AGENCY FOR TOXIC SUBSTANCES AND DISEASE REGISTRY

Public Health Assessment for

NORTH BRUNSWICK TOWNSHIP HIGH SCHOOL SITE
NORTH BRUNSWICK, MIDDLESEX COUNTY, NEW JERSEY

EPA FACILTY ID: NJD103805370

JANUARY 8, 2009

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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Prepared by:

New Jersey Department of Health and Senior Services
Public Health Protection and Emergency Preparedness
Consumer and Environmental Health Services
Hazardous Site Health Evaluation Program

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

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Summary

In June 2004, township officials and the New Jersey Department of Environmental Protection (NJDEP) requested assistance from the New Jersey Department of Health and Senior Services (NJDHSS) in the interpretation and public health evaluation of site-related contamination detected at the North Brunswick Township High School site, Raider Road, North Brunswick, Middlesex County. Prior to development, an area within the present location of the North Brunswick High School (NBTHS), the Public Service Electric and Gas (PSE&G) easement (NBTHS property), and Veteran's Park properties was used as a municipal dump which received various wastes including pharmaceutical/ laboratory research materials dating back to the 1940s through to approximately 1967. The waste material was partially discovered during school construction activities circa 1971/1972; however, the extent of the buried waste material was not fully encountered until 2003 during a school expansion project. The subsequent site investigations and remedial activities focused on the NBTHS, the PSE&G easement, Veteran's Park and the nearby Judd Elementary School properties.

Investigations and remedial actions were also conducted in the nearby residential area and were evaluated under a separate report titled *Site-Related Contamination At Three Nearby Residences* (ATSDR 2005). An update to this residential investigation has been incorporated into this PHA. In the autumn of 2004, contaminated soil at all three residences was remediated to below the regulatory cleanup levels under oversight by the NJDEP; therefore, the soil exposure pathway is considered eliminated. Past concentrations of arsenic in household dust was cited as a health hazard for one residence. The dust was remediated in April and May 2005. Post-remedial dust wipe samples indicate that the arsenic concentrations in household dust for this residence were reduced to levels that no longer pose a potential health concern for children. Trichloroethylene (TCE) was detected in the indoor air at six residences due to vapor intrusion from groundwater contamination. As a mitigation measure, the basement sumps were sealed and vented to the existing radon remediation system for all six residences.

The primary contaminants of concern (COCs) for the investigated areas include arsenic in surface soil, lead in settled dust, and TCE in indoor air for the NBTHS; arsenic in surface soil for Judd Elementary School; lead and arsenic in surface soil at Veteran's Park; TCE in groundwater; and TCE in indoor air at six nearby residences. Additional COCs posing a lesser risk and detected mainly in subsurface soil include several metals, volatile and semi-volatile organic compounds, polycyclic aromatic hydrocarbons, and Aroclor 1254 and Aroclor 1260 (fractions of Polychlorinated Biphenyl compounds). Completed exposure pathways include incidental ingestion of surface soil at high school building perimeter areas, areas outside the waste-fill boundary and the football field at the NBTHS, Veteran's Park and Judd Elementary School properties; incidental ingestion of lead contaminated settled dust on interior surfaces at NBTHS; and inhalation of indoor air contaminated with TCE at six nearby residences. Exposed individuals include area residents (children and adults), elementary and high school students (children and adults) and school employees (adults). Adverse non-cancer health effects are not expected to occur in children and adults for all past, present and future exposure pathways present at areas of concern. Additionally, since the NJDEP is monitoring indoor air at the six residences, chronic exposures to TCE in indoor air at concentrations exceeding NJDEP's Indoor Air Screening Level are not expected to occur to residents regarding current and future exposures.

It is noted that arsenic concentrations in soil outside the waste-fill boundary are likely present due to natural background levels and not associated with historic landfill activities. Judd Elementary School, the majority of the NBTHS building perimeter, and the NBTHS football field are outside the waste-fill boundary area.

Cumulative Lifetime Excess Cancer Risks (LECRs) were calculated based on past and present exposures to average soil contaminant concentrations (the likely scenario) for child residents are as follows for children attending Judd Elementary School and accessing Veteran's Park, the cumulative LECR is 10 in 1,000,000; and for children attending Judd Elementary School, accessing Veteran's Park, and living within one of the six residences with TCE detected in indoor air, the average LECR is 37 in 1,000,000. The cumulative LECR calculated based on past exposures to average soil contaminant concentrations (the likely scenario) for adults living within the community who have attended Judd Elementary School, attended NBTHS, and accessed Veteran's Park for a 38-year period were 14 in 1,000,000. The average LECR calculated based on average TCE concentrations detected in indoor air (the likely scenario) for adults living within one of the six residences is 21 in 1,000,000. The cumulative LECRs for child and adult residents are considered a very low to low increased risk when compared to the background risk for all or specific cancers.

Past and present exposures to site contaminants for the residential population are considered a ***No Apparent Public Health Hazard***. Remediation is necessary to prevent future exposures to contaminants in soil exceeding NJDEP's Residential Direct Contact Soil Cleanup Criteria (RDCSCC). NJDEP is requiring soil removal for lead and arsenic "hot spots" exceeding NJDEP's "Project Removal Criteria" (i.e. arsenic at 200 milligrams per kilogram (mg/kg); lead at 4,000 mg/kg) within Veteran's Park and areas to the south of Roosevelt Avenue. Following the soil removal of the "hot-spots", under NJDEP approved Deed Notices, contaminants remaining above the RDCSCC will be covered by a two-foot soil cap as a control measure to prevent future exposures. The soil cap will be applied to portions of Veteran's Park, the PSE&G easement (NBTHS property), and areas to the south of Roosevelt Avenue, including the northern portion of Block 143, Lots 94.01 and 95.01. The hazard category will be re-evaluated for the above areas once remedial measures have been completed.

In response to cancer cluster concerns expressed by the community, the NJDHSS Cancer Epidemiology Program reviewed cancer incidence data from 1979 through 2001 for North Brunswick Township and Middlesex County. No unusual number or distributions of cancer types were determined for the township or county. A request for an update to cancer incidence data for the New Brunswick High School Site area has been submitted which will be addressed in a follow-up health consultation for this site in the near future.

Recommendations include continued oversight of soil remedial activities for the NBTHS (including PSE&G easement) and Veteran's Park to ensure exposures are reduced to below NJDEP's regulatory cleanup criteria through either soil removal and/or installation of engineering controls; continued oversight of remedial activities regarding TCE contamination in groundwater to reduce concentrations to below the NJDEP's ground water vapor intrusion screening levels or a NJDEP approved alternative to minimize or eliminate the threat of vapor intrusion to the surrounding community; continued oversight of effectiveness of residential vapor ventilation systems; routine cleaning of hard surfaces (including window-sills) to minimize settled dust levels for the NBTHS; continued enforcement and practice of relevant community awareness actions of the current use restrictions for the eastern portion of Veteran’s Park until remediation of this area is completed; and the evaluation for the small arsenic “hot-spot” area to the south of Roosevelt Avenue to verify whether exposure prevention measures are required until the area is remediated in 2008.

Statement of Issues

In June 2004, township officials and the New Jersey Department of Environmental Protection (NJDEP) requested assistance from the New Jersey Department of Health and Senior Services (NJDHSS) in the interpretation and public health evaluation of site-related contamination detected during ongoing investigations being conducted for the North Brunswick Township High School site, Raider Road, North Brunswick, Middlesex County. Through a cooperative agreement with the Agency for Toxic Substances and Disease Registry (ATSDR), the NJDHSS reviewed environmental data and prepared this public health assessment to determine the public health implications associated with contamination found at the high school and for nearby areas including the Public Service Electric and Gas easement, Veteran's Park, and the Judd Elementary School.

In addition, the interpretation and public health evaluation of site-related contamination detected at three nearby residences was prepared in 2005 as a health consultation report titled *Site-Related Contamination At Three Nearby Residences* (ATSDR 2005). Based on recent remedial investigations and actions, an update to this health consultation has been incorporated into this public health assessment (PHA) with the inclusion of three additional residences added to the residential investigation area.

Background

The North Brunswick Township High School (NBTHS) is a public school located on Raider Road in North Brunswick Township, Middlesex County, New Jersey (see Figure 1). NBTHS is operated by the North Brunswick Board of Education and is situated on an approximate 48-acre tract of land, which includes a 150-foot utility easement operated by Public Service Electric and Gas (PSE&G) located along the western property boundary. Approximately 1,700 students, grades 9 through 12, attend the school. The school property includes recreational fields to the north and east. The high school is bordered by residential areas to the north and south; undeveloped woodland to the east; and Veteran's Park (approximately 16.9 acres) to the west. Judd Elementary School is located to the west of Veteran's Park (see Figure 2).

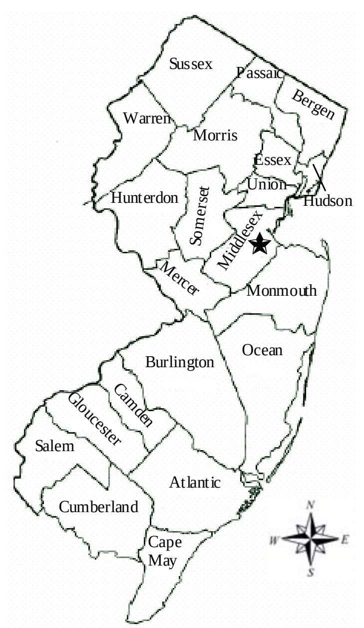

Figure 1: Location of North Brunswick High School

Site History

Prior to development, portions of the high school (including the PSE&G easement) and Veteran's Park were historically used as a municipal dump which received various materials including pharmaceutical/laboratory research wastes. Based on aerial photographs, the area appeared as a wooded lot prior to 1942.

Between 1951 and 1962, PSE&G installed electrical lines and a utility tower in the easement area. By 1967, Veteran's Park was developed as a recreational baseball field with the nearby Judd Elementary School under construction. Veteran's Park has been used by area residents for recreational purposes, including baseball, soccer and basketball until 2005 at which time the township closed the park due to the presence of site-related contamination. In May 1970, the North Brunswick Board of Education acquired the high school property from North Brunswick Township (Powell-Harpstead 2003). Construction of the high school was completed by 1972. Renovations for a new building addition to include a performing arts center, a gymnasium, a media center and over a dozen classrooms were completed in 2006.

In 1971, during construction of the high school, soil borings and test pit logs indicated fill material identified as "garbage and rubble" were present. An estimate to remove the material was obtained; however, there was no information provided to indicate if any of this material was removed during this period. In August 1982, pharmaceutical and other wastes (broken test tubes, microscopic slides, sealed vials, etc.) were uncovered by the high school grounds crew in an area known by high school personnel and students as "The Oval", an open grass-covered area previously located at the southwest corner of the high school (see Figure 2). "The Oval" had been used by the high school as a soccer practice field, marching band practice area and for high school social activities (i.e., Carnival). Approximately 10 cubic yards of this waste material was removed from "The Oval" by the high school grounds crew and dumped in the wooded area to the north of the high school (Powell-Harpstead 2003). This material was later located and removed in July/August 2004 as part of remedial activities (G. Hunsberger, Kleinfelder, personal communication, May 2007).

In 1985, additional vials were found in the "The Oval" prompting an investigation by NJDEP and the Middlesex County Health Department. Organic vapor analyzers were used to screen 24 high school locations, including "The Oval," and 6 background locations. NJDEP concluded no hazards were present from volatilizing organic chemicals in soil at the school (Powell-Harpstead 2003).

In July 2003, during excavation activities for a major renovation/expansion project at the high school, waste material was uncovered near and within "The Oval" area. The waste material consisted of pharmaceutical and laboratory type wastes, glass vials/bottles, and an unidentified dark brown material. Approximately 9,200 cubic yards of waste material/soil mix was excavated from this area and temporarily stockpiled on the NBTHS property (Powell Harpstead 2004). Construction activities were suspended and the NJDEP was notified. On behalf of the North Brunswick Township Board of Education and the Township of North Brunswick, the engineering services firm of Powell-Harpstead, Inc., (presently Kleinfelder) of West Chester, Pennsylvania initiated a remedial investigation at the site in 2003. The stockpiled waste material was removed from the high school property during the remedial activities (July 2004 to February 2005) conducted at the property.

Remedial Investigations/Actions

In July and August 2003, investigations were conducted to characterize and delineate the waste material discovered during the renovation/expansion project for the high school. A total of 54 soil samples were collected. The investigation areas included the high school property ("The Oval" area, building perimeter areas, and football field), Veteran's Park and the Judd Elementary School. Results of this investigation indicated the NJDEP Soil Cleanup Criteria (SCC) was exceeded for several metals, including arsenic and lead in the waste material/soil mix at "The Oval" area and at the eastern portion of Veteran's Park (Powell-Harpstead 2003).

On July 25, 2003, 18 interior surface wipe samples were collected from the NBTHS and 10 interior surface wipe samples were collected from the Judd Elementary School. The purpose of this investigation was to determine if site-related contaminants were present in settled dust on interior school surfaces. Follow-up interior surface wipe sampling was performed on November 8, 2005 at the 18 locations previously sampled at the NBTHS (Powell-Harpstead 2003).

Additional investigations were performed in October 2003 to further delineate and more fully characterize the waste material encountered on the high school property (including the PSE&G easement) and in Veteran's Park. Soil boring logs indicated waste material varied as a mixture of yellowish, red, brown, gray or black soil mixed with construction debris, animal bones, wood, ash, pebbles, paper, glass and rock fragments. The thickness of the waste material has been estimated to vary from approximately 0.5 to 3.7 feet with the thickest portions near or within the former "The Oval" area. Waste material was observed near the surface at five soil-boring locations within "The Oval" area and Veteran's Park. The general boundary of the waste material is depicted in Figure 3. Soil boring logs indicate approximately 0.5 to 2 feet of topsoil covered the waste material area. Background information also indicates that from 1977 through 1978, approximately 0.5 to 1 foot of topsoil was placed on the PSE&G easement area and the northern area of Veteran's Park; however, the purpose of the topsoil placement was not defined (Powell-Harpstead 2003).

The soil boring descriptions indicate that a clay layer exists below the waste material at varying thickness from 3.5 to 13.5 feet depending on the area. Groundwater samples were also collected below the waste material area at the high school property, including the PSE&G easement area (Powell-Harpstead 2004).

From July 2004 through February 2005, remedial actions included the removal and off-site disposal of approximately 9,500 tons of hazardous and 42,500 tons of non-hazardous (ID-27 waste) waste material/soil mix from the former "Oval" area, PSE&G easement and Veteran's Park. The waste material/soil mix, mainly contaminated with arsenic and lead, was disposed of at a waste handling facility (G. Hunsberger, Kleinfelder, personal communication, May 2007). The excavation boundary of the remedial action performed at the "The Oval" area is depicted in Figure 4.

Further delineation of soil contamination and waste fill material was conducted on the northern portion of Block 143, Lots 94.01 and 95.01. This area is located to the south of both Veteran's Park and Roosevelt Avenue. Results of surface and subsurface samples collected in

April 2005 and April 2006 indicated the NJDEP SCC was exceeded for several metals, including arsenic and lead for this area.

Quarterly groundwater monitoring has been conducted from July 2004 through March 2007 from a total of 18 groundwater wells located on the NBTHS property, the PSE&G easement, Veteran's Park, and the nearby residential area. Groundwater was also sampled from a sump located near the orchestra pit within the auditorium of the new building addition of the NBTHS. A granular-activated carbon bed treatment system has been installed to treat low concentrations of trichloroethylene (TCE) present in water within the sump. Sump water is sampled monthly with the treated effluent discharged to the sewer system by permit with the Middlesex County Utilities Authority (G. Hunsberger, Kleinfelder, personal communication, May 2007).

Indoor air samples were collected within the NBTHS based on concerns over possible vapor intrusion from contaminated subsurface media located below the southwest portion of the NBTHS (including the new addition) (Powell-Harpstead 2006). Additionally, during construction of the new building addition, a vapor suppression system was installed to help prevent the migration of subsurface contaminant vapors into the building interior (G. Hunsberger, Kleinfelder, personal communication, May 2007).

Planned Future Remedial Actions

NJDEP is requiring the removal of soil "hot-spots" exceeding ten times the Residential Direct Contact Soil Cleanup Criteria (RDCSCC) for lead and arsenic (i.e., 4,000 and 200 milligrams per kilogram, respectively). This "Project Removal Criteria" was established by agreement with the NJDEP. An estimated 4,600 cubic yards of arsenic and 300 cubic yards of lead contaminated "hot-spot" soils are planned for removal. Remaining lead and arsenic soil contamination exceeding the RDCSCC but below the "Project Removal Criteria" will be covered by a 2-foot soil cap (certified clean fill) as a control measure and maintained by a Deed Notice approved by NJDEP. The soil cap will encompass areas of Veteran's Park, the PSE&G easement (NBTHS property), and areas to the south of Roosevelt Avenue, including Block 143, Lots 94.01 and 95.01 (see Figures 5, 6 and 7). Veteran's Park and the NBTHS will have separate deed notices for remaining subsurface soil contamination exceeding the RDCSCC. This remedial action is tentatively scheduled to begin in the spring/summer of 2009.

Groundwater contaminated with TCE is located predominantly in the waste material area and towards the nearby residential area to the south of the high school (see Figure 9). Groundwater is planned for remediation through modern technology methods pending additional remedial investigation. A groundwater Classification Exemption Area (CEA) will be established through NJDEP to address remaining TCE concentrations in groundwater to reduce to levels that are considered low enough not to cause a threat to public health including the nearby residential area described below.

Nearby Residential Area Investigation

Remedial investigations conducted in 2003 indicated site-related contamination (arsenic in surface soil and TCE in ground water) was detected at three nearby residential properties. A health consultation report was completed in August 2005 regarding the public health interpretation of exposure at these residences (see Appendix A). Details of this health consultation are provided in the *Past ATSDR/NJDHSS Involvement* section of this PHA. Since August 2005, three residences have been added to the residential investigation area by NJDEP based on the extent of TCE contamination found in groundwater. An update regarding the public health interpretation of exposure to residents under this investigation has been incorporated in this PHA.

Site Visit

On October 18, 2005, a site visit was conducted of the North Brunswick High School and the adjacent Veteran's Park. Individuals present were Glenn Pulliam, Steven Miller, and Julie Petix of the NJDHSS, Leah Escobar of ATSDR, and representatives from the NJDEP, Middlesex County Health Department, North Brunswick Township Board of Education and Powell-Harpstead, Inc (environmental consultant for the NBTHS).

An inspection of the NBTHS expansion project and former "The Oval" area was conducted (see Photographs 1 and 2). "The Oval" area had been remediated prior to the site visit and was under construction as a storm water catch basin (see Photograph 3). This basin is connected to the township storm water system which discharges to Farrington Lake according to the NJDEP. A drainage swale was constructed in 2005 in the area immediately to the south of "The Oval" and behind the residential lots at the northern end of Plains Gap Road to divert surface water runoff from the surrounding area (see Photograph 4). The drainage swale also discharges to the township storm water system. The topography for the site is generally flat with a slight slope to the south.

The high school building interior was inspected to gather various information to aid in assessing exposures. NJDHSS inspected classrooms for general observations concerning interior dust wipe sampling conducted in July 2003 (see Photograph 5). NBTHS staff indicated wet-wipe cleaning of all classrooms and furniture is conducted during the summer break. Staff indicated that the majority of the school is carpeted including classrooms which are cleaned on a routine basis. Staff indicated that the school keeps all windows locked for security reasons. Fresh air is provided by the rooftop mounted heating, ventilation and air conditioning (HVAC) system. HVAC intake filters are changed out approximately every 3 months. Staff indicated the HVAC duct system has never been cleaned to their knowledge.

An inspection of the PSE&G easement area and Veterans Park, located to the west of the high school, was conducted (see Photograph 6). Township officials indicated the park is mostly used by area residents, including adults and children. NJDHSS was informed by township officials that an ordinance is in place restricting use of the park (not to be used for recreational or other purposes) due to the presence of site related contamination [(1)]. A single paved walking

[1] Current Status: Veteran's Park has been closed for the past two years (approximately) according to NJDEP.

path used by students was observed on the northern portion of the park leading to the area of the North Brunswick Manor Apartments located to the north of Veteran's Park (see Photograph 7). Perimeter monitoring wells were observed along the eastern boundary of Veterans Park (see Photograph 8).

Current conditions for the site include the completion of construction activities for the high school addition and storm water catch basin, and the restoration of surrounding areas disturbed by construction activities. Contaminated soil delineations have been completed for the Veteran's Park area. Delineation of VOC contamination in groundwater and the installation of new groundwater monitoring wells are continuing with the focus towards the nearby residential area. Soil and groundwater remediation activities are tentatively scheduled to begin in 2008.

Demographics

Using 2000 United States Census data, the ATSDR estimates that there are about 11,326 individuals residing within a one-mile radius of the North Brunswick High School site (see Figure 8).

