it refers to as "Assabet 3" and has already performed a pump test in pursuit of a new municipal drinking water permit.*

c. Given the distinction between site vs. property, and the fact that only three of the identified wells were used for irrigation, please change the text to read, (changes in bold):
"There are no private wells on the WR Grace property; however six private wells have been identified within 500 feet of the plume." (omits the word irrigation)

(Change the number of wells to include the additional private irrigation well on School Street?)

ATSDR Response:
A footnote was added (with information about the proposed well) and other appropriate changes were made in the PHA text.

Comment #75:
Comparison values, choice of CVs
Page 2; Discussion of Environmental Contamination, Evaluation Process, last paragraph on page 2.
Is there a subjective "professional judgment" aspect to the choice of ATSDR comparison values (CVs) or comparison doses? Does EPA use a different set of comparison values? What factors are considered in the choice of the list of CVs or the choice of which CV, or which comparison dose to use for a given scenario, (RfD? MRL? CEL?)? Are more protective CVs or comparison doses sometimes not used due to "professional judgment"?

ATSDR Response:
Comparison Values (CVs) are media-specific concentrations that are used by health assessors to select environmental contaminants for further evaluation. ATSDR maintains a database of CVs that is generally updated quarterly or as new information becomes available. Professional judgment is used by ATSDR health assessors in the selection and use of Comparison Values in Public Health Assessments. EPA and other agencies may use different CVs. Generally, ATSDR health assessors use a conservative approach when selecting contaminant specific CVs.

Comment #76:
Potential exposure pathways, criteria?
Page 3. Discussion of Environmental Contamination, Pathways of Human exposure; last paragraph on page 3.
Please state explicitly why each of the pathways is designated as a "potential" exposure pathway, (private irrigation wells, surface water, and sediment), rather than as a "complete" exposure pathway. Which of the five listed criteria was absent for each specific pathway?

ATSDR Response:
ATSDR evaluated each exposure pathway in accordance with its Public Health Assessment Guidance Manual. ATSDR considers five components in assessing exposure pathways.

(1) A source of contamination
(2) A release mechanism into water, soil, air, food chain (biota) or transfer between media (i.e. the fate and transport of environmental contamination).
(3) An exposure point or area (e.g. drinking water well, residential yard).
(4) An exposure route (e.g. ingestion, dermal contact, inhalation).
(5) A potentially exposed population (e.g. residents, children, workers).

If all of the elements described above are identified, a completed pathway exists. *If one or more components are missing OR uncertain, a potential exposure pathway exists.* If no completed or potentially completed exposure pathways are identified, no public health hazard will exist.

ATSDR considers private wells, surface water and sediment pathways at the W.R. Grace site to be potential exposure pathways, because an exposed population is uncertain for these pathways. Whereas, in the case of the municipal drinking water pathway there is a definite exposed population (people who ingested or came into contact with VOC contaminated water from the municipal drinking water supply from 1970 to 1978).

Comment #77:
Private wells-was a fifth private well identified to the south?
Page 4. Discussion of Environmental Contamination, Public Water Supply, Private Well, and Groundwater Sampling, page 4, first paragraph
Was an additional private well identified within 500 feet of the plume-or is there a typo in the text? The text states: "Two private irrigation wells are located north of the WR Grace site and five are located south of the site." (The text should say "WR Grace property" rather than "site". See previous comments.) The two wells north of the property are located on Lisa Lane and Bellantoni Drive. Four wells that were identified to the south include the Powder Mill Plaza irrigation well, and three non-irrigation wells: the well at the ice skating rink, and two wells on the Starmet property. Is there a fifth well to the south?

ATSDR Response:
A total of six private wells and one non-community public water supply have been identified within 500 feet of the plume. The information in this section of the PHA was modified in accordance with comments received by ATSDR from the Acton Water District during the public comment period.

Comment #78:
Private wells-they are not all irrigation wells.
Page 4. Discussion of Environmental Contamination, Public Water Supply, Private Well, and Groundwater Sampling, page 4, second paragraph
Please delete the word "irrigation" from the first sentence in this paragraph, so that the text reads: "As of 2002, W.R. Grace identified six private wells located within 500 feet of the plume of contamination from the W.R. Grace property." As noted later in the paragraph, three of the wells located to the south, were not irrigation wells. Please also note that VOCs were detected in at

least three of these private wells. Please correct the information about the Bellantoni well. Sampling permission was obtained for this well. VOCs including vinyl chloride were detected, and this well was subsequently decommissioned, (Please make the appropriate corrections on page v, page 4, page II, page 28)

ATSDR Response:
As discussed in the previous response, the information in this section of the PHA was modified in accordance with comments received by ATSDR from the Acton Water District during the public comment period.

Comment #79:
Surface Water Table = Table 7
Page 5. Typo Surface Water and Sediment Sampling, end of first complete paragraph on page 5.
Typo: Please correct the three references to the surface water table. It's Table 7, not Table 6.

ATSDR Response:
In the final PHA Surface Water is Table 7 and Sediment is Table 8. These corrections have been made in the PHA text.