Community Health Concerns

In response to cancer cluster concerns expressed by the community, the NJDHSS Cancer Epidemiology Program reviewed cancer incidence data from 1979 through 2001 for North Brunswick Township and Middlesex County. No unusual number or distributions of cancer types were determined for the township or county. This information has been provided in Appendix B.

The NJDHSS State Cancer Registry began in 1979; therefore, cancer incidence data for New Jersey does not pre-date 1979. State cancer registry data is currently complete through 2005. A request for an update to cancer incidence data for the New Brunswick High School Site area has been submitted which will be addressed in a follow-up health consultation for this site in the near future and will include a statement on the limitations of the data. This request also asked whether incidence of cancer to past and current residents who may have been students at NBTHS could be assessed.

Based on the expanded groundwater delineation, the residential area currently under investigation has recently been expanded to include a total of six residences. A public meeting was held in February 2007 to inform these residents of recent investigation data and future remedial actions to address TCE contamination found in indoor air within the residences, TCE contamination within groundwater, and remaining soil contamination at the nearby Veteran's Park area. NJDHSS provided information to address health concerns regarding exposure to TCE contamination in indoor air detected at the residences.

Past ATSDR/NJDHSS Involvement

ATSDR and NJDHSS evaluated analytical data of samples from surface soil, sump water, indoor dust and indoor air collected in 2004 and provided a health consultation regarding the public health interpretation of exposure for three residences close to the high school. The ATSDR and NJDHSS concluded there was a public health hazard for past exposures to arsenic contaminated soil; an indeterminate public health hazard for potential inhalation exposure to TCE in indoor air; and a no apparent public health hazard for one residence with arsenic contaminated dust as detailed in the health consultation titled *Site-Related Contamination at Three Nearby Residences* (see Appendix A). Contaminated soil from these residences was remediated in the autumn of 2004 to eliminate the soil exposure pathway. Arsenic contaminated dust was remediated from the one residence in April/May 2005. Remedial actions to reduce concentrations of TCE detected in indoor air were performed at all residences due to the presence of TCE in water within the basement sumps. These remedial actions involved installing sump covers and venting the airspace of the basement sumps to the exterior of the homes. The presence of the TCE in sump water is likely to originate from TCE contamination in groundwater.

This residential area is still under investigation due to the presence of TCE in groundwater. Remedial actions are planned for the near future to address TCE contaminated groundwater. An update regarding the evaluation of the public health interpretation of exposure to residents under investigation is incorporated into this PHA based on remedial actions and additional investigation data.

Environmental Contamination

An evaluation of site-related environmental contamination consists of a two tiered approach: 1) a screening analysis; and 2) a more in-depth analysis to determine public health implications of site-specific exposures. First, maximum concentrations of detected substances are compared to media-specific environmental guideline comparison values (CVs). If concentrations exceed the environmental guideline CV, these substances, referred to as Contaminants of Concern (COC), are selected for further evaluation. Contaminant levels above environmental guideline CVs do not mean that adverse health effects are likely, but that further evaluation is necessary. Once exposure doses are estimated, they are compared with health guideline CVs to determine the likelihood of adverse health effects.

Environmental Guideline Comparison

There are a number of CVs available for the screening environmental contaminants to identify COCs. These include ATSDR Environmental Media Evaluation Guides (EMEGs) and Reference Media Evaluation Guides (RMEGs). EMEGs are estimated contaminant concentrations that are not expected to result in adverse noncarcinogenic health effects. RMEGs represent the concentration in water or soil at which daily human exposure is unlikely to result in adverse noncarcinogenic effects. If the substance is a known or a probable carcinogen, ATSDR's Cancer Risk Evaluation Guides (CREGs) were also considered as comparison values. CREGs are estimated contaminant concentrations that would be expected to cause no more than one excess cancer in a million (10-6) persons exposed during their lifetime (70 years). In the absence of an ATSDR CV, other comparison values may be used to evaluate contaminant levels in environmental media. These include the NJDEP Residential Direct Contact Soil Cleanup

Criteria (RDCSCC); the New Jersey Maximum Contaminant Levels (NJMCLs) for drinking water; USEPA Region 3 Risk-Based Concentrations (RBCs) and NJDEP Indoor Air Screening Levels (IASL) for air. The NJDEP RDCSCC are based on human health impacts and also consider environmental impacts and natural background concentrations. For example, the RDCSCC for arsenic at 20 mg/kg is based on natural background concentrations within New Jersey and is, in comparison, higher than the CREG for arsenic at 0.5 mg/kg. RBCs are contaminant concentrations corresponding to a fixed level of risk (i.e., a Hazard Quotient of 1, or lifetime excess cancer risk of one in one million, whichever results in a lower contaminant concentration) in water, air, biota, and soil. Screening values for contaminants found in settled dust were obtained from EPA's World Trade Center Indoor Environment Assessment study (EPA 2003). These health-based benchmarks are derived from the evaluation of cancer and non-cancer effects using current toxicity criteria and, for settled dust, are weighted toward child exposures.

Substances exceeding applicable environmental guideline CVs were identified as COCs and evaluated further to determine whether these contaminants pose a health threat to exposed or potentially exposed receptor populations. If environmental guideline CVs are unavailable, these contaminants are selected for further evaluation.

North Brunswick Township High School Property

A summary of environmental contaminants present at the NBTHS property is provided based on information obtained from investigations conducted from July 2003 through March 2007.

<u>Soil</u>

Investigation of soil contamination present at the high school was initiated following the July 2003 discovery of buried waste material during construction activities for the high school expansion project. Soil investigations were conducted from July 2003 through February 2007 for the former "The Oval" area, the football field, and the general perimeter area of the high school.

Former "The Oval" and Areas Within Waste-Fill Boundary (NBTHS property)

Twenty-nine subsurface soil samples were collected from intervals within the 0.5 to 6 foot soil range within the waste-fill boundary on the high school property including the former "The Oval" area which was previously located on the southwest side of the high school (see Figure 2). Surface soil from the top six inches within "The Oval" was not sampled as the ground surface for this area was excavated from construction activities associated with the expansion project. Samples were analyzed for Priority Pollutant Metals, Priority Pollutant VOCs, Semi-Volatile Organic Compounds (including Phenolics), Polychlorinated Biphenyls (PCBs, Organochlorine Pesticides, and Total Petroleum Hydrocarbons. Two samples were also collected from excavated waste material from "The Oval" and analyzed for Toxicity Characteristic Leachate Procedure (TCLP) Metals to characterize for disposal purposes.

Based on maximum concentrations detected in subsurface soil, COCs include antimony, arsenic, cadmium, chromium, copper, lead, thallium, zinc, TCE, benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(g,h,i)perylene, benzo(k)fluoranthene, dibenzo(a,h)anthracene, indeno(1,2,3-cd)pyrene, and phenanthrene (see Table 1).

High School Building Perimeter and Areas Outside Waste-Fill Boundary (NBTHS property)

Soil samples were collected from twelve surface (0 to 0.5 foot) locations and nine subsurface (0.5 to 6 feet) locations in proximity to the high school building perimeter and outside the waste-fill boundary on the high school property (see Figure 3). Surface samples were analyzed for Priority Pollutant Metals. Subsurface samples were analyzed for Priority Pollutant Metals and Semi-Volatile Organic Compounds (SVOCs). Based on maximum concentrations detected in surface soil (0 to 0.5 foot) and subsurface soil (0.5 to 6 feet), arsenic is considered a COC (see Tables 2 and 3).

Football Field

Five surface soil samples (0 to 0.5 foot) were collected from the football field located to the north of the high school. Samples were analyzed for Priority Pollutant Metals. Based on maximum concentrations detected in surface soil, arsenic is considered a COC (see Table 4).

PSE&G Utility Easement Area

A summary of environmental contaminants present at the PSE&G utility easement along the western property boundary of the NBTHS property is provided based on investigations conducted in August through October 2003. Investigations were conducted to determine the horizontal and vertical extent of buried waste material discovered.

Four surface samples (0 to 0.5 foot) were collected from this easement area. Samples were analyzed for Priority Pollutant Metals. Based on maximum concentrations detected in surface soil, arsenic is considered a COC (see Table 5).

Nine subsurface soil samples were collected from various intervals within the 0.5 to 8.2 feet sample range. Samples were analyzed for Priority Pollutant Metals. Samples were analyzed for Priority Pollutant Metals, Priority Pollutant VOCs, SVOCs, phenolics, PCBs, organochlorine pesticides , and Total Petroleum Hydrocarbons.

Based on maximum concentrations detected in subsurface soil, COCs include antimony, arsenic, beryllium, cadmium, copper, lead, zinc, benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, and phenanthrene (see Table 6).

<u>Indoor Air</u>

Indoor air samples were collected on six occasions from April 2004 through December 2006. Indoor air samples were collected to determine whether groundwater VOC contamination was impacting the indoor air quality within the high school. Air samples were collected over a

24-hour period using SUMMA® canisters and analyzed for targeted VOCs including 1,2-dichloroethane, cis-1,2-dichloroethene, TCE and vinyl chloride using USEPA Method TO-15. These compounds were selected as their presence in contaminated groundwater were determined to be a potential source for vapor intrusion (G. Hunsberger, Kleinfelder, personal communication, April 2007).

Samples were collected from several areas including the faculty dining room, the former guidance office, girl's gym office, the main office storage area, Room 114, Room 103, Room 228, technical room, open area near Room 230, first floor common area, first floor cafeteria, and in the vicinity of a sump pit (orchestra area within new auditorium). Only TCE was detected in two samples at the former guidance office and near the orchestra sump pit at concentrations below the NJDEP Indoor Air Screening Level (IASL) of 3 micrograms per cubic meter ($\mu g/m^3$). Highlighting markers within the former guidance office were believed to be a potential source for this location. The markers were removed and indoor air of this room was re-sampled in July 2004 which indicated TCE was not detected. The presence of TCE near the orchestra sump pit likely present due to the infiltration of TCE contaminated groundwater within the sump. A remediation system was installed to treat the sump water prior to discharge to the county sewer system (G. Hunsberger, Kleinfelder, personal communication, April 2007). As of 2006, indoor air monitoring has been limited to one sample near the orchestra sump pit on a semi-annual basis. Following completion of the building addition in 2006, there have been no detections of TCE in indoor air at the location of the orchestra pit sump.

Analytical results indicated TCE was detected in indoor air above its respective environmental guideline CV. 1,2-Dichloroethane and vinyl chloride were not detected in indoor air; however, following ATSDR policy, one half of the reported analytical detection limits for these compounds were higher than their respective environmental guideline CVs (see Table 7). Therefore, 1,2-dichloroethane, TCE and vinyl chloride are considered COCs.

<u>Settled Dust</u>

On July 25, 2003 and November 8, 2005, 18 interior surface wipe samples were collected from window-sills and floors within the NBTHS to determine if site-related contaminants were present in settled dust. Samples were analyzed in accordance with ICP method SW486-6000s/7000s series for arsenic, cadmium, copper, lead and zinc. Results indicated the presence of arsenic, cadmium, lead, and zinc in settled dust (see Table 8). Results for copper and zinc were rejected due to the presence of these metals in the laboratory preparation blank. Based on a comparison to EPA's health-based benchmarks listed in the World Trade Center Indoor Environmental Assessment study, lead was detected in July 2003 at 25.2 $\mu g/ft^2$ - just above the screening value of 25$\mu g/ft^2$. The screening value for lead in dust was not exceeded in the November 2005 sample following remediation of "The Oval" area indicating that the removal of contaminated soil from this area and the practice of routine interior cleaning of the high school aided in reducing lead contamination in settled dust. Therefore, lead in settled dust is considered a COC for past exposures.

Judd Elementary School

A summary of environmental contaminants present at the Judd Elementary School property is provided based on investigations conducted in July 2003. Investigations were conducted at the school to determine if site-related contamination was present at this property.

Soil

On July 28, 2003, nine surface soil samples (0 to 0.5 feet) were collected from exposed soil locations and focused mostly on the east side of the school property towards Veteran's Park (G. Hunsberger, Kleinfelder, personal communication, May 2007). Samples were analyzed for Priority Pollutant Metals. Based on maximum concentrations detected in surface soil, arsenic is considered a COC (see Table 9).

Settled Dust

On July 25, 2003, 10 interior surface wipe samples were collected from the Judd Elementary School. The purpose of this investigation was to determine if site-related contaminants were present in settled dust on interior school surfaces. Samples were analyzed in accordance with ICP method SW486-6000s/7000s series for arsenic, cadmium, copper, lead and zinc. Results indicated detections of cadmium, copper, lead and zinc in settled dust were below the screening values for settled dust listed in EPA's World Trade Center Indoor Environmental Assessment study (see Table 10). Therefore, there are no COCs in settled dust for Judd Elementary School.

Veteran's Park

A summary of environmental contaminants present at Veteran's Park is provided based on information obtained from investigations conducted in August 2003 through April 2006. Investigations were conducted to determine the horizontal and vertical extent of buried waste material found at the NBTHS property.

Soil

A total of twenty-nine surface soil samples (0 to 0.5 foot) were collected mainly within the waste material area and analyzed for Priority Pollutant Metals and SVOCs. Based on maximum concentrations detected in surface soil, COCs include arsenic, lead, benzo(a)pyrene, benzo(g,h,i)perylene, and phenanthrene (see Table 11).

A total of eighty-two subsurface soil samples (0.5 to 5 feet) were collected mainly within the waste material area and analyzed for Priority Pollutant Metals, Priority Pollutant VOCs, SVOCs (including phenolics), PCBs, organochlorine pesticides, and Total Petroleum Hydrocarbons. Based on maximum concentrations detected in subsurface soil, COCs include arsenic, barium, cadmium, copper, lead, thallium, zinc, benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(g,h,i)perylene, benzo(k)fluoranthene, dibenzo(a,h)anthracene, indeno(1,2,3-cd)pyrene, and phenanthrene (see Table 12).

Block 143, Lots 94.01 and 95.01 (northern portion)

A summary of environmental contaminants present at the northern portion of Lots 94.01 and 95.01 bordering the south of Roosevelt Avenue is provided based on information obtained from investigations conducted in March 2005 through September 2006. Investigations were conducted to delineate the horizontal and vertical extent of buried waste material found at the NBTHS property.

Soil

A total of fifteen surface soil samples (0 to 0.5 foot) were collected and analyzed for Priority Pollutant Metals, SVOCs and PCBs. Based on maximum concentrations detected in surface soil, COCs include antimony, arsenic, barium, cadmium, chromium, copper, lead, nickel, zinc, acenaphthylene, benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(g,h,i)perylene, dibenzo(a,h)anthracene, phenanthrene, Aroclor 1254 and Aroclor 1260 (see Table 13).

A total of twenty-three subsurface soil samples (0.5 to 4.5 feet) were collected and analyzed for Priority Pollutant Metals, SVOCs and PCBs. Based on maximum concentrations detected in subsurface soil, COCs include antimony, arsenic, barium, cadmium, copper, lead, zinc, acenaphthylene, benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(g,h,i)perylene, dibenzo(a,h)anthracene, indeno(1,2,3-cd)pyrene, phenanthrene, and Aroclor 1260 (see Table 14).

Both lots are privately owned. Based on the discovery of the soil contamination on these properties, the Township of North Brunswick is in the process of purchasing a portion of the lots from the current owners. This purchase will encompass the contaminated areas along the northern portion of these lots. These contaminated areas are tentatively scheduled for remediation of surface soil contamination in the spring/summer of 2009 and will be capped and placed under separate NJDEP approved Deed Notices for each lot.

Groundwater (NBTHS/Veteran's Park/Nearby Residential Area)

Groundwater investigation is focused around the buried waste material area which is comprised of the former "The Oval" area of NBTHS, the PSE&G easement, the eastern portion of Veteran's Park and the nearby residential area to the south of the Roosevelt Avenue. The groundwater plume extends to the residential area to the south of the NBTHS. The general direction of groundwater flow is toward the south. A summary of environmental contaminants present in groundwater is provided based on analytical results from samples collected from October 2003 through March 2007.

Three grab groundwater samples were collected on October 15, 2003 from locations within the waste material area. Samples were analyzed for Priority Pollutant Metals, Priority

Pollutant VOCs, SVOCs (including phenolics), PCBs, organochlorine pesticides , and Total Petroleum Hydrocarbons.

Groundwater samples were collected from July 2004 through March 2007 from 17 groundwater monitoring wells located within the investigation area as part of the quarterly groundwater monitoring program overseen by NJDEP. Based on groundwater sampling data and well location, the groundwater table varies from approximately 5 to 13 feet below ground surface. Groundwater samples were analyzed for VOCs plus 10 non-target compounds (VOC+10), and total/dissolved metals for antimony, arsenic, barium, copper, lead, nickel, thallium and zinc.

Based on maximum concentrations detected in groundwater from grab sampling and monitoring wells, COCs include antimony, arsenic, cadmium, chromium, copper, lead, mercury, nickel, thallium, zinc, benzene, 1,2-dichloroethane, 1,1-dichloroethene, tetrachloroethylene (PCE), TCE, and vinyl chloride (see Tables 15 and 16). The predominant contaminant in groundwater is TCE as depicted in the isopleth map in Figure 9.

Nearby Residential Area

A summary of environmental contaminants detected in surface soil, household dust, basement sump water, and indoor air for the nearby residential area is based on recent remedial actions and environmental data. The current investigation area includes a total of six residences (identified as *residences A through F*) based on the extent of TCE contamination in groundwater.

Surface Soil

Surface soil (0 – 0.5 foot depth) samples collected in 2003 and 2004 from three residences (A, B, and C) in the vicinity of the NBTHS indicated arsenic concentrations ranging from 1.9 to 150 mg/kg (see Appendix A). In the autumn of 2004, contaminated soil at all three residences was removed to below the NJDEP RDCSCC of 20 mg/kg for arsenic and the excavated areas backfilled with certified clean fill. Therefore, arsenic in surface soil is no longer considered a COC for the residential area.

Household Dust

Nine dust wipe samples were collected from the indoor surfaces residences A, B, and C in 2004. Arsenic was detected in residence A at concentrations ranging from not detected to 53.6 micrograms of arsenic per square foot (μg/ft^2) of surface tested. The ATSDR and NJDHSS recommended remediation of arsenic-contaminated dust within this residence to reduce the exposure potential for incidental ingestion of dust to children. In April 2005, a Lindhaus HEPA Filtration Vacuum System was used to clean various surfaces in the house. In May 2005, nine wipe samples were collected within the home on the same surfaces previously sampled. Arsenic concentrations for eight samples were non-detect to 7.0μg/ft^2. One wipe sample collected from the basement floor (beneath the stairs) exhibited an arsenic concentration of 21 μg/ft^2 exceeding NJDEP's proposed 1996 clean-up standard of 20.4 μg/ft^2 for arsenic. This area was re-cleaned and re-sampled with results indicating an arsenic concentration of 2.4μg/ft^2. As arsenic concentrations in dust are below the current recommended screening value of 36 µg/ft^2 (EPA 2003), arsenic is no longer considered a COC for residence A.

Sump Water/Groundwater

Groundwater delineation of volatile organic contamination (primarily TCE) indicates that the TCE plume in groundwater extends to the nearby residential area at concentrations ranging from non-detect to 2,580 micrograms per liter (µg/L) (see Figure 9). The general direction of groundwater flow is toward the south. Based on delineation results, three additional residences (Residences D, E and F) have been included in the residential investigation to determine if groundwater contamination is impacting indoor air quality within the homes.

Water samples were collected from the basement sumps of residences A through F within the period of 2004 through 2006. TCE was detected in four of the six sumps at concentrations ranging from 4 to 140 micrograms of TCE per liter of water (µg/L). The latest TCE concentrations in groundwater for the December 2006 sampling event ranged from non-detect to 9.4 µg/L. As there are no other known or identified sources of TCE at the residences, the presence of TCE in the sump water suggests TCE contamination in groundwater has infiltrated into the sumps. The NJDEP Groundwater Quality Criteria for TCE is 1 µg/L. Following completion of soil remedial activities in the autumn of 2004, the highest concentration of TCE in sump water at residence A showed a concentration reduction from 140 µg/L to 1.4 µg/L as of December 2006.

Based on analytical results, TCE in groundwater is considered a COC for the residential investigation area.

Indoor Air

Indoor air samples have been collected in the basement area from the six residences. Following remedial actions for the residential sump pits, sampling has been conducted from June 2004 through June 2007. Results indicate that TCE was detected in five of the six residences with one residence at a concentration above the NJDEP Indoor Air Screening Level (IASL) of 3 µg/m^3.

Other VOCs have been detected in all six residences and may be associated with the interior use and storage of gasoline and/or cleaning products.

Although TCE was not detected in residence F, following ATSDR policy, one half of the reported analytical detection limit for TCE (0.55 µg/m^3) was higher than its respective environmental guideline CV. Based on analytical results, as TCE exceeds the EPA Risk-Based Concentration of 0.016 µg/m^3, it is considered a COC in indoor air for all six residences. Indoor air sample results are summarized below:

Indoor Air TCE Concentrations				
Residence	Number of Samples	Range of TCE Concentrations ($\mu g/m^3$)*	Last Round TCE Concentrations ($\mu g/m^3$)	Environmental Guideline Comparison Values ($\mu g/m^3$)
A	3	ND – 0.75J	ND	3 (a) 0.016 (b)
B	4	ND – 0.42J	ND	
C	3	ND – 0.32J	ND	
D	2	2.2 – 6.5	6.5	
E	1	ND - 2.4	ND	
F	1	ND (<1.1) (c)	ND	

(a) - NJDEP Indoor Air Screening Value
(b) - United States Environmental Protection Agency (EPA) - Region 3 Risk-Based Concentration
(c) - Method detection limit in parenthesis. Reportable concentration = 0.55 $\mu g/m^3$.
*micrograms of TCE per cubic meter of air
J = estimated value

Summary of Contaminants of Concern

A summary of the COCs is provided by investigation area.

North Brunswick High School Property		
Former "The Oval" and Areas within Waste-Fill Boundary - Subsurface Soil (>0.5 feet)		
Metals	VOCs	Other Compounds
Antimony, Arsenic, Cadmium, Chromium, Copper, Lead, Thallium, Zinc	TCE	Benzo(a)anthracene, Benzo(a)pyrene, Benzo(b)fluoranthene, Benzo(g,h,i)perylene, Benzo(k)fluoranthene, Dibenzo(a,h)anthracene, Indeno(1,2,3-c,d)pyrene, Phenanthrene
High School Building Perimeter and Areas Outside Waste-Fill Boundary; Football Field - Surface Soil (0-0.5 feet)		
Metals		
Arsenic		
High School Building Perimeter and Areas Outside Waste-Fill Boundary - Subsurface Soil (>0.5 feet)		
Metals		
Arsenic		
Indoor Air		
VOCs		
1,2-Dichloroethane, TCE, Vinyl Chloride		
Settled Dust		
Metals		
Lead		

PSE&G Utility Easement	
Surface Soil (0-0.5 feet)	
Metals	
Arsenic	
Subsurface Soil (>0.5 feet)	
Metals	Other Compounds
Antimony, Arsenic, Beryllium, Cadmium, Copper, Lead, Zinc	Benzo(a)anthracene, Benzo(a)pyrene, Benzo(b)fluoranthene, Phenanthrene
Judd Elementary School	
Surface Soil (0-0.5 feet)	
Metals	
Arsenic	
Veteran's Park	
Surface Soil (0-0.5 feet)	
Metals	Other Compounds
Arsenic, Lead	Benzo(a)pyrene, Benzo(g,h,i)perylene, Phenanthrene
Subsurface Soil (>0.5 feet)	
Metals	Other Compounds
Arsenic, Barium, Cadmium, Copper, Lead, Thallium, Zinc	Benzo(a)anthracene, Benzo(a)pyrene, Benzo(b)fluoranthene, Benzo(g,h,i)perylene, Benzo(k)fluoranthene, Dibenzo(a,h)anthracene, Indeno(1,2,3-c,d)pyrene, Phenanthrene
Block 143, Lots 94.01 and 95.01 (northern portion)	
Surface Soil (0-0.5 feet)	
Metals	Other Compounds
Antimony, Arsenic, Barium, Cadmium, Chromium, Copper, Lead, Nickel, Zinc	Aroclor 1254, Aroclor 1260, Acenaphthlene, Benzo(a)anthracene, Benzo(a)pyrene, Benzo(b)fluoranthene, Benzo(g,h,i)perylene, Dibenzo(a,h)anthracene, Phenanthrene
Subsurface Soil (0.5-4.5feet)	
Metals	Other Compounds
Antimony, Arsenic, Barium, Cadmium, Copper, Lead, Zinc	Aroclor 1260, Acenaphthlene, Benzo(a)anthracene, Benzo(a)pyrene, Benzo(b)fluoranthene, Benzo(g,h,i)perylene, Dibenzo(a,h)anthracene, Indeno(1,2,3-c,d)pyrene, Phenanthrene
NBTHS/Veteran's Park/Nearby Residential Area	
Groundwater	
Metals	VOCs
Antimony, Arsenic, Cadmium, Chromium, Copper, Lead, Mercury, Nickel, Thallium, Zinc	Benzene, 1,2-Dichloroethane, 1,1-Dichloroethene, PCE, TCE, Vinyl Chloride
Nearby Residential Area	
Indoor Air	
VOCs	
TCE	

Discussion

The method for assessing whether a health hazard exists to a community is to determine whether there is a completed exposure pathway from a contaminant source to a receptor population and whether exposures to contamination are high enough to be of health concern. Site-specific exposure doses can be calculated and compared with health guideline CVs.

Assessment Methodology

An exposure pathway is a series of steps starting with the release of a contaminant in environmental media and ending at the interface with the human body. A completed exposure pathway consists of five elements:

1. source of contamination;
2. environmental media and transport mechanisms;
3. point of exposure;
4. route of exposure; and
5. receptor population.

Generally, the ATSDR considers three exposure categories: 1) completed exposure pathways, that is, all five elements of a pathway are present; 2) potential exposure pathways, that is, one or more of the elements may not be present, but information is insufficient to eliminate or exclude the element; and 3) eliminated exposure pathways, that is, one or more of the elements is absent. Exposure pathways are used to evaluate specific ways in which people were, are, or will be exposed to environmental contamination in the past, present, and future.

The exposure pathways for the identified areas of concern include children and adults comprising the school student, school employee and area resident population associated with NBTHS, Judd Elementary School, and Veteran's Park. As Veteran's Park and the PSE&G easement properties are a contiguous grass-covered area, it is plausible that daily park usage by area residents may have inadvertently included the easement area. Therefore, these two properties have been grouped together as one exposure location. The evaluated exposure pathways for site-related contaminants are presented in Table 17.

Completed Exposure Pathways

<u>Ingestion of contaminated surface soils (past, present, future).</u> There is a completed exposure pathway regarding ingestion of contaminated surface soil (0 - 0.5 foot) for the NBTHS (school building perimeter including areas outside the waste-fill boundary and football field areas), Judd Elementary School, and Veteran's Park/PSE&G easement properties. As there are multiple exposure locations, the time-frame regarding past, present, and/or future exposures is dependent on the exposure location (see Table 17). Exposed individuals include students (children) and adult faculty at Judd Elementary School; students (adult) and adult faculty at the NBTHS; and area residents (children and adults) using Veteran's Park.

It is noted that arsenic concentrations in soil outside the waste-fill boundary are likely present due to natural background levels and not associated with historic landfill activities. The NJDEP RDCSCC for arsenic is 20 mg/Kg which is based on natural background concentrations. However, if a contaminant exceeds an Environmental Guideline CV it is established as a COC and is considered for further evaluation regardless of the locations from which environmental samples are collected, in this case from areas outside the waste-fill boundary. Judd Elementary School, the majority of the NBTHS building perimeter, and the NBTHS football field are outside the waste-fill boundary area (see Figure 3).

It is further noted that exposures were not assessed prior to the development of Veteran's Park as there is no environmental data to characterize surface soil when the area was operated as a landfill. As there are no environmental data for the period prior to 1967, potential exposures cannot be quantified.

Ingestion of contaminated settled dust (past). For the past, there is a completed exposure pathway regarding incidental ingestion of lead contaminated dust. Exposed individuals include students and adult faculty at the NBTHS.

Inhalation of TCE in indoor air at residences (past). For the past, there is a completed exposure pathway regarding the inhalation of indoor air contaminated with TCE for the six residences sampled. It is noted, however, that while concentrations of TCE were not detected for residence F it could not be excluded as a completed exposure pathway as ½ of the analytical detection limit for the sample from this residence exceeded the environmental guideline CV. The pathway involves TCE vapors migrating upwards through contaminated subsurface media and entering the indoor air of these residences where TCE contaminated air is inhaled.

Potential Pathways

Ingestion of contaminated surface soils at NBTHS "The Oval" (past). As this area contained high concentrations of several subsurface soil contaminates prior to remediation initiated in July 2003. No surface soil samples were collected from this area, thus, a completed exposure pathway cannot be determined as ATSDR considers the top three inches of soil the direct contact layer for incidental ingestion of soil. Since this area was used for high school activities prior to remediation, potential past exposures to students and faculty have been interpreted using subsurface contaminant concentrations to offer the reader a tentative evaluation of this area. Therefore, the reader is cautioned that the interpretation of past exposures for this area is not evidence-based due to the lack of surface soil data and, therefore, cannot be construed as a completed exposure pathway.

Ingestion of contaminated surface soils at Block 143, Lots 94.01 and 95.01 (past, present, future). There is a potential exposure pathway regarding ingestion of surface soil (0 – 0.5 foot) for these lots. Access to these lots is considered limited as these areas are heavily overgrown (past and present) with portions designated as wetland areas (Kleinfelder 2007). Therefore, as there is no intended recreational or other use of these areas which would support frequent ground surface contact by the public, potential exposures within these areas are assumed to be very limited or not occurring and are not considered to be a completed exposure pathway.

Inhalation of TCE in indoor air at NBTHS (past). For the past, there is a potential exposure pathway regarding the inhalation of air contaminated with TCE, 1,2-dichloroethane and vinyl chloride. Although 1,2-dichloroethane and vinyl chloride were not detected, the detection limits for these compounds exceeded their respective environmental CVs. The potential exposure pathway involves these contaminant vapors migrating upwards through contaminated subsurface media and entering the interior of the NBTHS where the contaminated air is inhaled. The detection of TCE in indoor air at the guidance office was likely due to the presence of highlighting markers at this location. The detection of TCE in indoor air at the orchestra sump pit was prior to the completion of the building addition where the sump is located. Following completion of the building addition in 2006, there have been no detections of TCE in indoor air at the sump location, thus, no completed exposures to students or faculty regarding indoor air contaminants are known to exist for this area.

Eliminated Pathways

Ingestion of contaminated subsurface soils (past, present, future). ATSDR considers the top three inches of soil as the direct contact layer for incidental ingestion of soil. As such, subsurface contaminants present at depths greater than 6 inches (0.5 foot) are not considered a direct contact exposure hazard. Therefore, there are no completed exposures for the NBTHS, the PSE&G easement, Veteran's Park, and the northern portion of Block 143, Lots 94.01 and 95.01 concerning subsurface soils.

Ingestion of groundwater (past, present, future). According to information obtained from a groundwater well search (Kleinfelder 2007), the NJDEP has verified five domestic wells are located 0.4 to 0.5 mile downgradient from site. A visual inspection of the area during investigation activities did not disclosed the presence of four of the five wells. These four wells (installed 1952 through 1959) were likely destroyed during commercial development of the area. The commercial properties at these locations have been verified to be connected to the public supplied water system (G. Hunsberger, Kleinfelder, personal communication, October 2008). Additionally, documentation indicates that city water was supplied during the development of the area in the early 1960s (Powell-Harpstead 2003).

One domestic well remains approximately 0.5 mile from the site at the time of the June 2007 Remedial Investigation Report was issued. The depth and install date of this well has not been confirmed. Groundwater investigation activities indicate contaminants in groundwater have been delineated to the area near the NBTHS and do not extend to this well location (G. Hunsberger, Kleinfelder, personal communication, October 2008). As such, there were no completed exposures via this pathway for the five domestic wells.

Public Health Implications of Completed Exposure Pathways

Once it has been determined that individuals have or are likely to come in contact with site-related contaminants (i.e., a completed exposure pathway), the next step in the public health assessment process is the calculation of site-specific exposure doses. This is called a health guideline comparison which involves looking more closely at site-specific exposure conditions, the estimation of exposure doses, and comparison to health guideline CVs. Health guideline CVs are based on data drawn from the epidemiologic and toxicologic literature and often include uncertainty or safety factors to ensure that they are amply protective of human health.

The maximum and average contaminants concentrations detected in surface soil, settled dust, and indoor air were used to assess the risk of non-cancer and cancer health effects to the exposed population. ATSDR considers the top three inches of soil the contact layer for incidental soil ingestion exposure. NJDEP requires a soil sample to be collected in a 6-inch interval; therefore, soil samples collected from the top six inches of soil was used to assess incidental soil ingestion exposure. Toxicological summaries for the contaminants evaluated in this section are provided in Appendix C.

Non-Cancer Health Effects

To assess non-cancer health effects, ATSDR has developed Minimal Risk Levels (MRLs) for contaminants that are commonly found at hazardous waste sites. An MRL is an estimate of the daily human exposure to a hazardous substance at or below which that substance is unlikely to pose a measurable risk of adverse, non-cancer health effects. MRLs are developed for a route of exposure, i.e., ingestion or inhalation, over a specified time period, e.g., acute (less than 14 days); intermediate (15-364 days); and chronic (365 days or more).

When MRLs for specific contaminants are unavailable, other health based comparison values such as the USEPA's Reference Dose (RfD) and Reference Concentrations (RfC) are used. The RfD is an estimate of a daily oral exposure and the RfC is an estimate of a daily inhalation exposure to the human population (including sensitive subgroups) that is likely to be without an appreciable risk of deleterious effects during a lifetime of exposure.

Incidental Ingestion of Soil – NBTHS

Contaminated surface soil for the NBTHS property has been identified at the football field and unpaved surfaces surrounding the perimeter of the high school.

Due to the absence of surface soil data for the former "The Oval" area, a completed exposure pathway cannot be determined. However, as students and faculty frequently used this area in the past, potential exposures to this group have been interpreted for this area as explained later in this section.

Exposures for the former “The Oval” area, the football field and unpaved areas are based on incidental ingestion of contaminated soil during high school related activities. Non-cancer exposure doses were calculated using the following formula:

$$\textit{Exposure Dose (mg/kg/day)} = \frac{C \times IR \times EF}{BW}$$

where, mg/kg/day = milligrams of contaminant per kilogram of body weight per day;
C = concentration of contaminant in surface soil (mg/kg);
IR = soil ingestion rate (kg/day);
EF = exposure factor representing the site-specific exposure scenario; and,
BW = body weight (kg)

The following site-specific exposure assumptions (USEPA 1997) were used to calculate past contaminant doses to NBTHS students and faculty. The exposure assumptions are based on information provided in background documentation and discussion with NBTHS faculty. The exposure period is conservatively estimated to include daily exposure for the entire school year for both students and faculty.

Exposed Population	**Body Weight**	**Ingestion Rate**	**Exposure Assumptions**	**Number of Years Exposed**
Student (14 to 18 years old)	67	100 mg/day	5 days per week 36 weeks per year	4 [a,b]
Adult Faculty	70			30 [a] 40 [b]

(a) Past exposures from former “The Oval” area used from 1972 through 2002. Area was under expansion activities and remedial investigation by July 2003.
(b) For unpaved school property areas and football field where remaining contaminants are below regulatory cleanup levels. Faculty exposure based on an approximated maximum term of employment at school.

Former “The Oval” Area and Area Within the Waste-Fill Boundary (NBTHS Property)

Based on background documentation and discussion with NBTHS faculty, “The Oval” area was frequently used in the past by NBTHS students and faculty for soccer practice, marching band practice and for outside school social events (i.e., Carnival). Surface soil samples were not collected since this area had been partially excavated to a depth of approximately 1 to 2 feet below the surface during construction activities in July 2003 (G. Hunsberger, Kleinfelder, personal communication, April 2007). ATSDR considers the top three inches of soil as the contact layer for soil ingestion exposures. Since this area was used for high school activities prior to remediation, potential past exposures to students and faculty have been interpreted using subsurface contaminant concentrations to offer the reader a tentative evaluation of this area. Therefore, the reader is cautioned that the interpretation of past exposures for this area is not evidence-based due to the lack of surface soil data; there are no completed exposure pathways for this area.

Arsenic. Arsenic is a naturally occurring element. A few of its uses include as a wood preservative (inorganic form) and as a pesticide (organic form). As it has been documented that the area was historically used as a municipal dump which received pharmaceutical/laboratory research wastes, elevated concentrations of arsenic in soil within the waste-fill area are presumed to have originated from the landfilled wastes. Inorganic arsenic has been historically used in the development of pharmaceuticals and as part of cancer treatment therapy. Arsenic was a constituent in Fowler solution, containing 1% potassium arsenite, which was a commonly used for treatment of psoriasis. Arsphenamine was historically used for as a standard treatment for syphilis. By the mid-1990s, the medicinal use of arsenic was limited primarily for the treatment of trypanosomiasis. The decline in the medicinal use of arsenic in the past 100 years is due to concerns about the toxicity and potential carcinogenicity of chronic arsenic therapy.

Long-term (chronic) exposure to low levels of inorganic arsenic can cause a “darkening of the skin and the appearance of small "corns" or "warts" on the palms, soles, and torso” (ATSDR 2001). Dermal (skin) contact with inorganic arsenic may cause redness and swelling. Organic arsenic compounds are considered less toxic than inorganic arsenic compounds’ however, at high doses, the health effects may be similar. The chronic MRL for arsenic (0.0003 mg/kg/day) is based on the health endpoint of skin lesions developed in farmers exposed to arsenic contaminated well water (ATSDR 2000).

Based on the maximum concentration of arsenic detected in soil, the potential chronic exposure dose calculated for students and adult faculty (i.e., 0.0027 mg/kg/day and 0.0025) exceeded the ATSDR MRL of 0.0003 mg/kg/day (see Table 18). The calculated student and adult exposure doses are about 3.4 and 3.1 times higher than the no observable adverse effect level (NOAEL) of 0.0008 mg/kg/day, respectively. However, based on the average concentration of arsenic detected (more likely exposure scenario), the calculated chronic exposure doses for students and adult faculty were lower than the NOAEL. As such, non-cancer adverse health effects for students or faculty associated with past exposures to arsenic detected in this area is not expected.

Lead. Lead is a naturally occurring bluish-gray metal found in small amounts in the earth’s crust. Lead is used in various products such as solder, paint, plastics, some brass and bronze products, ceramic glazes, automobile batteries and firearm ammunition. Due to its ability to cause adverse health effects in humans, its use in the U.S. has been reduced in recent years. Accumulation of lead in the body can cause damage to the nervous or gastrointestinal system, kidneys, or red blood cells (ATSDR 2006). Children, infants, and fetuses are the most sensitive populations. In adults, exposure to lead may decrease reaction times, cause weakness in fingers, wrists or and ankles, and possibly affect memory. Lead may also cause anemia and damage the male reproductive system.

The USEPA Adult Lead Methodology was used to provide a more specific assessment of past exposures based on existing lead data and exposures during the course of a standard 182-day school year. Based on the average concentration of lead in soil, an estimated geometric mean blood lead level of 2.3 µg/dL was calculated for potential exposures to students and adult faculty. The calculated 95^{th} percentile blood lead levels among fetuses of adult faculty was 7.1 µg/dL. The probabilities of fetal blood lead levels exceeding 10 µg/dL was 1.8 percent (USEPA 2003b).

Based on the adult lead methodology, the potential for adverse health effects associated with potential past exposures to lead contaminated soil for this area are not expected to have occurred to students and adult faculty.

Polycyclic Aromatic Hydrocarbons (PAHs). Benzo[a]anthracene, benzo[a]pyrene, benzo[b]fluoranthene, benzo[g,h,i]perylene, benzo[k]fluoranthene, dibenzo(a,h)anthracene, indeno(1,2,3-c,d)pyrene and phenanthrene have been detected in soils within "The Oval" area. These contaminants are a fraction of compounds termed PAHs and fall within the broad spectrum of SVOCs. PAHs are in a class of over 100 compounds and are formed as a result of incomplete combustion of coal, oil, wood and other organic materials. More commonly they are found in petroleum-based products such as coal tar, asphalt, creosote, and roofing tar. In the environment, PAHs are found as complex mixtures of compounds, and many have similar toxicological effects and environmental fate. Because they are produced by combustion processes, PAHs are widespread in the environment. Benzo[a]pyrene and dibenzo(a,h)anthracene are considered the most toxic forms of PAH to humans (ATSDR 1995).

There are no studies available establishing non-cancer health effects based on chronic exposures to PAH compounds. Based on available animal studies, a lowest observable adverse effect level (LOAEL) for intermediate exposures has been established for three PAH compounds (ATSDR 1995). The LOAEL is based on an increased liver weight in mice for the following compounds: acenaphthylene (175 mg/kg/day); fluoranthene (125 mg/kg/day); and fluorene (125 mg/kg/day). Based on available animal studies, a NOAEL based on intermediate exposures has been established for anthracene at 1,000 mg/kg/day (ATSDR 1995).

Based on the maximum concentration of all PAH compounds detected in soil for "The Oval" area, the highest exposure dose was calculated for students at 0.00000414 mg/kg/day for phenanthrene (see Table 18). As the calculated potential chronic exposure doses for students and adult faculty were at least 30 million times lower than the established LOAELs, non-cancer adverse health effects for students or faculty associated with potential past exposure to PAH compounds detected in the soil for this area are not expected.