Comment #80:
Sediment Table = Table 8.
Page 5. Surface Water and Sediment Sampling, second complete paragraph on page 5.
Typo: Please correct the three references to the sediment table. It's Table 8, not Table 7.

ATSDR Response:
In the final PHA Surface Water is Table 7 and Sediment is Table 8. These corrections have been made in the PHA text.

Comment #81:
Fish Table = Table 9.
Page 6. Fish Sampling, Top of page 6.

a. Typo: Please correct the reference to the fish table. It's Table 9, not Table 8.
b. The text states: "Lead was also detected but has no CV. Does EPA have an ARAR or other value for lead that it uses for comparison purposes for fish tissue concentrations? If so, please use this value for ATSDR's evaluation. (Check the Ecological and Public Health Risk Assessments from 2003 and 2004 that ATSDR included in its list of references as # 33, and # 36.)

ATSDR Response:
In the final PHA Fish Sampling is Table 9. This correction has been made in the PHA text. The following sentence was added to the PHA discussion regarding fish: “There is no CV for lead, however the detected level is below the World Health Organization guideline of 0.3 ug/g (ppm) for lead in fish.” The WHO guideline was also added as a reference and Table 9 was updated to reflect the changes. However, ATSDR should reiterate that no subsistence fishing population was identified in the vicinity of the W.R. Grace property and that during sampling

efforts no fish of edible size were caught. Therefore, it is unlikely that trespassers are catching or consuming fish in quantities that may contribute to adverse health effects.

Comment #82:
Manganese RfD, Typo?? Pages 7,13, and 16
ATSDR refers to two different numbers for the "established health guideline" (USEPA RfD) for manganese. On pages 7 and 16 it states that the health guideline is 0.05 mg/kg/day. On page 13 the text states that it is 0.14 mg/kg/day. Please make any appropriate corrections.

ATSDR Response:
For consistency, ATSDR changed all the manganese health guideline references to 0.05 mg/kg/day, because it is the most conservative. However, EPA IRIS does list an RfD of 0.14 mg/kg/day for total oral intake.

Comment #83:
Municipal water exposure
Page 7. Public Water Supply Wells, Historical Data, VOCs
When referring to contamination in the municipal drinking water wells between 1970 and 1978, the text states: "However, most likely the exposure duration was less than nine years." What is the basis for this statement? The WR Grace property was used for industrial purposes for decades before the contamination was discovered in the public water supply wells. According to the August 30, 2002, RI Report, Volume I, (p. 7-2):

"Dewey & Almy acquired the property in 1946 and manufactured synthetic rubber container sealant products. An organic chemical plant that produced latex products, plasticizers, and resins began operating in 1949, and a paper battery separator production facility was constructed in 1951. Grace acquired Dewey & Almy in 1954, and chemical operations were continued at the property."

Unless ATSDR has clear evidence to the contrary, please delete the sentence stating that exposure duration was likely less than nine years.

ATSDR Response:
The basis for this statement is that the Assabet wells were opened in 1970 and then taken offline in 1978, after VOC contamination was discovered. This period is the most likely exposure duration to VOCs in the municipal drinking water system. ATSDR concurs that the *actual* length of past exposure to VOCs in the municipal drinking water system is unknown. This is stated in the PHA in several places. However, in order to evaluate the very limited data set for past municipal drinking water exposures it was necessary for ATSDR to develop a “reasonable” exposure scenario that included the concentration of the contaminants in the municipal drinking water and a plausible duration of exposure. ATSDR believes the exposure assumptions it used are as realistic as possible and are a conservative estimate of exposure. The nine year exposure period (1970-1978) was used to assess non-carcinogenic risk to VOCs. It should be noted that ATSDR did use the default assumption for a lifetime of exposure (70 years) in its exposure dose calculations for carcinogenic risk for past exposure to VOCs in municipal drinking water.

ATSDR's assumptions are very conservative and likely over-estimate risk rather than under-estimate.

Comment #84:
Municipal wells - Inhalation and dermal exposures Pages 7,
Public Water Supply Wells, Historical Data, VOCs
As stated previously above, please include dermal and inhalation exposures in the evaluations of risk due to VOCs in the drinking water. The municipal well water was also used for showering and other domestic uses. Accordingly, please change the text in this part of the report, and elsewhere as appropriate.

ATSDR Response:
As stated in a previous response, ATSDR's estimated exposure dose calculations for past exposure to VOCs in the municipal drinking water supply considered ingestion, inhalation and dermal exposure. ATSDR deleted the word "oral" before the words "exposure dose" in each contaminant section for clarification.

Comment #85:
ATSDR's Evaluation Process
Pages 8 to 9, Public Water Supply Wells, Historical Data, VOCs, *Benzene*
a. The discussion of exposure to benzene in past municipal well water compares the calculated dose to the established health guideline of 0.004 mg/kg/day (US EPA RfD) and to the "Cancer Effect Level" (50 mg/kg/day), found in ATSDR 's Toxicological Profile for benzene. Please also calculate the inhalation and dermal exposure dose for benzene in past municipal well water, add these to the oral ingestion dose, and then compare the sum to the RfD and CEL doses.

It is striking how much higher the CEL is than the RfD. Please provide more information about CELs. Do they take into account exposures to children? Does EPA use these as reference values in their health risk assessments? CELs are not discussed in the text in Appendix C entitled "ATSDRs Evaluation Process". For each/all contaminants at the WR Grace Site, please use whichever comparison figures are most protective.

Since the current report uses CELs for comparison purposes in the PHA, please provide a discussion of CELs in Appendix C., including their source, relevance, applicability to vulnerable populations (including children, pregnant women, the elderly, etc.), uncertainty associated with them, and who besides ATSDR uses these figures.

ATSDR Response:
ATSDR exposure dose calculations for past exposure to benzene consider oral, dermal contact and ingestion. The RfD and CEL are different health guidelines. EPA's Reference Dose (RfD) is an estimate (with uncertainty spanning perhaps an order of magnitude) of the daily exposure of the human population to a potential hazard that is likely to be without risk of deleterious effects during a lifetime. The RfD is operationally derived from the No Observed Adverse Effect Level (from animal and human studies) by a consistent application of uncertainty factors that reflect various types of data used to estimate RfDs and an additional modifying factor, which is based on a professional judgment of the entire database of the chemical. The RfDs are not applicable to non-threshold effects such as cancer. A Cancer Effect Level (CEL) is the lowest exposure level

associated with the onset of carcinogenesis in experimental or epidemiologic studies. The CEL is used only in assessing carcinogenic effects and is based on human and/or animal studies for each individual contaminant. Part of the reason for the difference in these numbers is that the RfD is much lower due to the uncertainty factors used in deriving it, while the CEL is based on an actual human or animal effect from pertinent studies. Definitions of these health guidelines are provided in the PHA, but it is beyond the scope of the PHA to explain the toxicology involved in deriving RfDs, CELs and other health guidelines. Additional information is available at: www.epa.gov/iris.

Comment #86:
Methylene chloride, Typo
Page 8, Methylene Chloride conclusion, last sentence on page 8
Typo, The last sentence on this page is most likely meant to refer to "methylene chloride", rather than "benzene"?

ATSDR Response:
Thank you. This correction was made in the PHA.

Comment #87:
1,1-dichloroethene, also known as VDC
Page 10. 1,1 dichloroethene {a.k.a 1,1 dichloroethylene), second paragraph from bottom of page.
At the WR Grace Superfund Site in Acton and Concord, 1,1-dichloroethene is also known as vinylidene chloride or VDC. VDC is the most widespread contaminant at the WR Grace Superfund Site, and is used to depict the areal extent of contamination. These plume maps are labeled as VDC contamination, rather than DCE or 1, l-dichloroethene. Please provide some explanation of this in the text when referring to the figures, to avoid potential confusion. (The Figures in Attachments B, E, and D of these comments are all labeled as depicting VDC in groundwater.)

ATSDR Response:
ATSDR uses 1,1-dichloroethene to refer to this chemical contaminant in the PHA, because that is name the agency uses in its Toxicological Profiles and fact sheets. As indicated, there are several different acceptable names utilized in literature for this contaminant. ATSDR will add this alternate name (vinylidene chloride or VDC) in the PHA for clarification.

Comment #88:
Dermal absorption of vinyl chloride?
Page 11. Private wells, Vinyl chloride, second paragraph on page 11.
The text states: "ATSDR estimated dermal contact exposure doses for adults and children to vinyl chloride; however, no studies regarding vinyl chloride absorptions in humans were found for comparison. Animal data suggest that dermal absorption of vinyl chloride vapor is not likely to be significant."
a. Please include in the text the dose that ATSDR calculated for dermal exposure for adults and children. The text lists the inhalation doses, but not the dermal doses.

b. How do EPA public health risk assessments determine risk from dermal exposure to vinyl chloride? Please take the same approach as that used in the Public Health Risk Assessment done under EPA guidance.

c. Is dermal contact with vapor the issue, or contact with vinyl chloride in solution-in the water? In a previous sentence ATSDR discounted exposure to vinyl chloride vapor, via inhalation due to dilution with ambient air. ATSDR already has a dose estimate for dermal exposure to vinyl chloride--- so the animal studies about dermal absorption of vinyl chloride vapor may not be relevant.

ATSDR Response:
ATSDR added the dermal absorption doses to the text as follows:
ATSDR estimated dermal contact exposure doses for adults and children to vinyl chloride of 0.0000002 mg/kg/day and 0.0000001 mg/kg/day respectively. However, no studies regarding low dose, long term vinyl chloride absorption in humans were found for comparison. Animal data suggest that dermal absorption of vinyl chloride is not likely to be significant. *Because of the very low doses, exposure via dermal contact is unlikely to contribute to adverse health effects.*

Dermal contact with vinyl chloride in the water and volatilization during showering are unlikely to be significant exposure pathways.