Remaining Soil COCs. Exposure doses calculated for antimony, cadmium, chromium, copper, thallium, TCE, and zinc compared to health guideline CVs indicated non-cancer adverse health effects associated with potential past exposures to these contaminants in soil for the former "The Oval" area are not expected. A brief toxicological description of these COCs is provided below.

Antimony**.** Ingesting large doses of antimony can cause vomiting. Long-term chronic animal studies have also reported liver damage and blood changes. Although information on the toxic effects of chronic oral exposure to antimony is limited, antimony appears to affect heart muscle, the gastrointestinal tract, and the nervous system. The chronic oral RfD for antimony (0.0004 mg/kg/day) is based on reduced longevity, blood glucose, and altered cholesterol levels of a group of male and female rats in an oral bioassay study. A LOAEL of 0.35 mg/kg/day and an uncertainty factor of 1,000 were used to calculate the oral RfD (ATSDR 1992a).

Cadmium. Ingestion of very high levels of cadmium severely irritates the stomach, leading to vomiting and diarrhea. Long-term low level exposures leads to a buildup of cadmium in the kidneys and possible kidney disease. Other long-term effects include lung damage and fragile bones. In animal studies, high blood pressure, iron-poor blood, liver disease, and nerve or brain damage were reported. The chronic oral MRL for cadmium (0.0002 mg/kg/day) is based on the extent renal damage (i.e., proteinureia) to a group of cadmium exposed residents. Mean cadmium concentration in locally produced rice was used to assess exposures and urinary β-microglobulinuria was used as the index of renal damage. A NOAEL of 0.0021 mg/kg/day and an uncertainty factor of 10 were used to calculate the chronic oral MRL (ATSDR 1999c).

Chromium. Chromium is a naturally occurring element found in rocks, animals, plants, soil, and in volcanic dust and gases. Chromium is present in the environment in several different forms, which are chromium(0), chromium(III), and chromium(VI). No taste or odor is associated with chromium compounds. The metal chromium, which is the chromium(0) form, is used for making steel. Chromium(VI) and chromium(III) are used for chrome plating, dyes and pigments, leather tanning, and wood preserving. A chronic oral MRL is unavailable for chromium. The chronic oral RfD for hexavalent chromium (0.003 mg/kg/day) is based on decreased water consumption in rats (USEPA 2005e). An uncertainty factor of 900 and a NOAEL of 2.5 mg/kg/day were used to calculate the RfD (ATSDR 2000b).

Copper. Ingesting high levels of copper can cause nausea, vomiting, and diarrhea while at very-high doses of copper can cause damage to liver and kidneys. Chronic oral MRL for copper is unavailable. However, the intermediate oral MRL for copper (0.01 mg/kg/day) is available; the intermediate MRL is based on gastrointestinal effect in a group of men and women. An uncertainty factor of 3 and a NOAEL (i.e., the dose that showed no adverse health effect) of 0.042 mg/kg/day were used to calculate the intermediate MRL (ATSDR 2004a).

Thallium. Thallium is a bluish-white metal that is found in trace amounts in the earth's crust. It is used mostly in manufacturing electronic devices, switches, and closures, primarily for the semiconductor industry. Exposure to high levels of thallium can result in harmful health effects of the nervous system effects, such as numbness of fingers and toes, from breathing thallium. Studies in people who ingested large amounts of thallium over a short time have reported vomiting, diarrhea, temporary hair loss, and effects on the nervous system, lungs, heart, liver, and kidneys. The chronic oral RfD for thallium (0.00009 mg/kg/day) is based on a 90-day sub-chronic study of consumption of an aqueous solution of thallium sulfate in rats. An uncertainty factor of 3,000 and a NOAEL of 0.25 mg/kg/day were used to calculate the RfD (USEPA 1986e).

Zinc. Zinc is a naturally occurring element and has many commercial uses as coatings to prevent rust, in dry cell batteries, and mixed with other metals to make alloys like brass, and bronze. Acute health effects associated with ingesting large doses are stomach cramps, nausea, and vomiting. Low level chronic exposures to zinc can cause anemia and decrease the levels of good cholesterol. The intermediate and chronic oral MRL of 0.3 mg/kg/day is based on hematological effects, specifically decreases in erythrocyte superoxide dismutase activity, serum ferritin, and hematocrit, in women given daily supplements of 50 mg zinc as zinc gluconate for 10 weeks.

High School Building Perimeter and Areas Outside the Waste-Fill Boundary; Football Field

Arsenic. Based on the maximum concentration of arsenic detected in surface soil for these areas, the chronic exposure dose calculated for students and adult faculty (i.e., 0.0000081 mg/kg/day and 0.0000078, respectively) did not exceed the ATSDR MRL of 0.0003 mg/kg/day (see Table 19). As such, non-cancer adverse health effects for students or faculty associated with exposure to arsenic detected in the soil for these areas are not expected.

It is noted that arsenic concentrations in soil outside the waste-fill boundary are likely present due to natural background levels and not associated with historic landfill activities. The NJDEP RDCSCC for arsenic is 20 mg/Kg which is based on natural background concentrations.

Incidental Ingestion of Settled Dust – NBTHS

Results of wipe samples collected on July 25, 2003, indicated the presence of lead in settled dust on the floors within the NBTHS exceeding environmental CVs. Results of wipe samples collected on November 8, 2005, following soil remedial activities for “The Oval” area of the high school property indicated no contaminants were present in settled dust above their respective environmental CVs. Dust concentrations on window-sills and floors were assumed to be the same for surfaces frequently contacted by students and faculty (i.e. desks, chairs, etc.).

Lead. The U.S. EPA has set a health-based benchmark for lead in interior dust at 25 $\mu g/ft^2$ per the World Trade Center Indoor Environment Assessment study (EPA 2003). This screening value is considered to be protective of human health, particularly children. The maximum lead levels in dust for interior floors (25.2 $\mu g/ft^2$) within NBTHS during the July 2003 sampling event slightly exceeded the lead screening value (see Table 8). As the lead screening value is based on child exposures (aged 0 through 7 years), exposures for high school students and faculty are considered to be much lower given that hand-to-mouth activity associated with incidental ingestion of lead dust is much less for this exposed group than for children. Lead dust concentrations were below the screening value in the following November 2005 sampling event which may be attributed to routine interior cleaning activities and the remediation of “The Oval” area. Therefore, non-cancer adverse health effects associated with past incidental ingestion of lead contaminated dust are not expected to have occurred for students and faculty at NBTHS.

Incidental Ingestion of Soil – Judd Elementary School

Judd Elementary School is a public school for area children attending kindergarten through 5th grade. Exposures areas are based on incidental ingestion of contaminated surface soil during outdoor school related activities. Areas of concern are the unpaved surfaces on the school property. Non-cancer exposure doses were calculated using the same ingestion exposure formula used for NBTHS.

The following site-specific exposure assumptions (USEPA 1997) were used to calculate past contaminant doses to students (children) and school faculty. The exposure period is based on information provided in background documentation for the school as follows:

Exposed Population	Body Weight	Ingestion Rate	Exposure Assumptions	Number of Years Exposed
Student (5 to 11 years old)	29.21	200 mg/day	5 days per week 36 weeks per year	6 [a]
Adult Faculty	70	100 mg/day		40 [a,b]

(a) For property areas where contaminants are below the regulatory cleanup levels.
(b) Based on an approximated maximum term of employment at school.

Arsenic. Based on the maximum concentration of arsenic detected in surface soil for the unpaved areas of the property, the chronic exposure dose calculated for child students and adult faculty (i.e., 0.000024 mg/kg/day and 0.000005 mg/kg/day, respectively) did not exceed the ATSDR MRL of 0.0003 mg/kg/day (see Table 20). As such, non-cancer adverse health effects associated with exposure to arsenic detected in the soil for the unpaved portions of the school property are not expected.

Incidental Ingestion of Soil – Veteran's Park/PSE&G Easement

Based on background documentation and discussion with NBTHS faculty, Veteran's Park has been used for recreational purposes since approximately 1967. Contaminated surface soil for Veteran's Park is mainly along the eastern half of the park in the location of the waste-fill area (see Figure 3). Since access to the easement area has been unrestricted and it is contiguous with Veteran's Park, exposure assumptions for recreational use of the park area includes the grass-covered easement area. A use restriction has been in-place for the eastern portion of Veteran's Park upon discovery of surface soil contamination according to discussions with North Brunswick Township representatives during the October 2005 site visit. Exposures for the three areas are based on incidental ingestion of contaminated surface soil during recreational use. Non-cancer exposure doses were calculated using the same ingestion exposure formula for NBTHS.

Site-specific exposure assumptions (USEPA 1997) were used to calculate past contaminant doses to area residents, including children and adults as follows:

Exposed Population	Body Weight	Ingestion Rate	Exposure Assumptions	Number of Years Exposed
Child	21	200 mg/day	3 days per week 26 weeks per year	10
Adult	70	100 mg/day		38 [a]

(a) Based on the time period the park has been open for public use: 1967 though 2005.

Arsenic. Based on the maximum concentration of arsenic detected in surface soil for Veteran's Park, the chronic exposure dose calculated for children and adults (i.e., 0.0000754 and 0.0000113 mg/kg/day, respectively) did not exceed the ATSDR chronic MRL of 0.0003 mg/kg/day (see Table 21). Therefore, non-cancer adverse health effects associated with exposure to arsenic detected in soil at Veteran's Park are not expected.

Lead. The maximum concentration of lead detected in surface soil for the park area (1,640 mg/kg) exceeded the NJDEP RDCSCC of 400 mg/kg; however, the average concentration (the more likely scenario) of 108 mg/kg was below the NJDEP RDCSCC. Therefore, the potential for adverse health effects associated with exposure to lead detected in the surface soil at Veteran's Park are not expected.

Lead exposures regarding incidential ingestion of surface soil associated with the recreational use of Veteran's Park were evaluated for children using the USEPA's IEUBK model (USEPA 1994b).

The Integrated Exposure Uptake Biokenetic (IEUBK) model estimates a plausible distribution of blood lead levels centered on the geometric mean blood lead levels from available exposure information. Blood lead levels are indicators of exposure, and are also the most widely used index of internal lead body burdens associated with potential health effects. The model also calculates the probability (or P_{10}) that children's blood lead levels will exceed a level of concern. Health effects of concern have been determined to be associated with childhood blood lead levels at 10 micrograms of lead per deciliter of blood (or µg/dL) or less (USEPA 1986; CDC 1991). In using the IUEBK model, the USEPA recommends that the lead concentration in site soil does not result in a 5% probability of exceeding a blood lead concentration of 10 µg/dL (USEPA 1994c). The average lead concentration for surface soils in Veteran's Park was used as an input value to calculate expected children's blood lead levels due to incidental ingestion. The assumptions for the recreational exposure scenario for children aged six to 84 months are as follows:

1. Children were exposed to lead contaminated soil visiting Veteran's Park three times per week for six months a year.
2. IEUBK model default values were used for all other variables (USEPA 2002b).

The predicted geometric mean blood lead levels and the probability of blood lead levels exceeding 10 µg/dL (P_{10}) for children are shown in the following table:

Exposure Scenario		
Age (months)	**Blood Lead Level[a] (µg/dL)**	**P_{10} (%)[b]**
6 -12	2.26	0.079
12 - 24	2.32	0.093
24 - 36	2.19	0.061
36 - 48	2.06	0.040
48 - 60	1.84	0.016
60 - 72	1.70	0.008
72 - 84	1.62	0.005

[a]Geometric mean as calculated by the IEUBK model using time-weighted average of soil lead concentration: 108 mg/kg x 3/7 days = 47 mg/kg
[b]Probability of blood lead level > 10 µg/dL

The blood lead levels for children aged up to 84 months are below the action level (10 µg/dL). The P_{10} value for the entire 6-84 months age group interval was below the recommended protection level of five percent. Therefore, the potential for adverse non-cancer health effects to area children from ingestion of lead contaminated surface soils from the recreational use of Veteran's Park are not expected.

The US EPA Adult Lead Methodology estimated a geometric mean blood lead level of 1.6 µg/dL (EPA 2003). The calculated 95th percentile blood lead levels among fetuses of adult residents was 4.7 µg/dL. The probabilities of fetal blood lead levels exceeding 10 µg/dL are 0.4 percent (USEPA 2003b). As such, potential for adverse health effects to adults associated with lead exposures from the recreational use of Veteran's Park are not expected .

<u>PAHs.</u> Benzo[a]pyrene, benzo[g,h,i]perylene, and phenanthrene have been detected in surface soil at Veteran's Park. As mentioned earlier, the following LOAELs have been established for PAH compounds based on available animal studies: acenaphthylene (175 mg/kg/day); fluoranthene (125 mg/kg/day); and fluorene (125 mg/kg/day) (ATSDR 1995).

Based on the maximum concentration of PAH compounds detected in surface soil, the highest exposure dose was calculated for children at 0.000000298 mg/kg/day for benzo[a]pyrene (see Table 21). As the calculated chronic exposure doses for children and adults were more than 420 million times lower than the established LOAELs, non-cancer adverse health effects associated with exposure to PAH compounds detected in soil for Veteran's Park are not expected.

<u>Inhalation of TCE in Indoor Air – Residential Area</u>

The chronic inhalation RfC for TCE is based on the LOAEL (i.e., central nervous system effects in two occupational studies) of 38,000 µg/m^3. The RfC incorporates a safety factor of 1,000 to account for the use of the LOAEL, human variability (including sensitive populations such as children), (EPA 2001). There were no detected TCE concentrations exceeding the intermediate MRL of 500 µg/m^3 nor the chronic RfC of 40 µg/m^3 for all sampled residences (see Table 22). Therefore, adverse non-cancer health effects are not expected to occur for past, present, and future exposures to TCE in indoor air to adults and children living at the sampled residences.

Cancer Health Effects

The site-specific lifetime excess cancer risk (LECR) indicates the cancer potential of contaminants. LECR estimates are usually expressed in terms of excess cancer cases in an exposed population in addition to the background rate of cancer. For perspective, the lifetime risk of being diagnosed with cancer in the United States is 46 per 100 individuals for males, and 38 per 100 for females; the lifetime risk of being diagnosed with any of several common types of cancer ranges between 1 and 10 in 100 (SEER 2005). Typically, health guideline CVs developed for carcinogens are based on one excess cancer case per 1,000,000 individuals. ATSDR considers estimated cancer risks of less than one additional cancer case among one million persons exposed as insignificant or no increased risk (expressed exponentially as 10^{-6}).

According to the United States Department of Health and Human Services (USDHHS), the cancer class of contaminants detected at a site is as follows:

1 = Known human carcinogen
2 = Reasonably anticipated to be a carcinogen
3 = Not classified

The risk of cancer was evaluated based on the site-specific exposure scenario and exposure location. Cancer exposure doses were calculated using the following formula:

$$\textit{Cancer Exposure Dose (mg/kg/day)} = \frac{C \; x \; IR \; x \; EF x \; CF}{BW}$$

where C = concentration of contaminant in soil (mg/kg);
IR = intake rate of contaminated soil (mg/day);
EF = exposure factor representing the site-specific exposure scenario;
CF = conversion factor (10^{-6} kg/mg); and
BW = body weight (kg).

The site-specific assumptions and recommended exposure factors (EPA 2002) used to calculate the LECR are the same as those used to assess non-cancer health effects. The LECR for adults was calculated by multiplying the cancer exposure dose by the cancer slope factor (CSF). The CSF is defined as the slope of the dose-response curve obtained from animal and/or human cancer studies and is expressed as the inverse of the daily exposure dose, i.e., $(mg/kg/day)^{-1}$.

Several COCs are identified for the NBTHS, the PSE&G easement, Veteran's Park, Judd Elementary School, and the residential area; however, only COCs having CSFs are used to estimate the LECR to exposed individuals. Please refer to the *Completed Pathways* section of this report for specific discussions regarding evaluated potential exposure at areas of concern outside waste-fill boundary. Incidental Ingestion of Soil – NBTHS

COCs have been identified in soil for the football field and unpaved surfaces in proximity to the perimeter of the high school. Exposures occurring at these areas are based on daily incidental ingestion of contaminated surface soil during a standard 182-day school year. Calculated LECRs for students are based on a four-year period of school attendance. Calculated LECRs for adult faculty are based on an approximated maximum length of employment of 40 years unless otherwise noted.

Several COCs have been identified in subsurface soil for the former "The Oval" area which was used for high school activities prior to remediation in July 2003. As previously explained, potential past exposures to students and faculty have been interpreted using subsurface contaminant concentrations to offer the reader a tentative evaluation of this area.

Former "The Oval" Area and Areas Within the Waste-Fill Boundary (NBTHS Property)

Potential past exposures may have occurred from 1972 through 2002 based on the school's date of construction to construction and remediation activities initiated in 2003; therefore, potential exposures to adult faculty are limited to a 30-year period. The reader is cautioned that the LECRs for past exposures provided for this area are not evidence-based due to the lack of surface soil data necessary to interpret past exposures. Therefore, incidental ingestion of contaminated soil is not considered a completed exposure pathway for this area.

Based on the average (the likely scenario) and maximum (an unlikely scenario) contaminant concentrations detected in subsurface soil, the LECRs were estimated to be 46 in 1,000,000 and 230 in 1,000,000 for students exposed for a four-year period.

Based on the average (the likely scenario) and maximum (an unlikely scenario) contaminant concentrations detected in subsurface soil, the LECRs were estimated to be 331 in 1,000,000 and 1,640 in 1,000,000 for adult faculty exposed for a 30-year period (see Table 23).

High School Building Perimeter and Areas Outside the Waste-Fill Boundary;Football Field

Based on the average (the likely scenario) and maximum (an unlikely scenario) contaminant concentrations detected in soil, the LECRs for students were less than 1 in 1,000,000, which is considered insignificant or no increased risk.

Based on the average (the likely scenario) and maximum (an unlikely scenario) contaminant concentrations detected in soil, the LECRs were estimated to be 3 in 1,000,000 and 7 in 1,000,000 for adult faculty exposed for a 40-year period which is a very low increase in risk compared to the background risk of cancer (see Table 24).

Please refer to the *Completed Pathways* section of this report for specific discussions regarding evaluated potential exposure at areas of concern outside waste-fill boundary.

<u>Incidental Ingestion of Soil – Judd Elementary School</u>

Calculated LECRs for child students are based on a six-year period of attendance. Calculated LECRs for adult faculty are based on an approximated maximum length of employment of 40 years.

Based on the average (the likely scenario) and maximum (an unlikely scenario) contaminant concentrations detected in soil, the LECRs were estimated to be 2 in 1,000,000 and 3 in 1,000,000 for child students aged 5 though 11 exposed for a six-year period which is a very low increase in risk compared to the background risk of cancer.

Based on the average (the likely scenario) and maximum (an unlikely scenario) contaminant concentrations detected in soil, the LECRs for adult faculty were estimated to be 3 in 1,000,000 and 4 in 1,000,000 for adult faculty exposed for a 40-year period which is a very low increase in risk compared to the background risk of cancer (see Table 25).

Please refer to the *Completed Pathways* section of this report for specific discussions regarding evaluated potential exposure at areas of concern outside waste-fill boundary.

Incidental Ingestion of Soil – Veteran's Park/PSE&G Easement

Calculated LECRs for area children and adults are based on daily exposures occurring at the park for 10 and 38 years, respectively.

Based on the average (the likely scenario) and maximum (an unlikely scenario) contaminant concentrations detected in soil, the LECRs were estimated to be 8 in 1,000,000 and 16 in 1,000,000 for area children exposed for a 10-year period.

Based on the average (the likely scenario) and maximum (an unlikely scenario) contaminant concentrations detected in soil, the LECRs were estimated to be 4 in 1,000,000 and 7 in 1,000,000 for area adult residents exposed for a 38-year period (see Table 26).

The excess cancer risks calculated for past and present exposures to resident children and adults based on average contaminant concentrations are considered a very low increase in risk compared to the background risk of cancer.

Inhalation of TCE in Indoor Air

The risk of cancer for past exposures regarding the inhalation of indoor air contaminated with TCE was evaluated for students and adult faculty at the NBTHS and for children and adults of nearby residences. Cancer exposure doses were calculated using the following formula:

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

where C = concentration of TCE in air (mg/m^3);
IR = inhalation rate (m^3/hour);
EF = exposure factor representing the site-specific exposure scenario;
ED = exposure duration (year);
BW = body weight (kg); and
AT = averaging time (year).

Nearby Residential Area

The LECR was estimated for the six nearby residences with detections of TCE in indoor air from the June 2004 through June 2007 indoor air investigation period. The following site specific assumptions and recommended exposure factors (EPA 2002) were used to calculate the contaminant dose based on maximum and average length of residency:

Assumptions for Calculating Adult and Child Cancer Exposure Dose

<table>
<tr><th>Exposed Population</th><th>IR
(m^3/hour)</th><th>EF [a]
(unitless)</th><th>ED
(years)</th><th>BW
(kg)</th><th>AT
(years)</th></tr>
<tr><td>Child</td><td>12</td><td>1</td><td rowspan="2">10 [b]</td><td>33</td><td rowspan="2">70 [c]</td></tr>
<tr><td>Adult</td><td>20</td><td>1</td><td>70</td></tr>
</table>

(a) Exposure factor of 1 equals a continuous exposure frequency of 24 hours per day.
(b) Based on maximum length of residency for current residents.
(c) Represents a lifetime exposure.

The LECR for adults was calculated by multiplying the cancer exposure dose by the cancer slope factor (CSF). The CSF is defined as the slope of the dose-response curve obtained from animal and/or human cancer studies and is expressed as the inverse of the daily exposure dose, i.e., $(mg/kg/day)^{-1}$.

Resident Exposures (past). The calculated LECRs for residents are based on the arithmetic mean of detected TCE concentrations from available data.

Based on the arithmetic mean of detected TCE concentrations in the indoor air at each sampled residence, LECRs were estimated to be 21 in 1,000,000 for adults and 27 in 1,000,000 for children which is considered a low increased risk when compared to the excess background risk of all or specific cancers (see Table 27).

The detected TCE concentrations in indoor air for each sampled residence following sump remediation is within typical average background concentrations found in US homes and ambient air. In addition, based on the detected TCE concentrations, the excess cancer risks calculated for past exposures for all sampled residences are low in comparison to the background risk of all or specific cancers. Although the risk for individuals to develop cancer for past exposure to TCE in indoor air is low, remedial actions were implemented for all six residences samples to ensure future inhalation exposure to TCE remains below the NJDEP's RIASL.

Cumulative LECRs – Residential Population

Cumulative LECRs were calculated based on past and present exposures to average soil contaminant concentrations (the likely scenario) for child residents and adult residents who attend or have attended Judd Elementary School and NBTHS, and have accessed Veteran's Park. Cumulative LECRs were also calculated for children living within the six nearby residences currently under investigation where TCE was detected in indoor air. The cumulative LECRs calculated for the exposed residential population is as follows (see Table 28):

For children attending Judd Elementary School and accessing Veteran's Park, the average LECR (the likely scenario) is 10 in 1,000,000;

For children attending Judd Elementary School, accessing Veteran's Park, and living within one of the residences with TCE detected in indoor air, the average LECR is 37 in 1,000,000; and

For residents who have attended Judd Elementary School, attended NBTHS, and accessed Veteran's Park for a 38-year period, the average LECR is 14 in 1,000,000.

The cumulative LECRs for child and adult residents are considered a very low to low increased risk when compared to the background risk for all or specific cancers. The exposure time for adults living within the nearby residences under investigation is less than 30 years since this area was developed in the mid-1990s. The cumulative LECR for adults living within this residential investigation area would be considered equal to those listed in Table 27.

Multiple Chemical Exposure Assessment

Thus far, the assessment approach described in this report has focused on evaluating chemical-specific and pathway-specific exposures. However, ATSDR and NJDHSS recognize that exposures can involve multiple chemicals through more than one exposure pathway. As part of this evaluation, a Hazard Index (HI) was calculated for NBTHS, Judd Elementary School, and Veteran's Park/PSE&G easement areas based on the exposure dose to average concentrations (the likely scenario) of site contaminants. In order to assess the joint toxic action resulting from exposure to multiple contaminants, the calculated HI must meet or exceed 1.0. The calculated HIs for the three above areas of concern did not exceed 1.0; therefore, incidental ingestion of soil and settled dust based on average concentrations of site contaminants (primarily arsenic and lead in soil; cadmium and lead in settled dust) should not produce significant additive or interactive effects to exposed children and adults.

Health Outcome Data

In May and September of 2004, North Brunswick residents contacted the NJDHSS Cancer Epidemiology Program regarding several individuals who live near or attended North Brunswick Township High School who had been diagnosed with cancer in the past several years. In response to this concern, the Cancer Epidemiology Program reviewed cancer incidence data from 1979 through 2001 for North Brunswick Township and Middlesex County. According to the Cancer Epidemiology Program, the number and distribution of cancer types in Middlesex County did not appear to be unusual when compared to the state; in addition, a review of North Brunswick Township data by gender and age group did not indicate an unusual occurrence of any type of cancer (see Appendix B).

The NJDHSS State Cancer Registry began in 1979; therefore, cancer incidence data for New Jersey does not pre-date 1979. State cancer registry data is currently complete through 2005. A request for an update to cancer incidence data for the New Brunswick High School Site area has been submitted which will be addressed in a follow-up health consultation for this site in the near future.

Child Health Considerations

ATSDR's Child Health Initiative recognizes that the unique vulnerabilities of infants and children demand special emphasis in communities faced with contamination in their environment. Children are at greater risk than adults from certain kinds of exposures to hazardous substances because they eat and breathe more than adults. They also play outdoors and often bring food into contaminated areas. Children are also smaller, resulting in higher doses of chemical exposure per body weight. The developing body systems of children can sustain permanent damage if toxic exposures occur during critical growth stages. Most importantly, children depend completely on adults for risk identification and management decisions, housing decisions, and access to medical care.

Judd Elementary School and Veteran's Park are the areas of concern where child exposures to contaminated surface soil are most likely and frequently to occur. The pathway of concern is ingestion of contaminated surface soil for the unpaved portions of these properties. Based on the average soil concentrations (the likely scenario) for COCs detected at Judd Elementary School and Veteran's Park, non-cancer adverse health effects associated with exposure to contaminated surface soils are not expected to occur in children. For cancer health effects, the cumulative LECR for exposures at these locations indicate there is a very low increased risk posed to children based on average soil concentrations at these locations.

For the residential area, non-cancer health effects associated with the inhalation of TCE contaminated indoor air detected at the six residences sampled are not expected to occur in children. For cancer health effects, the cumulative LECR at these locations indicate there is a low increased risk posed to children based on TCE concentrations detected in indoor air.

Conclusion

Prior to development, an area within the present location of the North Brunswick High School (NBTHS), the Public Service Electric and Gas (PSE&G) easement (NBTHS property), and Veteran's Park was used as a municipal dump which received various wastes including pharmaceutical/ laboratory research materials dating back to the 1940s through to approximately 1967. The waste material was partially discovered during school construction activities circa 1971/1972; however, the extent of the buried waste material was not fully encountered until 2003 during a school expansion project. The subsequent site investigations and remedial activities focused on the NBTHS (including the PSE&G easement), Veteran's Park and the Judd Elementary School properties. In addition, an investigation of six nearby residences was initiated in 2003 to identify and delineate the extent of site-related contamination in this area as detailed in a separate report titled *Site-Related Contamination At Three Nearby Residences* (ATSDR 2005). This report provides an update to the residential investigation.

In the autumn of 2004, site-related arsenic contamination in soil at all three residences was remediated to below the regulatory cleanup levels under oversight by the NJDEP; therefore the soil exposure pathway is considered eliminated (see Appendix A). Past concentration of arsenic in household dust was cited as a health hazard for one residence. The dust was remediated in April and May 2005. Post-remedial dust wipe samples indicate that the arsenic concentrations in household dust for this residence were reduced to levels that no longer pose a potential health concern for children. Trichloroethylene (TCE) was detected in the indoor air at six residences. As a mitigation measure, the basement sumps were sealed and vented to the existing radon remediation system for all six residences.

The primary COCs for the investigated areas include arsenic in surface soil, lead in settled dust, and TCE in indoor air for the NBTHS; arsenic in surface soil for Judd Elementary School; lead and arsenic in surface soil at Veteran's Park; TCE in groundwater; and TCE in indoor air at six nearby residences. Additional COCs posing a lesser risk and detected mainly in subsurface soil include several metals, volatile and semi-volatile organic compounds, polycyclic aromatic hydrocarbons, and Aroclor 1254 and Aroclor 1260 (fractions of Polychlorinated Biphenyl compounds). Completed exposure pathways include incidental ingestion of surface soil at the high school building perimeter areas, areas outside the waste-fill boundary and the football field at the NBTHS, Veteran's Park and Judd Elementary School properties, and incidental ingestion of lead contaminated settled dust on interior surfaces at NBTHS, and inhalation of indoor air contaminated with TCE at six nearby residences. Exposed individuals include area residents (children and adults), elementary and high school students (children and adults) and school employees (adults). Adverse non-cancer health effects are not expected to occur in children and adults for all past, present and future exposure pathways present at areas of concern. Additionally, since the NJDEP is monitoring indoor air at the six residences, chronic exposures to TCE in indoor air at concentrations exceeding NJDEP's Indoor Air Screening Level are not expected to occur to residents regarding current and future exposures.

It is noted that arsenic concentrations in soil outside the waste-fill boundary are likely present due to natural background levels and not associated with historic landfill activities. Judd Elementary School, the majority of the NBTHS building perimeter, and the NBTHS football field are outside the waste-fill boundary area

Present and future exposures to potentially contaminated surface soil have been eliminated for the former "The Oval" area at NBTHS due to the removal of contaminated soil from this area completed in February 2005. Past exposures for students and school faculty could not be interpreted as surface soil samples were not collected from this area as a result of surface soil removal/disturbance from construction activities prior to investigation efforts.

Cumulative LECRs were calculated based on past and present exposures to average soil contaminant concentrations (the likely scenario) for child residents are as follows:

For children attending Judd Elementary School and accessing Veteran's Park, the cumulative LECR is 10 in 1,000,000; and

For children attending Judd Elementary School, accessing Veteran's Park, and living within one of the six residences with TCE detected in indoor air, the average LECR is 37 in 1,000,000. The average LECR calculated based on average TCE concentrations detected in indoor air (the likely scenario) for adults living within one of the six residences is 21 in 1,000,000.

The cumulative LECRs calculated based on past exposures to average soil contaminant concentrations (the likely scenario) for adults living within the community who have attended Judd Elementary School, attended NBTHS, and accessed Veteran's Park for a 38-year period were 14 in 1,000,000. The cumulative LECR for child and adult residents are considered a very low to low increased risk when compared to the background risk for all or specific cancers.

Past and present exposures to site contaminants for the residential population are considered a ***No Apparent Public Health Hazard***. Remediation is necessary to prevent future exposures to contaminants in soil exceeding NJDEP's RDCSCC. NJDEP is requiring soil removal for lead and arsenic "hot spots" exceeding NJDEP's "Project Removal Criteria" (i.e. arsenic at 200 mg/kg; lead at 4,000 mg/kg) within Veteran's Park and areas to the south of Roosevelt Avenue. Following the soil removal of the "hot-spots", under NJDEP approved Deed Notices, contaminants remaining above the RDCSCC will be covered by a two-foot soil cap as a control measure to prevent future exposures. The soil cap will be applied to portions of Veteran's Park, the PSE&G easement (NBTHS property), and areas to the south of Roosevelt Avenue, including the northern portion of Block 143, Lots 94.01 and 95.01.

A groundwater Classification Exemption Area (CEA) will be established in the future through the NJDEP to address remaining TCE concentrations in groundwater to reduce levels that are considered low enough not to cause a threat to public health including the nearby residential area.

In response to cancer cluster concerns expressed by the community, the NJDHSS Cancer Epidemiology Program reviewed cancer incidence data from 1979 through 2001 for North Brunswick Township and Middlesex County. No unusual number or distributions of cancer types were determined for the township or county. A request for an update to cancer incidence data for the New Brunswick High School Site area has been submitted which will be addressed in a follow-up health consultation for this site in the near future.

Recommendations

1. NJDEP should continue oversight of soil remedial activities for the NBTHS, Veteran's Park and PSE&G easement areas to ensure site-related contaminants are reduced to below NJDEP's regulatory cleanup criteria through either soil removal and/or installation of engineering controls. Soil removal actions should include provisions to prevent migration of dust during removal and/or soil stockpiling activities to uncontaminated areas, including the high school property.

2. NJDEP should continue oversight of remedial activities regarding TCE contamination in groundwater to reduce concentrations to below the NJDEP's ground water vapor intrusion screening levels, or a NJDEP approved alternative, to minimize or eliminate the threat of vapor intrusion to the surrounding community.

3. NJDEP should continue monitoring the effectiveness of the vapor ventilation systems installed at the six nearby residences. Powered ventilation systems installed at 3 of the 6

residences should be operational until the threat of vapor intrusion has been reduced where it no longer poses a threat to public health.

4. Routine cleaning of hard surfaces (including window-sills) is recommended to minimize settled dust levels for NBTHS. This is particularly recommended while soil remediation activities for Veteran's Park is being conducted in the near future.

5. Continued enforcement and practice of relevant community awareness actions to alert area residents of the in-place use restriction for the eastern portion of Veteran's Park until remediation of this area is completed. The PSE&G easement area should be included in the use restriction.

6. Surface soil should be evaluated for the small arsenic "hot-spot" area to the south of Roosevelt Avenue to verify whether exposure prevention measures are required until the area undergoes remedial actions planned for 2008.

Public Health Action Plan

The purpose of a Public Health Action Plan is to ensure that this Public Health Assessment not only identifies public health hazards, but also provides a plan of action designed to mitigate and prevent adverse human health effects resulting from exposure to hazardous substances in the environment. Included is a commitment on the part of the ATSDR and the NJDHSS to follow-up on this plan to ensure that it is implemented. The public health actions to be implemented by the ATSDR and NJDHSS are as follows:

Public Health Actions Taken

1. The ATSDR and NJDHSS reviewed information and relevant data to evaluate the potential health implications for exposures to site-related contaminants detected in soil at the North Brunswick Township High School, Judd Elementary School, Veteran's Park, and the PSE&G easement area and in settled dust at the North Brunswick Township High School and Judd Elementary School.

2. A health consultation was completed by the NJDHSS in August 2005 evaluating the potential health implications for exposures to site-related contaminants detected in soil and indoor air at three residential properties located near the North Brunswick Township High School (see Appendix A). An update to the investigation of this residential area has been incorporated into this PHA to provide an update regarding the public health interpretation of exposure at six residences based on remedial actions and additional investigations since the issuance of the prior health consultation report

3. The NJDHSS attended public meetings held in February 2007 and January 2008 with area residents concerning recent remedial investigations and planned future remedial actions to address remaining soil and groundwater contamination for the NBTHS site and nearby residential area.

Public Health Actions Planned

1. This Public Health Assessment will be provided to board of education and township officials, NJDEP, and the Middlesex County Public Health Department. NJDHSS will notify area residents that this report is available for their review upon request. Representatives of the ATSDR and NJDHSS are available to discuss the results of this report with interested parties.

2. The NJDHSS and the ATSDR is in the process of reviewing recent soil, groundwater data and other site-related information which will be addressed in a follow-up health consultation for this site in the near future. The NJDHSS and the ATSDR will review and evaluate future remedial actions and control measures to address remaining site-related soil contamination at Veteran's Park and the immediate surrounding area and groundwater contamination/vapor intrusion for the nearby residential area.

3. A request for an update to cancer incidence data for the New Brunswick High School Site area has been submitted which will be addressed in a follow-up health consultation for this site in the near future.

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CERTIFICATION

The Public Health Assessment for the North Brunswick Township High School site, North Brunswick, Middlesex County, New Jersey was prepared by the New Jersey Department of Health and Senior Services under a cooperative agreement with the Agency for Toxic Substances and Disease Registry. It is in accordance with approved methodology and procedures existing at the time the Public Health Assessment was initiated.

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Agency for Toxic Substances and Disease Registry

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

Alan Yarbrough
Team Leader, CAT, CAPEB, DHAC
Agency for Toxic Substances and Disease Registry

Table 1: Contaminants in Subsurface Soil (0.5 - 6 feet) - North Brunswick Township High School Property: Former "The Oval" and Areas Within Waste-Fill Boundary. Sample Data: July - October, 2003.

Contaminant	Number of Samples	Number of Detections	Concentration: milligrams/kilogram					Contaminant of Concern
			Minimum	Maximum	Average	Environmental Guideline Comparison Value	NJDEP RDCSCC [a]	
METALS								
Antimony	29	10	ND	36	4	20 (RMEG) [b]	14	**Yes**
Arsenic	29	29	2.3	3,600	728	0.5 (CREG) [c]	20	**Yes**
Beryllium	29	17	ND	1	0	100 (EMEG) [d]	2	No
Cadmium	29	15	ND	17	4	10 (EMEG)	39	**Yes**
Chromium	29	29	9.6	490	46	200 (RMEG)	240	**Yes**
Copper	29	29	4.1	3,900	384	500 (EMEG)	600	**Yes**
Cyanide (Total)	8	3	ND	1	0	1,000 (RMEG)	1,100	No
Lead	29	29	6.5	4,400	728	NA	400	**Yes**
Mercury	29	20	ND	7	1	NA	14	No
Nickel	29	28	ND	240	27	1,000 (RMEG)	250	No
Selenium	29	3	ND	2	0	300 (EMEG)	63	No
Silver	29	4	ND	12	1	300 (RMEG)	110	No
Thallium	29	5	ND	2	0	5.5 (RBC)N [e]	2	**Yes**
Zinc	29	29	15.3	33,300	3,823	20,000 (RMEG)	1,500	**Yes**
VOLATILE ORGANIC COMPOUNDS								
1,1,2-Trichloroethane	19	1	ND	0.005	0.0003	10 (CREG)	22	No
1,1-Dichloroethene	19	1	ND	0.004	0.0002	500 (EMEG)	8	No
1,2-Dichloroethene, trans-	22	1	ND	0.033	0.0015	1,000 (RMEG)	1,000	No
Benzene	19	4	ND	0.046	0.0041	10 (CREG)	3	No
Bromomethane	19	1	ND	0.022	0.0012	70 (RMEG)	79	No
Chloroform	19	2	ND	0.014	0.0012	500 (EMEG)	19	No
Chloromethane	19	1	ND	0.016	0.0008	NA	520	No
Ethylbenzene	19	1	ND	0.007	0.0004	5,000 (RMEG)	1,000	No
Methylene Chloride	19	1	ND	0.008	0.0004	90 (CREG)	49	No
Toluene	19	6	ND	0.45	0.0257	1,000 (EMEG)	1,000	No
Trichloroethene	19	3	ND	7.5	0.3984	1.6 (RBC)C	23	**Yes**

Table 1 - continued

Contaminant	Number of Samples	Number of Detections	Concentration: milligrams/kilogram					Contaminant of Concern
			Minimum	Maximum	Average	Environmental Guideline Comparison Value	NJDEP RDCSCC [(a)]	
Xylenes	19	2	ND	0.011	0.0009	30,000 (EMEG)	410	No
SEMI-VOLATILE ORGANIC COMPOUNDS (SVOCs)								
Bis(2-ethylhexyl)phthalate	20	2	ND	1.5	0.09	46 (RBC)C	49	No
Hexachlorobenzene	18	1	ND	0.31	0.02	0.4 (CREG)	0.66	No
Polycyclic Aromatic Hydrocarbons (SVOC fraction)								
Acenaphthene	20	1	ND	0.67	0.03	3,000 (RMEG)	3,400	No
Anthracene	20	3	ND	1.8	0.18	20,000 (RMEG)	10,000	No
Benzo(a)anthracene	20	4	ND	5.1	0.52	0.22 (RBC)C	0.9	**Yes**
Benzo(a)pyrene	20	4	ND	3.8	0.39	0.1 (CREG)	0.66	**Yes**
Benzo(b)fluoranthene	20	4	ND	4	0.40	0.22 (RBC)C	0.9	**Yes**
Benzo(g,h,i)perylene	20	4	ND	1.3	0.14	NA	NA	**Yes**
Benzo(k)fluoranthene	20	4	ND	3.4	0.37	2.2 (RBC)C	0.9	**Yes**
Chrysene	20	4	ND	4.8	0.49	22 (RBC)C	9	No
Dibenz(a,h)anthracene	20	2	ND	0.6	0.05	0.022 (RBC)C	0.66	**Yes**
Fluoranthene	20	5	ND	8.6	0.89	2,000 (RMEG)	2,300	No
Fluorene	20	2	ND	0.54	0.04	2,000 (RMEG)	2,300	No
Indeno(1,2,3-cd)pyrene	20	4	ND	1.3	0.15	0.22 (RBC)C	0.9	**Yes**
Phenanthrene	20	4	ND	5.6	0.59	NA	NA	**Yes**
Pyrene	0	0	ND	0	0.00	2,000 (RMEG)	1,700	No
Phenolics (SVOC fraction)								
Phenolics	8	0	ND	ND	ND	20,000 (RMEG)	10,000	No
POLYCHLORINATED BIPHENYLS (PCBs)								
Aroclor 1260	8	4	ND	0.31	0.07	0.32 (RBC)C	0.49	No
ORGANOCHLORINE PESTICIDES								
4,4'-DDD	8	1	ND	0.034	0.004	2.7 (RBC)C	3	No
TOTAL PETROLEUM HYDROCARBONS								
TPHC	10	5	ND	2,300	314	NA	10,000	No

(a) New Jersey Department of Environmental Protection Residential Direct Contact Soil Cleanup Criteria; (b) Reference Media Evaluation Guide; (c) Cancer Risk Evaluation Guide; (d) Environmental Media Evaluation Guide; (e) USEPA Region 3 Risk-Based Concentration (N: Non-carcinogenic effects, C: Carcinogenic effects); NA - Not Available; ND - Not Detected

Table 2: Contaminants in Surface Soil (0 - 0.5 feet) - North Brunswick Township High School: High School Building Perimeter and Areas Outside the Waste-Fill Boundary. Sample Data: July 2003.