Comment #89:
PAHs & dermal exposure
Page 16-17 Polycyclic Aromatic Hydrocarbons (PAHs)
Was dermal exposure to PAHs assessed? The text states: "No studies were located regarding the distribution of PAHs in humans following dermal exposure". What does that mean? There is no further mention of dermal exposure to PAHs in sediment in the text, but Table 10 lists a numeric risk estimate of 8.83E-07. Please add this information along with any relevant discussion to the text. Again, please take the same approach as that used in the Public Health Risk Assessment done under EPA guidance.

ATSDR Response:
Yes, dermal exposure to PAHs was assessed. ATSDR calculated dermal exposure doses and also calculated theoretical excess cancer risk for dermal exposure to acenaphthylene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(g,h,i)perylene, dibenz(a,h)anthracene and phenanthrene. The estimated exposure doses were very low and unlikely to contribute to adverse health effects. ATSDR also calculated an excess theoretical cancer risk for each of the PAHs and then combined them (even though they may not all be additive in risk). This is a very conservative approach. The combined theoretical excess cancer risk for the 6 PAHs identified via dermal contact is 8.83E-07 (the numeric risk estimate from Table 10). The combined theoretical excess cancer risk for the 6 PAHs from incidental ingestion is 1.60E-06. ATSDR then combined the incidental ingestion and dermal theoretical excess cancer risks for this pathway, which indicate a total combined risk of 2.48E-06. This is the theoretical excess cancer risk cited in the PHA for this pathway and also cited in Table 10. As previously indicated, explaining every toxicological calculation is beyond the scope of the PHA and would complicate and lengthen the PHA considerably. ATSDR has chosen to summarize this information in the document text to make it easier for the lay-reader to understand.

Comment #90:
Vapor intrusion, Volatilization into buildings
Page 18-19. Volatilization of VOCs from groundwater into buildings
The second complete paragraph on page 19 states: "ATSDR used a very health protective model and the highest values found in the groundwater to create a worst-case evaluation."

Please clarify what groundwater data were used to assess the volatilization of VOCs into buildings. Was it site-wide data that considered a potential building over any part of the plume? Or just data from areas where current buildings overlie the current groundwater plume? In the latter case did the data only apply to the part of the site that WR Grace refers to as the Northeast Area, using the maximum contaminant levels only from this area? (The Northeast groundwater exposure area is outlined on the figure in Attachment D.) Higher contaminant levels are present in other portions of the plume.

It is important to clarify in the text the aerial extent of the current evaluation given that the site may eventually be reused with the potential of new buildings being proposed or built. If the evaluation does not extend to land overlying the existing plume that do not currently have buildings, please state this explicitly in the text.

ATSDR Response:
The table below indicates the data used in the VOC Indoor Air Modeling. The Johnson & Ettinger Model was used to estimate indoor air concentrations. The concentrations used in the model were the maximum concentrations found in groundwater. If higher levels of VOCs are found in groundwater in the future or if the site use changes (i.e. new buildings are proposed or built) it may be prudent to re-evaluate the volatilization of VOCs from groundwater into buildings. This assessment was based on site-wide data available to ATSDR through August 2004.

Exposure Point	Chemical of Potential Concern	Maximum Groundwater Concentration (ppb)	Incremental Risk (unitless)	Model Air Concentration (ppb)	Guidance Value (ppb)	Source
Former Lagoon Area	1,1-Dichloroethene	100	5.4E-03[1]	272	25,000	NOAEL
	Vinyl chloride	27	1.5E-06	156	10,000	LOAEL
Southeast Landfill Area	1,1-dichloroethene	59	2.1E-03[1]	106	25,000	NOAEL
	1,2-dichloroethene	110	2.6E-03[1]	23	None	N/A
	1,2-dichloropropane	15	7.1E-08	3	15,000	LOAEL
	Benzene	190	8.2E-07	77	780	LOAEL
	Vinyl chloride	17.5	6.5E-07	67	10,000	LOAEL
Southwest Landfill Area	Benzene	7.2	9.1E-08	9	780	LOAEL
	Vinyl chloride	3	5.3E-08	5	10,000	LOAEL

Comment #91:
Arsenic-dermal exposures in municipal water Page 20.
Arsenic, fourth paragraph

a. Thank you for assessing cumulative cancer risk, and presenting this information in both the text and Table 10. Please calculate risk from dermal exposure to arsenic in current municipal well water and add this to the text and to the risk figures in Table 10.

b. The fourth paragraph on page 20 lists different routes of exposure to arsenic. Please include dermal contact in municipal water and private well water in this list. Please also note in the text on page 20, as well as in Table 10 that ATSDR did not have any data for arsenic in past municipal well water, past or current private well water, past surface water and sediment, or past or current soils, so the total numeric cancer risk for arsenic may actually be higher than the current estimate.

ATSDR Response:
ATSDR calculated a theoretical excess cancer risk for dermal exposure to the maximum concentration of arsenic found in municipal wells (0.0052 mg/L). This is the same approach used in the theoretical excess cancer risk calculations for ingestion of contaminants in the municipal wells. The estimated dose for dermal exposure is 0.0000040 mg/kg/day and the theoretical excess cancer risk is 6.07E-07. This information was added to the appropriate discussions of arsenic in the PHA text and added to Table 10. The following footnote was added to Table 10: "theoretical excess cancer risks in this table are based on maximum contaminant concentrations available to ATSDR in data through August 2004".

Comment #92:
Manganese dermal exposure Page 13
and Page 20. Manganese
Why was dermal exposure not assessed for manganese, as it was for arsenic? Both contaminants were found in sediment, surface water and municipal well water. Please include an assessment of dermal exposure to manganese in the PHA.

ATSDR Response:
There is very limited information available on dermal exposure to manganese. In most cases manganese uptake across intact skin is considered extremely limited. ATSDR's Toxicological Profile for manganese indicates that no studies were located regarding absorption in animals after dermal exposure. There was only one human study available regarding dermal exposure to manganese. It was a case report of a man burned with a hot acid solution containing 6% manganese. The authors speculated that skin absorption occurred across the burn area. This study has little or no relevance to the very low levels of manganese found in the municipal drinking water. The primary pathway of exposure for manganese would have been ingestion, so ATSDR evaluated that pathway. ATSDR calculated an estimated exposure dose for ingestion of manganese, based on the maximum concentration found in the municipal water supply, and concluded that adverse health effects were unlikely. Therefore, it is even less likely that smaller doses from dermal contact would cause an adverse health effect. In addition, the limited studies available indicate that manganese is not readily absorbed through the skin. Based on this

information, ATSDR does not believe this is a viable pathway exposure pathway for manganese, therefore dermal exposure dose calculations were deemed unnecessary.

Comment #93:
TCE health guideline
Page 21. Trichloroethylene (TCE), first paragraph on page 21.
The text states: " ... people may have been exposed to TCE at levels that slightly exceed the health guideline." Please state in the text that the federal drinking water standard (or MCL) for TCE is 5.0 ppb. The maximum detection that ATSDR used for TCE in past municipal well water was 8.0 ppb, detected in 1978. Please also list the health guideline that the text references, if it is not the MCL.

ATSDR Response:
ATSDR inserted a footnote indicating that the health guideline is the MCL.

Comment #94:
Child Health Considerations; Pages 22-23.
The only risk estimate or calculations in the 2008 PHA that consider exposure to children appear to be for municipal and irrigation well water exposures. ATSDR makes the assumption that children do not have current access to the site and, as noted before, past exposures are only assessed for the municipal well water. Please consider that it is possible that children currently access the site.

Consideration of child health will be especially important with any future reuse of the site. ACES respectfully requests that ATSDR recommend that for any planned future reuse further evaluation be done under EPA guidance to evaluate exposures/risks to children.

ATSDR Response:
ATSDR considered children in every pathway of exposure in the PHA. ATSDR calculated exposure doses for adults and children throughout its assessment. In addition, for every trespassing scenario, ATSDR added an additional exposure dose calculation for adolescents. For trespassing scenarios, it is very unlikely that one to six year old children would access the W.R. Grace property. Trespassers are more likely to be adults and adolescents. Because this is the most realistic scenario, it is the basis for ATSDR's conclusions and recommendations regarding on-site contaminant exposures. ATSDR concurs that if the land use changes that re-evaluation of potential risk, pertinent to new site use, would be prudent public health practice.

ATSDR added the following Recommendation to the PHA: "If land use changes for the W.R. Grace property in the future, ATSDR recommends that the property owner assess the impact of the potential reuse on public health, especially for children".

Comment #95:
Discuss non-cancer health outcomes
Page 23. Heath Outcome Data
In addition to cancer there are community concerns about other health outcomes possibly related to the WR Grace Site.

a. Please address non-cancer health outcomes in the Health Outcome Data section of the report.

At a minimum please refer the reader to other pages in the report that discuss some of these concerns. As requested in comment 18 above, please also create a Table or Index to items of community concern and add a reference to this Table/Index in the Health Outcome Data section of the report. (Refer the reader to pages 54-57 - low birthweight and infant mortality, and pages 58-60 - ALS, birth defects, asthma, autism, etc. Also pages 63-64 concerning airborne contaminants. See draft Table in comment 18 above for more references.)

b. Please create a table for cumulative non-cancer related health risks. comparable to Table 10 which estimates cumulative carcinogenic risk.

ATSDR/MDPH Response:
Part A: The discussion of infant mortality, low birth weights, autism, and pediatric asthma available in the 'Response to Comments Received' Appendix I of the PHA will remain in that section because these outcomes were evaluated in response to comments on the initial release of the PHA, not because these outcomes were thought to be potentially associated with exposure to the W.R. Grace site.
Part B: No Table was added for cumulative non-cancer related health risks. Non-cancer health risks are not generally cumulative or additive, so a Table implying such might be misleading. Non-cancer health risks are better explained via descriptive text rather than in a table format.

Comment #96:
Include West Concord Data Page 23.
Health Outcome Data
Please add discussion of the cancer incidence information for Concord Census Tract 3612 to the Health Outcome Data section of the report. Please ensure that the discussion is comparable to that provided for the Town of Acton, covering each of the individual time periods, as well as the overall period. Please also ensure that it includes discussion of the statistically significant higher incidence of leukemia in Concord for the 1988-1993 time period.