Contaminant	Number of Samples	Number of Detections	Concentration: milligrams/kilogram					Contaminant of Concern
			Minimum	Maximum	Average	Environmental Guideline Comparison Value	NJDEP RDCSCC [(a)]	
METALS								
Antimony	12	0	ND	ND	ND	20 (RMEG) [(b)]	14	No
Arsenic	12	12	2.7	11	5	0.5 (CREG) [(c)]	20	**Yes**
Beryllium	12	12	0.4	0.85	0.56	100 (EMEG) [(d)]	2	No
Cadmium	12	0	ND	ND	ND	10 (EMEG)	39	No
Chromium	12	12	14	21	17	200 (RMEG)	240	No
Cobalt	12	12	2.5	8.34	4.80	20 (EMEG)	NA	No
Copper	12	12	5.8	14	10	500 (EMEG)	600	No
Lead	12	12	7	31	20	NA	400	No
Mercury	12	6	ND	1.40	0.18	NA	14	No
Nickel	12	12	6.9	15	9	1,000 (RMEG)	250	No
Selenium	12	0	ND	ND	ND	300 (EMEG)	63	No
Silver	12	0	ND	ND	ND	300 (RMEG)	110	No
Thallium	12	0	ND	ND	ND	5.5 (RBC)N [(e)]	2	No
Vanadium	12	12	20	31	26	200 (EMEG)	370	No
Zinc	12	12	25	120	40	20,000 (RMEG)	1,500	No

(a) New Jersey Department of Environmental Protection Residential Direct Contact Soil Cleanup Criteria; (b) Reference Media Evaluation Guide; (c) Cancer Risk Evaluation Guide; (d) Environmental Media Evaluation Guide; (e) USEPA Region 3 Risk-Based Concentration (N: Non-carcinogenic effects, C: Carcinogenic effects); NA - Not Available; ND - Not Detected

Table 3: Contaminants in Subsurface Soil (0.5 - 6 feet) - North Brunswick Township High School: High School Building Perimeter and Areas Outside the Waste-Fill Boundary. Sample Data: July - October 2003.

Contaminant	Number of Samples	Number of Detections	Concentration: milligrams/kilogram					Contaminant of Concern
			Minimum	Maximum	Average	Environmental Guideline Comparison Value	NJDEP RDCSCC [(a)]	
METALS								
Antimony	9	0	ND	0	0	20 (RMEG) [(b)]	14	No
Arsenic	9	9	2.2	8	4	0.5 (CREG) [(c)]	20	**Yes**
Beryllium	9	9	0.3	1.0	0.6	100 (EMEG)	2	No
Cadmium	9	0	ND	0	0.00	10 (EMEG)	39	No
Chromium	9	9	12.5	22	17	200 (RMEG)	240	No
Cobalt	3	3	1.6	7	4	20 (EMEG)	NA	No
Copper	9	9	4.5	37	9	500 (EMEG)	600	No
Lead	8	8	3.7	39	12	NA	400	No
Mercury	9	4	ND	17	2.28	NA	14	No
Nickel	9	8	0.0	20	10	1,000 (RMEG)	250	No
Selenium	9	1	ND	ND	ND	300 (EMEG)	63	No
Silver	9	0	ND	ND	ND	300 (RMEG)	110	No
Thallium	9	0	ND	0.0	0.00	5.5 (RBC)N [(e)]	2	No
Vanadium	4	3	0.0	37	23	200 (EMEG)	370	No
Zinc	9	9	12.3	61	27	20,000 (RMEG)	1,500	No
SEMI-VOLATILE ORGANIC COMPOUNDS - Polycyclic Aromatic Hydrocarbons								
Fluoranthene	6	0	ND	0	0.00	2,000 (RMEG)	2,300	No
Pyrene	6	0	ND	0	0.00	2,000 (RMEG)	1,700	No

(a) New Jersey Department of Environmental Protection Residential Direct Contact Soil Cleanup Criteria; (b) Reference Media Evaluation Guide; (c) Cancer Risk Evaluation Guide; (d) Environmental Media Evaluation Guide; (e) USEPA Region 3 Risk-Based Concentration (N: Non-carcinogenic effects, C: Carcinogenic effects); NA - Not Available; ND - Not Detected

Table 4: Contaminants in Surface Soil (0 - 0.5 feet) - North Brunswick Township High School: Football Field. Sample Data: July 28, 2003.

Contaminant	Number of Samples	Number of Detections	Concentration: milligrams/kilogram					Contaminant of Concern
			Minimum	Maximum	Average	Environmental Guideline Comparison Value	NJDEP RDCSCC [(a)]	
METALS								
Antimony	5	0	ND	ND	ND	20 (RMEG) [(b)]	14	No
Arsenic	5	5	2.9	10	5	0.5 (CREG) [(c)]	20	**Yes**
Beryllium	5	5	0.3	0.82	0.45	100 (EMEG) [(d)]	2	No
Cadmium	5	0	ND	ND	ND	10 (EMEG)	39	No
Chromium	5	5	10	20	15	200 (RMEG)	240	No
Cobalt	5	5	1.2	9.91	3.79	20 (EMEG)	NA	No
Copper	5	5	5.1	9	7	500 (EMEG)	600	No
Lead	5	5	15	55	25	NA	400	No
Mercury	5	5	0.1	3.70	0.95	NA	14	No
Nickel	5	5	3.8	7	5	1,000 (RMEG)	250	No
Selenium	5	0	ND	ND	ND	300 (EMEG)	63	No
Silver	5	0	ND	ND	ND	300 (RMEG)	110	No
Thallium	5	0	ND	ND	ND	5.5 (RBC)N [(e)]	2	No
Vanadium	5	5	10	21	17	200 (EMEG)	370	No
Zinc	5	5	14	25	21	20,000 (RMEG)	1,500	No

(a) New Jersey Department of Environmental Protection Residential Direct Contact Soil Cleanup Criteria; (b) Reference Media Evaluation Guide; (c) Cancer Risk Evaluation Guide; (d) Environmental Media Evaluation Guide; (e) USEPA Region 3 Risk-Based Concentration (N: Non-carcinogenic effects, C: Carcinogenic effects); NA - Not Available; ND - Not Detected

Table 5: Contaminants in Surface Soil (0 - 0.5') - PSE&G Utilities Easement. Sample Data: July/August, 2003.

Contaminant	Number of Samples	Number of Detections	Concentration: milligrams/kilogram					Contaminant of Concern
			Minimum	Maximum	Average	Environmental Guideline Comparison Value	NJDEP RDCSCC (a)	
METALS								
Antimony	4	0	ND	0	0.0	20 (RMEG) (b)	14	No
Arsenic	4	4	10.4	37	24	0.5 (CREG) (c)	20	**Yes**
Beryllium	4	4	ND	0.7	0.5	100 (EMEG) (d)	2 (f)	No
Cadmium	4	1	ND	1	0.2	10 (EMEG)	39	No
Chromium	4	4	22.6	28	25	200 (EMEG)	240	No
Copper	4	4	19.8	39	28	500 (EMEG)	600	No
Lead	4	4	35.7	150	73	NA	400	No
Mercury	4	3	ND	0.1	0.1	NA	14	No
Nickel	4	4	ND	15	9	1,000 (RMEG)	250	No
Selenium	4	0	ND	0.0	0.0	300 (EMEG)	63	No
Silver	4	0	ND	0	0.0	300 (RMEG)	110	No
Thallium	4	0	ND	0.0	0.0	5.5 (RBC)N (e)	2	No
Zinc	4	4	110.0	290	180	20,000 (RMEG)	1,500	No

(a) New Jersey Department of Environmental Protection Residential Direct Contact Soil Cleanup Criteria; (b) Reference Media Evaluation Guide; (c) Cancer Risk Evaluation Guide; (d) Environmental Media Evaluation Guide; (e) USEPA Region 3 Risk-Based Concent

Table 6: Contaminants in Subsurface Soil (0.5 - 8.2 feet) - PSE&G Utilities Easement. Sample Data: August - October, 2003.

Contaminant	Number of Samples	Number of Detections	Concentration: milligrams/kilogram					Contaminant of Concern
			Minimum	Maximum	Average	Environmental Guideline Comparison Value	NJDEP RDCSCC [a]	
METALS - Depth: 0.5 - 8.2 feet								
Antimony	9	1	ND	53	5.9	20 (RMEG) [b]	14	**Yes**
Arsenic	9	9	1.4	80	16	0.5 (CREG) [c]	20	**Yes**
Beryllium	9	7	ND	2.3	0.6	100 (EMEG) [d]	2 [f]	**Yes**
Cadmium	9	2	ND	11	1.5	10 (EMEG)	39	**Yes**
Chromium	9	9	6.9	110	34	200 (EMEG)	240	No
Copper	9	9	2.9	830	137	500 (EMEG)	600	**Yes**
Cyanide (Total)	3	0	ND	0.0	0.0	1,000 (RMEG)	1,100	No
Lead	9	9	9.4	24,000	2,787	NA	400	**Yes**
Mercury	9	3	ND	0.6	0.1	NA	14	No
Nickel	9	8	ND	100	25	1,000 (RMEG)	250	No
Selenium	9	0	ND	0.0	0.0	300 (EMEG)	63	No
Silver	9	1	ND	11	1.2	300 (RMEG)	110	No
Thallium	9	2	ND	1.9	0.3	5.5 (RBC)N [e]	2	No
Zinc	9	9	29.6	2,000	481	20,000 (RMEG)	1,500	**Yes**
VOLATILE ORGANIC COMPOUNDS - Depth: 3.5 - 8.2 feet								
Benzene	3	2	ND	0.02	0.01	10 (CREG)	3	No
Ethylbenzene	3	1	ND	0.002	0.001	5000 (RMEG)	1,000	No
Methylene Chloride	3	2	ND	0.01	0.00	90 (CREG)	49	No
Toluene	3	2	ND	0.01	0.01	1000 (EMEG)	1,000	No
Trichloroethene	3	3	0.03	0.16	0.08	1.6 (RBC)C	23	No
Xylene	3	1	ND	0.002	0.001	30,000 (EMEG)	410	No
SEMI-VOLATILE ORGANIC COMPOUNDS (SVOC) - Depth: 0.5 - 8.2 feet								
Bis(2-ethylhexyl)phthalate	5	1	ND	0.19	0.04	46 (RBC)C	49	No

Table 6 - continued

Contaminant	Number of Samples	Number of Detections	Concentration: milligrams/kilogram					Contaminant of Concern
			Minimum	Maximum	Average	Environmental Guideline Comparison Value	NJDEP RDCSCC	
Polycyclic Aromatic Hydrocarbons (SVOC fraction) - Depth: 0.5 - 8.2 feet								
Benzo(a) anthracene	6	1	ND	0.27	0.05	0.22 (RBC)C	0.9	**Yes**
Benzo(a) pyrene	6	1	ND	0.34	0.06	0.1 (CREG)	0.66	**Yes**
Benzo(b) fluoranthene	6	1	ND	0.38	0.06	0.22 (RBC)C	0.9	**Yes**
Benzo(k) fluoranthene	6	1	ND	0.35	0.06	2.2 (RBC)C	0.9	No
Chrysene	6	1	ND	0.33	0.06	22 (RBC)C	9	No
Fluoranthene	6	2	ND	0.42	0.13	2,000 (RMEG)	2,300	No
Phenanthrene	6	2	ND	0.27	0.08	NA	NA	**Yes**
Pyrene	6	2	ND	0.58	0.17	2,000 (RMEG)	1700	No
Phenolics (SVOC fraction) - Depth: 3.5 - 8.2 feet								
Phenolics	3	0	ND	ND	ND	-	-	No
POLYCHLORINATED BIPHENYLS - Depth: 3.5 - 8.2 feet								
All PCBs	3	0	ND	ND	ND	-	-	No
ORGANOCHLORINE PESTICIDES (OCPs) - Depth: 3.5 - 8.2 feet								
All OCPs	3	0	ND	ND	ND	-	-	No
TOTAL PETROLEUM HYDROCARBONS - Depth: 3.5 - 8.2 feet								
TPHCs	3	1	ND	72	24	NA	10,000	No

(a) New Jersey Department of Environmental Protection Residential Direct Contact Soil Cleanup Criteria; (b) Reference Media Evaluation Guide; (c) Cancer Risk Evaluation Guide; (d) Environmental Media Evaluation Guide; (e) USEPA Region 3 Risk-Based Concentration (N: Non-carcinogenic effects, C: Carcinogenic effects); (f) - Based on naturally occurring background concentrations; NA - Not Available; ND - Not Detected

Table 7: Contaminants in Indoor Air - North Brunswick Township High School.
Sample Data: April 2004 through December 2006

Contaminant	Number of Samples [a]	Number of Detections	Concentration: micrograms/cubic meter					Contaminant of Concern
			Minimum	Maximum	Average	Environmental Guideline Comparison Value	NJDEP IASL [c]	
VOLATILE ORGANIC COMPOUNDS								
1,2-Dichloroethane	15	0	0.41 [b] (DL = <0.81)	0.41 [b] (DL = <0.81)	0.41 [b] (DL = <0.81)	0.04 (CREG) [d]	2	**Yes**
1,2-Dichloroethene (cis)	15	0	ND (DL = <0.79)	ND (DL = <0.79)	ND (DL = <0.79)	37 (RBC)N [e]	36	No
Trichloroethylene	22	2 [f]	0.14 [b] (DL = 0.27)	0.7	0.18	0.016 (RBC)C	3	**Yes**
Vinyl Chloride	15	0	0.26 [b] (DL = <0.51)	0.26 [b] (DL = <0.51)	0.26 [b] (DL = <0.51)	0.1 (CREG)	1	**Yes**

(a) - No detections present for one ambient air sample collected 11/08/2005; (b) - Non-detect result: concentration at 1/2 the report detection limit (DL) in parenthesis; (c) New Jersey Department of Environmental Protection Indoor Air Screening Level; (d) Cancer Risk Evaluation Guide; (e) USEPA Region 3 Risk-Based Concentration (N: Non-carcinogenic effects, C: Carcinogenic effects); (f) Detections present at Guidance Office and sump pit; ND - Not Detected

Table 8: Contaminants in Settled Dust - North Brunswick Township High School. Pre-Remedial and Post-Remedial Data

Contaminant	Number of Samples (location)	Number of Detections	Concentration: micrograms per square foot (µg/ft^2) min	max	avg	Settled Dust Screening Values (µg/ft^2) [(a)]	Contaminant of Concern
METALS - North Brunswick High School: Pre-Remediation of Soil at "The Oval" - Sample Date: July 25, 2003 [(b)]							
Arsenic	3 (window sill)	1	ND	**10.70**	3.57	36	No
	15 (floor)	3	ND	5.99	0.75		
Cadmium	3 (window sill)	2	ND	**0.65**	0.41	145	No
	15 (floor)	5	ND	0.65	0.19		
Lead	3 (window sill)	3	3	7.30	5.13	25	**Yes**
	15 (floor)	14	ND	**25.20**	5.69		
METALS - North Brunswick High School: Post-Remediation of Soil at "The Oval" - Sample Date: November 8, 2005							
Arsenic	3 (window sill)	3	1.60	3.40	2.23	36	No
	15 (floor)	15	1.20	**10.10**	2.23		
Cadmium	3 (window sill)	0	ND			145	No
	15 (floor)	0					
Lead	3 (window sill)	3	0.61	1.90	1.20	25	No
	15 (floor)	14	ND	**8.00**	2.11		
Zinc	3 (window sill)	3	11.20	**20.60**	17.43	43,720	No
	15 (floor)	15	8.10	112	46.97		

(a) Compared to maximum contaminant concentration detected (i.e. bold concentrations);
Source: World Trade Center Indoor Environment Assessment: Selecting Contaminants of Potential Concern and Setting Health-Based Benchmarks, Table A-3, US EPA, May 2003; (b) Copper and Zinc data rejected due to contamination of laboratory blank;
ND - Not Detected

Table 9: Contaminants in Surface Soil (0 - 0.5 feet) - Judd Elementary School: Unpaved Areas.
Sample Data: July 28, 2003.

Contaminant	Number of Samples	Number of Detections	Concentration: milligrams/kilogram					Contaminant of Concern
			Minimum	Maximum	Average	Environmental Guideline Comparison Value	NJDEP RDCSCC (a)	
METALS								
Antimony	9	0	ND	ND	ND	20 (RMEG) (b)	14	No
Arsenic	9	9	1.8	7.1	4.5	0.5 (CREG) (c)	20	**Yes**
Beryllium	9	8	ND	1.7	0.7	100 (EMEG) (d)	2	No
Cadmium	9	0	ND	ND	ND	10 (EMEG)	39	No
Chromium	9	9	6.0	34	17	200 (RMEG)	240	No
Cobalt	9	8	0	8.9	5.0	20 (EMEG)	NA	No
Copper	9	9	4.4	58	28	500 (EMEG)	600	No
Lead	9	9	4.5	47	29	NA	400	No
Mercury	9	3	ND	0.1	0.03	NA	14	No
Nickel	9	7	ND	15	10	1,000 (RMEG)	250	No
Selenium	9	0	ND	ND	ND	300 (EMEG)	63	No
Silver	9	0	ND	ND	ND	300 (RMEG)	110	No
Thallium	9	1	ND	1.5	0.2	5.5 (RBC)N (e)	2	No
Vanadium	9	9	8.5	49	28	200 (EMEG)	370	No
Zinc	9	9	6.1	65	43	20,000 (RMEG)	1,500	No

(a) New Jersey Department of Environmental Protection Residential Direct Contact Soil Cleanup Criteria; (b) Reference Media Evaluation Guide; (c) Cancer Risk Evaluation Guide; (d) Environmental Media Evaluation Guide; (e) USEPA Region 3 Risk-Based Concentration (N: Non-carcinogenic effects, C: Carcinogenic effects); NA - Not Available; ND - Not Detected

Table 10: Contaminants in Settled Dust - Judd Elementary School. Sample Date: July 25, 2003

Contaminant	Number of Samples (location)	Number of Detections	Concentration: micrograms per square foot (µg/ft^2)			Settled Dust Screening Values (µg/ft^2) [(a)]	Contaminant of Concern
			min	max	avg		
METALS							
Arsenic	4 (window sill)	0	ND			36	No
	6 (floor)	0					
Cadmium	4 (window sill)	4	0.86	**5.43**	2.64	145	No
	6 (floor)	0	ND				
Copper	4 (window sill)	4	7.12	**24.30**	15.05	5,830	No
	6 (floor)	6	5.14	8.85	6.85		
Lead	4 (window sill)	4	1.51	**7.21**	3.33	25	No
	6 (floor)	6	0.76	2.27	1.38		
Zinc	4 (window sill)	4	28.90	79.80	54.75	43,720	No
	6 (floor)	6	52.90	**172**	87.78		

(a) Compared to maximum contaminant concentration detected (i.e. bold concentrations);
Source: World Trade Center Indoor Environment Assessment: Selecting Contaminants of Potential Concern and Setting Health-Based Benchmarks, Table A-3, US EPA, May 2003;
ND - Not Detected

Table 11: Summary of Contaminant Concentrations in Surface Soil (0 - 0.5 feet) - Veteran's Park.
Sample Data: August 2003 to June 2005.