ATSDR/MDPH Response:
MDPH/BEH has updated the Health Outcome Data section to include a discussion of the cancer incidence evaluation for Concord CT 3612.

Comment #97:
Public Availability Session in Acton Town Hall
Page 24 Community Health Concerns
While the October 28, 2003 availability session had been scheduled for the Acton Memorial Library, it was actually held at Acton Town Hall in Room 204.

ATSDR Response:
This change was made in the PHA.

Comment #98:
Birth defects; Page 27 -- Comment for MDPH & ATSDR
According to the information on page 59, birth defects data are collected by the Massachusetts Center for Birth Defects Research and Prevention within the Massachusetts Department of Public Health (MDPH), Bureau of Family and Community Health and Nutrition. The MDPH Bureau of Environmental Health will request these data on birth defects and will make them

available as part of the final report.

Please include the birth defects data, discussion and analysis in appropriate sections of the text of the ATSDR report and in the MDPH document. Please also include this information on page 27 as part of ATSDR's response to the question about birth defects.

MDPH Response:
MDPH/BEH has requested birth defects data from the Massachusetts Center for Birth Defects Research and Prevention within the MDPH Bureau of Community Health Access and Prevention (formerly the Bureau of Family and Community Health and Nutrition) and will make an evaluation of these data available as part of a future Health Consultation.

Comment #99:
Proper disclosure of brain & CNS cancer and leukemia incidence
Page 27 of ATSDR report; ATSDR summary flyer distributed on Aug. 26, 2008

ACES respectfully and very strongly requests that ATSDR include the following information in a new bullet after the first bullet on the bottom of page 27:
"Statistically significant elevations were observed for brain and CNS cancer in the town of Acton as a whole during the first time period 1982-1987. There were a few locations in Acton where two or three individuals were located in relative proximity to each other, with some located in the southern area of town near the W.R. Grace site. Statistically significant elevations were observed for leukemia in Concord Census Tract 3612, during the middle time period, 1988-1993."

This information is from the second bullet point in the "Conclusions" section of the MDPH report, page 33; and from the "Analysis of Geographic Distribution of Cancer Incidence" section of the MDPH, report on page 29.

As a matter of transparency and full public disclosure it is vital that ATSDR include this bullet point in response to the question on page 27 of the ATSDR PHA and also in the ATSDR summary flyer that was distributed at the August 26, 2008 public meeting. To leave it out is misleading to the public. The bullet point that will come after it, at the top of page 28, states MDPH's conclusions about its geographic analysis on the neighborhood level.

ATSDR/MDPH Response:
The following modified text inserted into the PHA: In general, the six cancer types evaluated in this report (leukemia and cancers of the bladder, brain and CNS, kidney, liver, and lung and bronchus) occurred approximately at or near the expected rates for Acton, its individual census tracts, and Concord CT 3612 during the 19-year time period 1982–2000. However, statistically significant elevations were observed for brain and CNS cancer in the town of Acton as a whole during the first time period, 1982–1987, and for leukemia in Concord CT 3612 during the middle time period, 1988–1993. While females in Acton were diagnosed with bladder cancer slightly more often than expected during 1982–2000, the elevation was not statistically significant and there were no consistent trends over time.

MDPH/BEH will work with ATSDR to draft appropriate language for future flyers.

Comment #100:
Appendix E not Appendix D. Page 28
Conclusions
Typo: The health hazard categories are in Appendix E not Appendix D.

ATSDR Response:
This change was made in the Conclusions section of the PHA text.

Comment #101:
Past exposures municipal well water Page 28.
Conclusions section
As stated in comments 10, 14 and 15 above, please retain the current discussion and analysis of past exposure to TCE and other VOC contaminants in municipal well water. But given the serious limitations with the data set, including the lack of vinyl chloride data prior to 1985, and acrylonitrile data, please conclude an indeterminate risk for exposures via the municipal well water. Note that the Acton Water District has recently located additional VOC data that shows past detections of benzene, toluene, chloroethane, and other contaminants in public supply well Assabet 2 between 1982 and 1987.

ATSDR Response:
As noted in response to previous comments, after careful consideration, ATSDR has agreed to change the conclusion category for past exposure to VOCs in the municipal drinking water supply to an *indeterminate public health hazard*. ATSDR has reviewed the additional VOC data provided by the Acton Water District and provided its evaluation of this information in the response to comment 5 and incorporated information, as appropriate, into the Final PHA.

Comment #102:
Premature to determine future risks
Page 28. Conclusions, end of first bullet point
The text states: *"ATSDR considers current and future exposure to VOCs, arsenic and manganese in the municipal drinking supply to be a no apparent public health hazard."* Please delete the words "and future" from this sentence.
Please consider:

- By definition we do not yet know future contaminant levels at the wells. There are no data to analyze to calculate future dose levels, or exposure risk.
- The Acton Water District wells do not have any past or current treatment for the removal of arsenic, manganese, or other inorganic contaminants
- ATSDR states on page 34: "ATSDR agrees that arsenic and manganese levels could increase in the School Street wells in the future."
- According to WR Grace reports, VOC levels are also likely to increase at the wells in the future.
- It should be WR Grace's responsibility to clean up the contaminants that originated on its property, without the ongoing need or requirement of the Acton Water District to provide treatment in order to remove WR Grace contaminants from public drinking water. No treatment system is 100% effective 100% of the time. (It may be advisable to also determine exposure levels based on contaminant levels in untreated water.)
- ATSDR's focus according to their October 2003 handout is on past and current exposures, not future ones.

(please also see related comments on this issue in the September 30, 2008 comments submitted by OTO Associates on behalf of the Town of Acton.)

ATSDR Response:
ATSDR believes that the institutional controls that are in place (water treatment process for VOCs and sampling/ monitoring of municipal well water by the Acton Water District in accordance with the Safe Drinking Water Act for VOCs, arsenic and manganese) are sufficient to prevent future exposure to contaminants at levels that would cause adverse health effects.

Comment #103:
Soils were not evaluated in this PHA
Page 29. Conclusions. first bullet point on page 29
Please explicitly state in this bullet point that ATSDR did not evaluate exposures to contaminants in soils in the current study.

ATSDR Response:
ATSDR removed the word soil from the conclusion in this section. It now reads as follows: "Of the contaminants evaluated in sediment and surface water, only arsenic indicates elevated risk."

Comment #104:
30 year exposure only for adults
Page 32, Responses to Comments Received, Response to Comment 1
Is it true that ATSDR's dose calculations were based on a 30 year exposure duration only for adults, and that the exposure duration was 12 years for adolescents, and 6 years for children? (See Appendix C in the 2008 PHA.) If so, please change the response to comment 1 accordingly.

ATSDR Response:
Yes, most of ATSDR's exposure duration assumptions for non-carcinogenic health effects in the PHA for adults are based on 30 years, 12 years for adolescents and six years for children.

However, ATSDR used different exposure duration assumptions for historical exposure to VOCs in municipal well water. ATSDR assumed 9 years of exposure for adults and 6 years for children. Nine years is the time from when the Assabet wells were opened in 1970 to the time they were taken offline in 1978. (ATSDR did not do adolescent calculations for this pathway, because the child exposure scenario is more conservative).

ATSDR used the default assumption of 70 years of exposure when calculating carcinogenic risk for all pathways.

Comment #105:
Discrepancy in exposure assumptions?
Page 35-37. Responses to Comments Received, Response to Comments 4 and 6.
It looks like there may have been a typo in the exposure assumptions for irrigation wells in response to comment #4.

In response to comment #4, (page 36), ATSDR stated that for exposure via irrigation wells ATSDR assumed an exposure frequency of 24 days per year (2 days per week during three summer months). This is the same exposure scenario as that used for current sediment and surface water exposures.

But the response to comment #6, (also about exposure via private irrigation wells), states that the exposure assumptions were "incidental ingestion and dermal contact by wading or swimming in pools filled with water from these irrigation wells 1.5 hours per day for 90 days. Appendix C. states these same exposure assumptions for private irrigation wells. Please correct the response to comment #4 if appropriate.

ATSDR Response:
Thank you for your comment. ATSDR reviewed its exposure dose calculations and confirmed for exposure via irrigation wells that it used 1.5 hours per day for 90 days per year for the exposure frequency. The response to comment #4 in the PHA text was changed.

Comment #106:
Different assumptions for vinyl chloride than for VDC and benzene? Page 37.
Responses to Comments Received, Response to Comment # 6
The text states: "For vinyl chloride ATSDR estimated 30 year and 8 year maximum exposures. For VDC and benzene, ATSDR estimated an 8 year exposure."

Why was a thirty year exposure assumed for vinyl chloride, but not for VDC or benzene?

ATSDR Response:
ATSDR performed multiple exposure dose calculations for each pathway. For the Lisa Lane and Bellantoni Wells, ATSDR assumed 8 years of exposure for an adult for benzene, vinyl chloride and VDC. The estimated exposure doses for benzene, vinyl chloride and VDC were below the established health guideline. For conservatism, ATSDR also considered a 30 year exposure to vinyl chloride at its maximum concentration in a private well and calculated an exposure dose. The estimated exposure dose from utilizing a 30 year exposure assumption was also below the established health guideline.

Comment #107:
More data in site repository
Page 57. Responses to Comments Received, Response to Comment # 41
The text states "It is also important to note that ATSDR evaluated all environmental data for the site". Please change this to:

"ATSDR evaluated all available current environmental data for the site in the 2002-2004 Remedial Investigation and Ecological and Public Risk Assessment documents produced under the guidance of EPA. Review of most historical site data was beyond the scope and ATSDR resources available for the 2008 Public Health Assessment, except that ATSDR did review one summary table of historical municipal well data that was in a 1992 report by MDPH, written under a cooperative agreement with ATSDR."