Contaminant	Number of Samples	Number of Detections	Concentration: milligrams/kilogram					Contaminant of Concern
			Minimum	Maximum	Average	Environmental Guideline Comparison Value	NJDEP RDCSCC [a]	
METALS - Sample Data: August 2003 to June 2005								
Antimony	13	0	ND	ND	ND	20 (RMEG) [b]	14	No
Arsenic	25	25	5.9	30.2	17.0	0.5 (CREG) [c]	20	**Yes**
Barium	12	12	49.1	171	107	30,000 (EMEG) [d]	700	No
Beryllium	13	9	ND	1.3	0.4	100 (EMEG)	2	No
Cadmium	13	2	ND	0.6	0.1	10 (EMEG)	39	No
Chromium	12	12	15.1	85.9	27.5	200 (RMEG)	240	No
Cobalt	13	13	1.5	7.1	3.4	20 (EMEG)	NA	No
Copper	24	23	0.0	82.6	33.8	500 (EMEG)	600	No
Lead	29	29	5.4	1,640	113	NA	400	**Yes**
Mercury	13	9	ND	0.4	0.1	NA	14	No
Nickel	13	13	ND	15.2	9.0	1,000 (RMEG)	250	No
Selenium	13	0	ND	ND	ND	300 (EMEG)	63	No
Silver	13	0	ND	ND	ND	300 (RMEG)	110	No
Thallium	25	0	ND	ND	ND	5.5 (RBC)N [e]	2	No
Vanadium	13	13	26.2	130.0	39.0	200 (EMEG)	370	No
Zinc	25	25	20.7	365	138	20,000 (RMEG)	1,500	No
SEMI-VOLATILE ORGANIC COMPOUNDS - Polycyclic Aromatic Hydrocarbons - Sample Data: August 2003								
Acenapthlene	1	0	ND	ND	ND	3,000 (RMEG)	3,400	No
Acenaphthylene	1	0	ND	ND	ND	NA	NA	No
Anthracene	1	0	ND	ND	ND	20,000 (RMEG)	10,000	No
Benzo(a) anthracene	1	1	0.124	0.124	0.124	0.22 (RBC)C	0.9	No
Benzo(a) pyrene	1	1	0.144	0.144	0.144	0.1 (CREG)	0.66	**Yes**
Benzo(b) fluoranthene	1	1	0.138	0.138	0.138	0.22 (RBC)C	0.9	No

Table 11 - continued

Contaminant	Number of Samples	Number of Detections	Concentration: milligrams/kilogram					Contaminant of Concern
			Minimum	Maximum	Average	Environmental Guideline Comparison Value	NJDEP RDCSCC (a)	
SEMI-VOLATILE ORGANIC COMPOUNDS - Polycyclic Aromatic Hydrocarbons								
Benzo(ghi) perylene	1	1	0.100	0.100	0.100	NA	NA	**Yes**
Benzo(k) fluoranthene	1	1	0.162	0.162	0.162	2.2 (RBC)C	0.9	No
Chrysene	1	1	0.169	0.169	0.169	22 (RBC)C	9	No
Dibenzo(a,h) anthracene	1	0	ND	ND	ND	0.022 (RBC)C	0.66	No
Fluoranthene	1	1	0.139	0.139	0.139	2,000 (RMEG)	2,300	No
Fluorene	1	0	ND	ND	ND	2,000 (RMEG)	2,300	No
Indeno (1,2,3-cd) pyrene	1	1	0.079	0.079	0.079	0.22 (RBC)C	0.9	No
Napthhalene	1	0	ND	ND	ND	1,000 (RMEG)	230	No
Phenanthrene	1	1	0.059	0.059	0.059	NA	NA	**Yes**
Pyrene	1	1	0.183	0.183	0.183	2,000 (RMEG)	1700	No

(a) New Jersey Department of Environmental Protection Residential Direct Contact Soil Cleanup Criteria; (b) Reference Media Evaluation Guide; (c) Cancer Risk Evaluation Guide; (d) Environmental Media Evaluation Guide; (e) USEPA Region 3 Risk-Based Concentration (N: Non-carcinogenic effects, C: Carcinogenic effects); NA - Not Available; ND - Not Detected

Table 12: Summary of Contaminant Concentrations in Subsurface Soil (0.5 - 5 feet) - Veteran's Park. Sample Data: August 2003 to April 2006.

Contaminant	Number of Samples	Number of Detections	Concentration: milligrams/kilogram					Contaminant of Concern
			Minimum	Maximum	Average	Environmental Guideline Comparison Value	NJDEP RDCSCC [(a)]	
METALS - Depth: 0.5 - 5 feet; Sample Data: August 2003 to April 2006								
Antimony	20	6	ND	6.6	1.3	20 (RMEG) [(b)]	14	No
Arsenic	82	81	ND	719	80.4	0.5 (CREG) [(c)]	20	**Yes**
Barium	40	39	ND	3,220	553	30,000 (EMEG) [(d)]	700	**Yes**
Beryllium	20	16	ND	1.4	0.4	100 (EMEG)	2	No
Cadmium	20	6	ND	10.4	2.0	10 (EMEG)	39	**Yes**
Chromium	20	20	11.1	110.0	34.8	200 (RMEG)	240	No
Cobalt	2	2	3.9	10.6	7.2	20 (EMEG)	NA	No
Copper	59	59	2.8	1,800	254	500 (EMEG)	600	**Yes**
Cyanide (Total)	2	0	ND	ND	ND	1,000 (RMEG)	1,100	No
Lead	63	63	5.4	5,290	560	NA	400	**Yes**
Mercury	20	10	ND	5.3	0.7	NA	14	No
Nickel	20	20	3.0	140	32.3	1,000 (RMEG)	250	No
Selenium	20	0	ND	ND	ND	300 (EMEG)	63	No
Silver	20	5	ND	6.3	0.9	300 (RMEG)	110	No
Thallium	59	16	ND	4.0	0.6	5.5 (RBC)N [(e)]	2	**Yes**
Vanadium	2	2	31.8	48.8	40.3	200 (EMEG)	370	No
Zinc	60	60	9.6	8,920	1,167	20,000 (RMEG)	1,500	**Yes**
VOLATILE ORGANIC COMPOUNDS - Depth: 3.3 - 4.5 feet; Sample Data: October 2003								
1,2-Dichlorobenzene	2	1	ND	0.014	0.007	20,000 (EMEG)	5,100	No
1,3-Dichlorobenzene	2	1	ND	0.013	0.0065	1,000 (EMEG)	5,100	No
1,4-Dichlorobenzene	2	1	ND	0.023	0.0115	4,000 (EMEG)	570	No
Benzene	2	1	ND	0.003	0.0015	10 (CREG)	3	No
Ethylbenzene	2	1	ND	0.002	0.001	5000 (RMEG)	1,000	No
Toluene	2	1	ND	0.025	0.0125	1000 (EMEG)	1,000	No
Xylene	2	1	ND	0.004	0.002	30,000 (EMEG)	410	No

Table 12 - continued

Contaminant	Number of Samples	Number of Detections	Concentration: milligrams/kilogram					Contaminant of Concern
			Minimum	Maximum	Average	Environmental Guideline Comparison Value	NJDEP RDCSCC [(a)]	
SEMI-VOLATILE ORGANIC COMPOUNDS (SVOC) - Depth: 0.5 - 3.8 feet; Sample Data: October 2003								
Bis(2-ethylhexyl)phthalate	20	3	ND	0.99	0.11	NA	49	No
Polycyclic Aromatic Hydrocarbons (SVOC fraction) - Depth: 0.5 - 3.8 feet; Sample Data: October 2003								
Acenapthlene	20	1	ND	0.37	0.02	3,000 (RMEG)	3,400	No
Acenaphthylene	20	1	ND	0.07	0.00	NA	NA	No
Anthracene	20	2	ND	2.50	0.17	20,000 (RMEG)	10,000	No
Benzo(a) anthracene	20	6	ND	7.50	0.60	0.22 (RBC)C	0.9	**Yes**
Benzo(a) pyrene	20	6	ND	5.30	0.47	0.1 (CREG)	0.66	**Yes**
Benzo(b) fluoranthene	20	6	ND	5.50	0.49	0.22 (RBC)C	0.9	**Yes**
Benzo(ghi) perylene	20	4	ND	2.20	0.21	NA	NA	**Yes**
Benzo(k) fluoranthene	20	6	ND	4.10	0.37	2.2 (RBC)C	0.9	**Yes**
Chrysene	20	6	ND	7	0.58	22 (RBC)C	9	No
Di-n-butyl phthalate	20	1	ND	0.22	0.01	5,000 (RMEG)	5,700	No
Dibenzo(a,h) anthracene	20	3	ND	0.97	0.07	0.022 (RBC)C	0.66	**Yes**
Fluoranthene	20	6	ND	13	0.95	2,000 (RMEG)	2,300	No
Fluorene	20	2	ND	0.54	0.04	2,000 (RMEG)	2,300	No
Indeno (1,2,3-cd) pyrene	20	4	ND	2.10	0.20	0.22 (RBC)C	0.9	**Yes**
Napthhalene	20	1	ND	0.09	0.00	1,000 (RMEG)	230	No
Phenanthrene	20	4	ND	7.30	0.54	NA	NA	**Yes**
Pyrene	20	6	ND	12	0.97	2,000 (RMEG)	1700	No
Phenolics (SVOC fraction) - Depth: 3.3 - 4.5 feet; Sample Data: October 2003								
Phenolics	2	0	ND	ND	ND	20,000 (RMEG)	10,000	No
POLYCHLORINATED BIPHENYLS (PCBs) - Depth: 3.3 - 4.5 feet; Sample Data: October 2003								
Arochlor 1260	2	1	ND	0.26	0.13	0.32 (RBC)C	0.49	No
ORGANOCHLORINE PESTICIDES - Depth: 3.3 - 4.5 feet; Sample Data: October 2003								
4,4'-DDD	2	1	ND	0.15	0.08	2.7 (RBC)C	3	No
TOTAL PETROLEUM HYDROCARBONS - Depth: 3.3 - 4.5 feet; Sample Data: October 2003								
TPHCs	2	1	ND	1.1	0.55	NA	10,000	No

(a) New Jersey Department of Environmental Protection Residential Direct Contact Soil Cleanup Criteria; (b) Reference Media Evaluation Guide; (c) Cancer Risk Evaluation Guide; (d) Environmental Media Evaluation Guide; (e) USEPA Region 3 Risk-Based Concentration (N: Non-carcinogenic effects, C: Carcinogenic effects); NA - Not Available; ND - Not Detected

Table 13: Summary of Contaminant Concentrations in Surface Soil (0 - 0.5 feet) - Block 143, Lots 94.01 and 95.01. Sample Data: March 2005 through September 2006.

Contaminant	Number of Samples	Number of Detections	Concentration: milligrams/kilogram					Contaminant of Concern
			Minimum	Maximum	Average	Environmental Guideline Comparison Value	NJDEP RDCSCC [(a)]	
METALS								
Antimony	9	4	ND	18.3	4.7	20 (RMEG) [(b)]	14	**Yes**
Arsenic	15	15	7.6	1,830	268	0.5 (CREG) [(c)]	20	**Yes**
Barium	7	7	46.3	3,370	1,113	30,000 (EMEG) [(d)]	700	**Yes**
Beryllium	9	0	ND	ND	ND	100 (EMEG)	2	No
Cadmium	9	4	ND	17.2	5.3	10 (EMEG)	39	**Yes**
Chromium	9	9	9.1	202	53.9	200 (RMEG)	240	**Yes**
Copper	9	9	18.3	2,080	471	500 (EMEG)	600	**Yes**
Lead	9	9	43.0	3,560	843	NA	400	**Yes**
Mercury	9	9	0.1	6.4	1.8	NA	14	No
Nickel	9	9	7.6	252	64	1,000 (RMEG)	250	**Yes**
Selenium	9	6	ND	4.1	1.7	300 (EMEG)	63	No
Silver	9	4	ND	7.6	2.4	300 (RMEG)	110	No
Thallium	8	0	ND	ND	ND	5.5 (RBC)N [(e)]	2	No
Zinc	9	9	134.0	26,300	5,253	20,000 (RMEG)	1,500	**Yes**
SEMI-VOLATILE ORGANIC COMPOUNDS (SVOCs)								
Bis(2-ethylhexyl)phthalate	9	4	ND	0.416	0.119	NA	49	No
Polycyclic Aromatic Hydrocarbons (SVOC fraction)								
Acenapthlene	9	1	ND	0.031	0.003	3,000 (RMEG)	3,400	No
Acenaphthylene	9	1	ND	0.033	0.004	NA	NA	**Yes**
Anthracene	9	4	ND	0.140	0.044	20,000 (RMEG)	10,000	No
Benzo(a) anthracene	9	5	ND	0.492	0.197	0.22 (RBC)C	0.9	**Yes**
Benzo(a) pyrene	9	4	ND	0.422	0.159	0.1 (CREG)	0.66	**Yes**
Benzo(b) fluoranthene	9	4	ND	0.458	0.178	0.22 (RBC)C	0.9	**Yes**

Table 13 - continued

Contaminant	Number of Samples	Number of Detections	Concentration: milligrams/kilogram					Contaminant of Concern
			Minimum	Maximum	Average	Environmental Guideline Comparison Value	NJDEP RDCSCC [(a)]	
Polycyclic Aromatic Hydrocarbons (SVOC fraction)								
Benzo(ghi) perylene	9	4	ND	0.235	0.067	NA	NA	**Yes**
Benzo(k) fluoranthene	9	4	ND	0.418	0.142	2.2 (RBC)C	0.9	No
Chrysene	9	7	ND	0.571	0.216	22 (RBC)C	9	No
Dibenzo(a,h) anthracene	9	3	ND	0.069	0.019	0.022 (RBC)C	0.66	**Yes**
Di-n-butly phthalate	9	3	ND	0.182	0.042	5,000 (RMEG)	5,700	No
Fluoranthene	9	7	ND	0.904	0.345	2,000 (RMEG)	2,300	No
Fluorene	9	1	ND	0.037	0.004	2,000 (RMEG)	2,300	No
Indeno (1,2,3-cd) pyrene	9	4	ND	0.205	0.068	0.22 (RBC)C	0.9	No
Napthhalene	9	0	ND	ND	ND	1,000 (RMEG)	230	No
Phenanthrene	9	5	ND	0.730	0.195	NA	NA	**Yes**
Pyrene	9	5	ND	0.895	0.328	2,000 (RMEG)	1700	No
POLYCHLORINATED BIPHENYLS (PCBs)								
Aroclor 1254	9	2	ND	15.2	1.75	0.32 (RBC)C	0.49	**Yes**
Aroclor 1260	9	3	ND	0.847	0.25	0.32 (RBC)C	0.49	**Yes**

(a) New Jersey Department of Environmental Protection Residential Direct Contact Soil Cleanup Criteria; (b) Reference Media Evaluation Guide; (c) Cancer Risk Evaluation Guide; (d) Environmental Media Evaluation Guide; (e) USEPA Region 3 Risk-Based Concentration (N: Non-carcinogenic effects, C: Carcinogenic effects); NA - Not Available; ND - Not Detected

Table 14: Summary of Contaminant Concentrations in Subsurface Soil (0.5 - 4.5 feet) - Block 143, Lots 94.01 and 95.01. Sample Data: March 2005 through September 2006.

Contaminant	Number of Samples	Number of Detections	Concentration: milligrams/kilogram					Contaminant of Concern
			Minimum	Maximum	Average	Environmental Guideline Comparison Value	NJDEP RDCSCC [(a)]	
METALS								
Antimony	11	7	ND	22.3	7.9	20 (RMEG) [(b)]	14	**Yes**
Arsenic	23	23	1.7	3,870	465	0.5 (CREG) [(c)]	20	**Yes**
Barium	10	9	ND	8,580	2,604	30,000 (EMEG) [(d)]	700	**Yes**
Beryllium	9	0	ND	ND	ND	100 (EMEG)	2	No
Cadmium	9	6	ND	13	5	10 (EMEG)	39	**Yes**
Chromium	9	9	11	76	40	200 (RMEG)	240	No
Copper	12	12	5.7	2,580	466	500 (EMEG)	600	**Yes**
Lead	18	18	6.0	21,400	2,168	NA	400	**Yes**
Mercury	9	6	ND	5	2	NA	14	No
Nickel	9	7	ND	108	48	1,000 (RMEG)	250	No
Selenium	9	5	ND	13	3	300 (EMEG)	63	No
Silver	9	4	ND	4	2	300 (RMEG)	110	No
Thallium	9	0	ND	ND	ND	5.5 (RBC)N [(e)]	2	No
Zinc	13	13	20	16,700	6,082	20,000 (RMEG)	1,500	**Yes**
SEMI-VOLATILE ORGANIC COMPOUNDS (SVOCs)								
Bis(2-ethylhexyl)phthalate	10	7	ND	1.380	0.400	NA	49	No
Polycyclic Aromatic Hydrocarbons (SVOC fraction)								
Acenapthlene	10	1	ND	0.029	0.003	3,000 (RMEG)	3,400	No
Acenaphthylene	10	5	ND	0.106	0.032	NA	NA	**Yes**
Anthracene	10	6	ND	0.115	0.041	20,000 (RMEG)	10,000	No
Benzo(a) anthracene	10	6	ND	0.544	0.180	0.22 (RBC)C	0.9	**Yes**
Benzo(a) pyrene	10	7	ND	0.433	0.228	0.1 (CREG)	0.66	**Yes**
Benzo(b) fluoranthene	10	7	ND	0.510	0.241	0.22 (RBC)C	0.9	**Yes**

Table 14 - continued

Contaminant	Number of Samples	Number of Detections	Concentration: milligrams/kilogram					Contaminant of Concern
			Minimum	Maximum	Average	Environmental Guideline Comparison Value	NJDEP RDCSCC [(a)]	
Polycyclic Aromatic Hydrocarbons (SVOC fraction)								
Benzo(ghi) perylene	10	6	ND	0.225	0.101	NA	NA	**Yes**
Benzo(k) fluoranthene	10	7	ND	0.403	0.194	2.2 (RBC)C	0.9	No
Chrysene	10	7	ND	0.603	0.231	22 (RBC)C	9	No
Dibenzo(a,h) anthracene	10	5	ND	0.075	0.030	0.022 (RBC)C	0.66	**Yes**
Di-n-butly phthalate	10	6	ND	0.342	0.104	5,000 (RMEG)	5,700	No
Fluoranthene	10	6	ND	0.760	0.260	2,000 (RMEG)	2,300	No
Fluorene	10	1	ND	0.356	0.036	2,000 (RMEG)	2,300	No
Indeno (1,2,3-cd) pyrene	10	5	ND	0.225	0.076	0.22 (RBC)C	0.9	**Yes**
Napthhalene	10	3	ND	0.167	0.022	1,000 (RMEG)	230	No
Phenanthrene	10	7	ND	0.391	0.139	NA	NA	**Yes**
Pyrene	10	7	ND	0.896	0.327	2,000 (RMEG)	1700	No
POLYCHLORINATED BIPHENYLS (PCBs)								
Aroclor 1260	8	4	ND	2.660	0.476	0.32 (RBC)C	0.49	**Yes**

(a) New Jersey Department of Environmental Protection Residential Direct Contact Soil Cleanup Criteria; (b) Reference Media Evaluation Guide; (c) Cancer Risk Evaluation Guide; (d) Environmental Media Evaluation Guide; (e) USEPA Region 3 Risk-Based Concent

Table 15: Summary of Contaminant Concentrations in Grab Groundwater Samples (6 to 8 feet below grade) Within Waste Material Area - North Brunswick Township High School. Sample Date: October 15, 2003

Contaminant	Number of Samples	Number of Detections	Concentration: micrograms/liter					Contaminant of Concern
			Minimum	Maximum	Average	Environmental Guideline Comparison Value	NJDEP GWQC [a]	
TOTAL METALS								
Antimony	3	0	ND	ND	ND	4 (RMEG) [b]	6	No
Arsenic		3	440	43,000	15,180	0.02 (CREG) [c]	3	**Yes**
Beryllium		3	29	100	69	2,000 (RMEG)	2,000	No
Cadmium		2	ND	220	120	2 (EMEG) [d]	4	**Yes**
Chromium		3	100	2,400	1,300	100 (MCL) [e]	70	**Yes**
Copper		3	1,400	6,500	3,100	100 (EMEG)	1,300	**Yes**
Cyanide (total)		0	ND	ND	ND	200 (RMEG)	100	No
Lead		3	1,400	23,000	8,700	15 (MCL)	5	**Yes**
Mercury		3	2.8	170	68	NA	2	**Yes**
Nickel		3	1,100	2,200	1,733	100 (LTHA) [f]	100	**Yes**
Selenium		0	ND	ND	ND	50 (EMEG)	40	No
Silver		0	ND	ND	ND	50 (RMEG)	40	No
Thallium		0	ND	ND	ND	0.5 (LTHA)	2	No
Zinc		3	1,200	110,000	57,067	2,000 (LTHA)	2,000	**Yes**
VOLATILE ORGANIC COMPOUNDS								
Trichloroethylene	3	3	2	89	43	5 (MCL)	1	**Yes**
Vinyl Chloride		1	ND	3	1	0.03 (CREG)	1	**Yes**
SEMI-VOLATILE ORGANIC COMPOUNDS (SVOCs)								
Polycyclic Aromatic Hydrocarbons (SVOC fraction)								
Naphthalene	3	3	4	7	6	100 (LTHA)	300	No
Phenolics (SVOC fraction)								
Phenolics	3	1	ND	0.08	0.03	2,000 (LTHA)	2,000	No

Table 15 - continued

Contaminant	Number of Samples	Number of Detections	Concentration: micrograms/liter					Contaminant of Concern
			Minimum	Maximum	Average	Environmental Guideline Comparison Value	NJDEP GWQC [(a)]	
POLYCHLORINATED BIPHENYLS								
PCBs - Total	3	0	ND	ND	ND	0.02 (CREG)	0.50	No
ORGANOCHLORINE PESTICIDES								
All Compounds	3	0	ND	ND	ND	-	-	No
TOTAL PETROLEUM HYDROCARBONS								
TPHC	3	0	ND	ND	ND	-	-	No