ATSDR had access to extensive current data from the Remedial Investigation and Risk Assessment Investigations for the WR Grace Superfund Site performed under EPA guidance in the 2002-2004 time frame, but relied on a single historical document for past data. The public repository for the WR Grace Site contains hundreds of historical documents containing countless tables of data for past contaminant levels in groundwater, soils, surface water, air, sludge, sediments, etc. Due to logistical and/or resource constraints ATSDR review of these data was not part of the scope of the PHA. Should additional resources in terms of time and personnel become available ACES requests that a public health risk assessment be conducted for past exposures, using the extensive data set available in the public repository.

ATSDR Response:
ATSDR modified its response to Comment 41 to read as follows:
"ATSDR evaluated environmental data for the W.R. Grace site available through August 2004. A large portion of the data reviewed came from the 2002-2004 Remedial Investigation and Ecological and Public Risk Assessment documents produced under the guidance of EPA. ATSDR also reviewed the limited historical data that was available from the Draft 1992 Public Health Assessment written by MDPH under cooperative agreement with ATSDR. A full review of all historical environmental data related to the W.R. Grace was beyond the scope and ATSDR resources available for the 2008 Public Health Assessment."

Comment #108:
Appendix C.
Municipal well water, dermal and inhalation exposures,
Appendix C; Pages 89-90
Municipal well water, should consider dermal and inhalation exposures also, not just ingestion for both past exposures to VOCs and current exposures to arsenic and manganese. (Note that arsenic and manganese are not removed from the drinking water by any past nor current treatment by the AWD at the municipal wells.) Please make appropriate changes to the text in Appendix C.

ATSDR Response:
- ATSDR calculated an estimated dose for dermal absorption of arsenic in the municipal drinking water supply based on the maximum concentration (0.0052 mg/L) and assuming 3 hours of dermal contact for 365 days per year for a lifetime (70 years). The estimated dose of 0.000004 mg/kg/day was well below the established health guideline of 0.0003 mg/kg/day. Therefore, adverse health effects from dermal exposure to arsenic from the municipal drinking water supply are unlikely.
- Dermal absorption of manganese from exposure through municipal well water would be limited, because it is not readily absorbed through the skin at low doses.
- Ingestion, inhalation and dermal exposure pathways for VOCs were considered in assessing past VOC exposure from the municipal drinking water supply.

Comment #109:
Non-cancer risk estimates-create new table Page 96,
top of page, before Cancer Risk section.
As requested in a previous comment, please create a table that shows a cumulative evaluation for non-cancer risks, (comparable to Table 10 in the 2008 PHA which does this for cancer-risk.) Please refer to this table on page 96 in Appendix C. at the end of the Non-Cancer Health Effects Section that begins on page 94.

ATSDR Response:
ATSDR has discussed non-carcinogenic health risks in the text of the PHA by pathway of exposure and in the Discussion and Public Health Implications sections. The non-carcinogenic risk evaluation from contaminants does not easily translate into table format, because risk for contaminants may be additive, synergistic, antagonistic, etc. Because of the complexity involved ATSDR prefers to leave this discussion in the text.

Comment #110:
Cancer risk estimates-Table 10; Appendix. C. Page 97, Last sentence on page
Typo: Cancer risk estimates are included in Table 10 not Table 9.

ATSDR Response:
Table 9 has been changed to Table 10 in the text of Appendix C.

Comment #111:
References:

Add Public Release 1992 ATSDR Report to reference section
ATSDR consulted the 1992 ATSDR report for historical municipal well data. There are two versions of this report-the "Initial Release" version and the "Draft: Public Comment Release" version. The "Initial Release" is already included in the reference section of the 2008 report. Please add the "Public Comment Release" version also. Please note that Comment 11 above refers to the "Public Comment Release" version of this report.

ATSDR Response:
Per request, both versions (Initial & Draft Public Comment) of the previous Public Health Assessment have been listed in the Reference section of the current PHA.

Comment #112:
1992 Public Comment Release vs. Initial Release, Comments by Lynne Jennings, EPA Project Manager
ACES has a copy of the "Initial Release" 1992 report with an accompanying cover letter, dated October 6, 1992, from Louise House of ATSDR Region I to Michael LeBlanc at the Massachusetts DEP. (Attachment I) Also with these documents is a memorandum dated January 8, 1993, from Lynne Jennings at EPA, Region I, (the WR Grace Superfund Site, project manager at that time?), providing comments on the draft Public Health Assessment. (Attachment J.)

A comparison of the "Initial Release" report to the "Public Comment" report shows that changes that Lynne Jennings suggested to the "Initial Release" PHA were incorporated into the "Public Comment" version of the report. For example, see Ms. Jennings' comments about page 23 of the report and compare this to the relevant pages in the two versions of the PHA. (See Attachment K. for pages 21-24 of the "Initial Release" PHA and Attachment L. for pages 22-24 for the "Public Comment Release" PHA.

ATSDR Response:
Thank you for this comment and the additional information regarding the differences in the Initial Release and the Draft Public Comment Release of the original 1992 Public Health Assessment written by MDPH under cooperative agreement with ATSDR.

MDPH References

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