(a) New Jersey Department of Environmental Protection Groundwater Quality Criteria; (b) Reference Media Evaluation Guide; (c) Cancer Risk Evaluation Guide; (d) Environmental Media Evaluation Guide; (e) Maximum Contaminant Level; (f) Lifetime Health Advisory

Table 16: Summary of Contaminant Concentrations in Shallow Groundwater (5 to 13 feet below grade): North Brunswick Township High School/Veteran's Park/Residential Areas. Sample Data: July 2004 through March 2007

Contaminant	Number of Samples	Number of Detections	Concentration: micrograms/liter					Contaminant of Concern
			Minimum	Maximum	Average	Environmental Guideline Comparison Value	NJDEP GWQC [a]	
TOTAL METALS: Well Count: 17								
Antimony	33	2	ND	13	1	4 (RMEG) [b]	6	**Yes**
Arsenic	59	21	ND	81	6	0.02 (CREG) [c]	3	**Yes**
Barium	47	22	ND	1,020	167	2,000 (RMEG)	2,000	No
Copper	55	21	ND	1,000	48	100 (EMEG) [d]	1,300	**Yes**
Lead	59	35	ND	232	16	15 (MCL) [e]	5	**Yes**
Nickel	59	28	ND	223	40	100 (LTHA) [f]	100	**Yes**
Thallium	26	7	ND	33	6	0.5 (LTHA)	2	**Yes**
Zinc	44	42	ND	607	128	2,000 (LTHA)	2,000	No
TOTAL METALS - UPGRADIENT WELL MW-1								
Antimony	2	0	ND	0	0	4 (RMEG)	6	No
Arsenic	6	2	ND	52	15	0.02 (CREG)	3	**Yes**
Barium	4	2	ND	1,800	502	2,000 (RMEG)	2,000	No
Copper	5	3	ND	213	53	100 (EMEG)	1,300	**Yes**
Lead	6	5	ND	183	36	15 (MCL)	5	**Yes**
Nickel	5	3	ND	592	135	100 (LTHA)	100	**Yes**
Thallium	4	0	ND	0	0	0.5 (LTHA)	2	No
Zinc	4	2	ND	253	73	2,000 (LTHA)	2,000	No
DISSOLVED METALS: Well Count: 16								
Antimony	33	1	ND	10	0.3	4 (RMEG)	6	**Yes**
Arsenic	52	7	ND	19	1.4	0.02 (CREG)	3	**Yes**
Barium	41	13	ND	759	114	2,000 (RMEG)	2,000	No
Copper	47	3	ND	85	3.0	100 (EMEG)	1,300	No
Lead	52	6	ND	40	1.3	15 (MCL)	5	**Yes**
Nickel	52	16	ND	150	26	100 (LTHA)	100	**Yes**
Thallium	20	2	ND	15	1.4	0.5 (LTHA)	2	**Yes**
Zinc	36	30	ND	580	85	2,000 (LTHA)	2,000	No

Table 16 - continued

Contaminant	Number of Samples	Number of Detections	Concentration: micrograms/liter					Contaminant of Concern
			Minimum	Maximum	Average	Environmental Guideline Comparison Value	NJDEP GWQC [(a)]	
DISSOLVED METALS - UPGRADIENT WELL MW-1								
Antimony	2	0	ND	0	0	4 (RMEG)	6	No
Arsenic	4	1	ND	8.7	2.18	0.02 (CREG)	3	No
Barium	3	1	ND	880	293	2,000 (RMEG)	2,000	No
Copper	3	0	ND	0	0	100 (EMEG)	1,300	No
Lead	4	1	ND	3	0.75	15 (MCL)	5	No
Nickel	3	0	ND	0	0	100 (LTHA)	100	No
Thallium	2	1	ND	20	10	0.5 (LTHA)	2	**Yes**
Zinc	2	0	ND	0	0	2,000 (LTHA)	2,000	No
VOLATILE ORGANIC COMPOUNDS: Well Count 17								
Benzene	59	9	ND	4	0.24	0.6 (CREG)	1	**Yes**
Chloroform	58	1	ND	0.17	0.00	70 (LTHA)	70	No
Chloromethane	58	0	ND	0	0.00	30 (LTHA)	NA	No
1,2-Dichlorobenzene	41	3	ND	3.3	0.11	600 (LTHA)	600	No
1,4-Dichlorobenzene	41	1	ND	0.57	0.01	75 (LTHA)	75	No
1,1-Dichloroethane	58	6	ND	2.4	0.13	NA	50	No
1,2-Dichloroethane	59	8	ND	15	0.59	0.4 (CREG)	2	**Yes**
1,1-Dichloroethene	58	3	ND	1.2	0.06	7 (MCL)	1	**Yes**
1,2-Dichloroethene (cis)	58	31	ND	52	3.53	70 (MCL)	70	No
1,2-Dichloroethene (trans)	58	10	ND	21	0.89	100 (MCL)	100	No
Ethylbenzene	58	4	ND	2.7	0.10	700 (LTHA)	700	No
Tetrachloroethylene	59	2	ND	3.8	0.07	5 (MCL)	1	**Yes**
Toluene	58	9	ND	9.9	0.47	200 (EMEG)	1,000	No
Trichloroethylene	71	52	ND	2,580	209	5 (MCL)	1	**Yes**
1,1,2-Trichloroethane	58	1	ND	0.28	0.00	0.6	3	No
Vinyl Chloride	59	19	ND	6.3	0.57	0.03 (CREG)	1	**Yes**
Xylenes	58	6	ND	5.7	0.25	2,000 (RMEG)	1,000	No
VOLATILE ORGANIC COMPOUNDS - UPGRADIENT WELL MW-1								
Above VOCs	5	0	ND	ND	ND	-	-	No

(a) New Jersey Department of Environmental Protection Groundwater Quality Criteria; (b) Reference Media Evaluation Guide; (c) Cancer Risk Evaluation Guide; (d) Environmental Media Evaluation Guide; (e) Maximum Contaminant Level; (f) Lifetime Health Advisory; NA - Not Available; ND - Not Detected

Table 17 – Evaluated Exposure Pathways

Pathway	Pathway Exposure Pathway Elements					Pathway Classification
	Environmental Medium	Route of Exposure	Location	Exposed Population	Point of Exposure	
Soil	Surface Soil (0 – 6 inches)	Ingestion	North Brunswick Township High School	Students and Adult Faculty	Former "The Oval" Area	Past – Potential [a] Present & Future – Eliminated [b]
					High School Football Field	Past, Present & Future – Completed
					High School Building Perimeter (unpaved areas)	
			Judd Elementary School	Students (Child) and Adult Faculty	School Property (unpaved areas)	Past, Present & Future – Completed
			Veteran's Park/PSE&G Easement	Area Residents (Child and Adult)	Park and Easement (unpaved areas)	Past & Present – Completed Future – TBRE [c]
Settled Dust	Settled Dust	Ingestion	North Brunswick Twp. High School	Students and Adult Faculty	Interior Surfaces	Past – Completed Present & Future – TBRE [c]
Indoor Air	Indoor Air	Inhalation	6 Residences	Area Residents (Child and Adult)	Basement Interior	Past – Completed Present & Future – Interrupted [d]

(a) Surface soil data not collected; therefore, completed past exposures cannot be interpreted for this area.
(b) Area no longer used for high school related activities by 2003 due to expansion (construction) activities and remedial investigations.
(c) To Be Re-Evaluated – Pending successful completion of remedial actions planned for Veteran's Park, PSE&G Easement and North Brunswick Township High School in 2009.
(d) Present and Future exposures are considered interrupted as the New Jersey Department of Environmental Protection (NJDEP) is actively monitoring the residences to prevent chronic exposures regarding inhalation of TCE in indoor air at concentrations exceeding the Indoor Air Screening Level.

Table 18: Comparison of Soil Ingestion Exposure Dose with Health Guideline Comparison Values (CVs). North Brunswick High School: Former "The Oval" Area and Area Within the Waste-Fill Boundary - Subsurface Layer > 0.5 feet. (see footnote)

Contaminant Of Concern	Max. (mg/kg)	Avg. (mg/kg)	Maximum Exposure Dose (mg/kg/day)		Health Guideline CVs (mg/kg/day)		Potential for Non-cancer Health Effects
			Student [a]	Adult [b]	ATSDR MRL [c]	USEPA RfD [d]	
METALS							
Antimony	36	4	2.66E-05	2.54E-05	NA	4E-04	No
Arsenic	3,600	728	2.66E-03 (5.38E-04)	2.54E-03 (5.12E-04)	3E-04 C 5E-03 A	3E-04	**Yes**
Cadmium	17	4	1.26E-05	1.20E-05	2E-04 C	1E-03	No
Chromium	490	46	3.63E-04	3.45E-04	3E-04 C	3E-03	No
Copper	3,900	384	2.89E-03	2.75E-03	0.01 A/I	4E-02	No
Lead	4,400	728	3.26E-03	3.10E-03	NA	NA	No [e]
Thallium	2.3	0.3	1.70E-06	1.62E-06	NA	7E-05	No
Zinc	33,300	3,703	2.46E-02	2.35E-02	0.3 C/I	0.3	No
VOLATILE ORGANIC COMPOUNDS							
Trichloroethene	7.5	0.34	2.52E-07	2.40E-07	0.2 A	3E-04	No
SEMI-VOLATILE ORGANIC COMPOUNDS (SVOC)							
Polycyclic Aromatic Hydrocarbon (SVOC fraction)							
Benzo(a)anthracene	5.1	0.47	3.77E-06	3.59E-06	NA	NA	No [f]
Benzo(a)pyrene	3.8	0.36	2.81E-06	2.68E-06	NA	NA	No [f]
Benzo(b)fluoranthene	4.0	0.37	2.96E-06	2.82E-06	NA	NA	No [f]
Benzo(g,h,i)perylene	1.3	0.13	9.62E-07	9.16E-07	NA	NA	No [f]
Benzo(k)fluoranthene	3.4	0.33	2.52E-06	2.40E-06	NA	NA	No [f]
Dibenz(a,h)anthracene	0.6	0.05	4.44E-07	4.23E-07	NA	NA	No [f]

Table 18 - continued

Contaminant Of Concern	Max. (mg/kg)	Avg. (mg/kg)	Maximum Exposure Dose (mg/kg/day)		Health Guideline CVs (mg/kg/day)		Potential for Non-cancer Health Effects
			Student [(a)]	Adult [(b)]	ATSDR MRL [(c)]	USEPA RfD [(d)]	
Indeno(1,2,3-cd)pyrene	1.3	0.13	9.62E-07	9.16E-07	NA	NA	No [(f)]
Phenanthrene	5.6	0.54	4.14E-06	3.95E-06	NA	NA	No [(f)]

(a) Student exposure assumptions: 5 days/week, 36 weeks/year; 67 kg body weight; 100 mg/day ingestion rate; (b) Adult exposure assumptions: 5 days/week, 36 weeks/year; 70 kg body weight; 100 mg/day ingestion rate; (c) Agency for Toxic Substances Disease Registry's Minimal Risk Level (A = Acute < 15 days, I = Intermediate 15-364 days, C= Chronic > 364 days); (d) Reference Dose; (e) As evaluated using the US EPA Adult Lead Model (2003) (see text); (f) Based on comparison to the LOAEL; Value in parenthesis based on average concentration

(Footnote) Surface soil was not sampled for this area. Potential past exposures to students and faculty have been interpreted using subsurface contaminant concentrations to offer the reader a tentative evaluation of this area. The reader is cautioned that the interpretation of past exposures provided for this area area not evidence-based due to the lack of surface soil data necessary to justify exposures. Therefore, incidental ingestion of contaminated soil is not considered a completed exposure pathway for this area.

Table 19: Comparison of Soil Ingestion Exposure Dose with Health Guideline Comparison Values (CVs). North Brunswick High School - Surface Contact Layer.

Contaminant of Concern	Max. (mg/kg)	Avg. (mg/kg)	Maximum Exposure Dose (mg/kg/day)		Health Guideline CVs (mg/kg/day)		Potential for Non-cancer Health Effects
			Student [(a)]	Adult [(b)]	ATSDR MRL [(c)]	USEPA RfD [(d)]	
METALS - High School Building Perimeter and Areas Outside the Waste-Fill Boundary							
Arsenic	11	5	8.10E-06	7.75E-06	3E-04 C	3E-04	No
METALS - Football Field							
Arsenic	10	5	7.16E-06	6.82E-06	3E-04 C	3E-04	No

(a) Student exposure assumptions: 5 days/week, 36 weeks/year; 67 kg body weight; 100 mg/day ingestion rate; (b) Adult exposure assumptions: 5 days/week, 36 weeks/year; 70 kg body weight; 100 mg/day ingestion rate; (c) Agency for Toxic Substances Disease Registry's Minimal Risk Level (A = Acute < 15 days, I = Intermediate 15-364 days, C= Chronic > 364 days); (d) Reference Dose; NA - Not Available

It is noted that the arsenic concentrations detected were below the NJDEP RDCSCC of 20 mg/kg for areas outside the waste-fill boundary area, including the football field. Therefore, as arsenic exists naturally in the environment, concentrations detected at these locations are considered to be part of background concentrations and not associated with past landfill activities. However, for the purposes of the PHA, contaminants which exceed an Environmental Guideline CV they are established as COCs and are considered for further evaluation regardless of the locations from which environmental samples are collected, in this case from areas outside the waste-fill boundary.

Table 20: Comparison of Soil Ingestion Exposure Dose with Health Guideline Comparison Values (CVs). Judd Elementary School: Unpaved Areas - Surface Contact Layer.

Contaminant of Concern	Max. (mg/kg)	Avg. (mg/kg)	Maximum Exposure Dose (mg/kg/day)		Health Guideline CVs (mg/kg/day)		Potential for Non-cancer Health Effects
			Child [(a)]	Adult [(b)]	ATSDR MRL [(c)]	USEPA RfD [(d)]	
METALS							
Arsenic	7.1	4.5	2.39E-05	4.99E-06	3E-04 C	3E-04	No

(a) Child (student) exposure assumptions: 5 days/week, 36 weeks/year; 29 kg mean body weight (5 through 11 year olds); 200 mg/day ingestion rate; (b) Adult exposure assumptions: 5 days/week, 36 weeks/year; 70 kg body weight; 100 mg/day ingestion rate; (c) Agency for Toxic Substances Disease Registry's Minimal Risk Level (A = Acute < 15 days, I = Intermediate 15-364 days, C= Chronic > 364 days); (d) Reference Dose; NA - Not Available

It is noted that the arsenic concentrations detected were below the NJDEP RDCSCC of 20 mg/kg and that the Judd Elementary School is outside the waste-fill boundary area. Therefore, as arsenic exists naturally in the environment, concentrations detected at these locations are considered to be part of background concentrations and not associated with past landfill activities. However, for the purposes of the PHA, contaminants which exceed an Environmental Guideline CV they are established as COCs and are considered for further evaluation regardless of the locations from which environmental samples are collected, in this case from areas outside the waste-fill boundary.

Table 21: Comparison of Soil Ingestion Exposure Dose with Health Guideline Comparison Values (CVs). Veteran's Park/PSE&G Easement - Surface Contact Layer.

Contaminant of Concern	Max. (mg/kg)	Avg. (mg/kg)	Maximum Exposure Dose (mg/kg/day)		Health Guideline CVs (mg/kg/day)		Potential for Non-cancer Health Effects
			Child [(a)]	Adult [(b)]	ATSDR MRL [(c)]	USEPA RfD [(d)]	
METALS							
Arsenic [(g)]	37	18	7.54E-05	1.13E-05	3E-04 C	3E-04	No
Lead [(g)]	1,640	108	3.34E-03	5.01E-04	NA	NA	No [(e)]
SEMI-VOLATILE ORGANIC COMPOUNDS - Polycyclic Aromatic Hydrocarbons							
Benzo(a) pyrene	0.14	0.14	2.98E-07	4.40E-08	NA	NA	No [(f)]
Benzo(ghi) perylene	0.10	0.10	2.08E-07	3.04E-08	NA	NA	No [(f)]
Phenanthrene	0.06	0.06	1.26E-07	1.82E-08	NA	NA	No [(f)]

(a) Child exposure assumptions: 3 days/week, 26 weeks/year; 21 kg body weight, 10 year exposure; 200 mg/day ingestion rate; (b) Adult exposure assumptions: 3 days/week, 26 weeks/year, 38 year exposure; 70 kg body weight; 100 mg/day ingestion rate; (c) Agency for Toxic Substances Disease Registry's Minimal Risk Level (A = Acute < 15 days, I = Intermediate 15-364 days, C= Chronic > 364 days); (d) Reference Dose; (e) As evaluated using the US EPA IEUBK and Adult Lead Models (2003, 2004) (see text); (f) Based on comparison to the LOAEL; (g) - combined Veteran's Park and PSE&G Easement concentrations; NA - Not Available

Table 22: Comparison of Indoor Air Contaminant Concentrations with Health Guideline Comparison Values (CVs) Nearby Residential Area. Sample Data: June 2004 through June 2007

Contaminant	Range of Detected TCE Concentrations ($\mu g/m^3$) *	Average of Detected TCE Concentrations ($\mu g/m^3$)	Health Guideline CVs - ($\mu g/m^3$)			Potential for Non-Cancer Health Effects
			ATSDR MRL [(a)]	U.S. EPA RfC [(b)]	NJDEP IASL [(c)]	
VOLATILE ORGANIC COMPOUNDS						
Trichloroethylene	0.32 J - 6.5	1.3	500 I	40	3	No

* - Micrograms per cubic meter

(a) - Agency for Toxic Substance and Disease Registry Minimal Risk Levels (I = Intermediate 15-364 days, C= Chronic > 364 days); b) U.S. Environmental Protection Agency's Reference Concentration: considered for lifetime exposure to contaminant without deleterious effects;

(c) New Jersey Department of Environmental Protection Indoor Air Screening Leve; J - Estimated Value

Table 23: Calculated LECR with Contaminants in Soil at North Brunswick High School: Former "The Oval" Area - Past Exposures: 1972 through 2002 (see footnote)

Contaminant of Concern	DHHS Cancer Class [a]	Average (Maximum) (mg/kg)	Exposure Dose (mg/kg/day)		CSF [c] (mg/kg/d) $^{-1}$	LECR [d]	
			Student [a] Avg. (Max.)	Adult [b] Avg. (Max.)		Student Avg. (Max.)	Adult Avg. (Max.)
METALS							
Arsenic	1	728 (3,600)	3.08E-05 (1.52E-04)	2.20E-04 (1.09E-03)	1.5	4.62E-05 (2.28E-04)	3.30E-04 (1.63E-03)
Lead	2	728 (4,400)			NA		
VOLATILE ORGANIC COMPOUNDS							
Trichloroethene	2	0.34 (7.5)	1.44E-08 (3.17E-07)	1.03E-07 (2.26E-06)	0.40	5.75E-09 (1.27E-07)	4.11E-08 (9.06E-07)
POLYCYCLIC AROMATIC HYDROCARBONS							
Benzo(a)anthracene	2	0.47 (5.1)	1.99E-08 (2.16E-07)	1.42E-07 (1.54E-06)	0.73	1.45E-08 (1.57E-07)	1.04E-07 (1.12E-06)
Benzo(a)pyrene	2	0.36 (3.8)	1.52E-08 (1.61E-07)	1.09E-07 (1.15E-06)	7.30	1.11E-07 (1.17E-06)	7.93E-07 (8.38E-06)
Benzo(b)fluoranthene	2	0.37 (4)	1.56E-08 (1.69E-07)	1.12E-07 (1.21E-06)	0.73	1.14E-08 (1.23E-07)	8.16E-08 (8.82E-07)
Benzo(k)fluoranthene	2	0.33 (3.4)	1.40E-08 (1.44E-07)	9.96E-08 (1.03E-06)	0.073	1.02E-09 (1.05E-08)	7.27E-09 (7.49E-08)
Dibenz(a,h)anthracene	2	0.05 (0.6)	2.11E-09 (2.54E-08)	1.51E-08 (1.81E-07)	7.30	1.54E-08 (1.85E-07)	1.10E-07 (1.32E-06)
Indeno(1,2,3-cd)pyrene	2	0.13 (1.3)	5.50E-09 (5.50E-08)	3.93E-08 (3.93E-07)	0.73	4.01E-09 (4.01E-08)	2.87E-08 (2.87E-07)
					LECR Sum=	**4.64E-05 (2.30E-04)**	**3.31E-04 (1.64E-03)**

(a) Department of Health and Human Services Cancer Class: 1 = known human carcinogen; 2 = reasonably anticipated to be a carcinogen; 3 = not classified;
(b) Student exposure assumptions: 5 days/week, 36 weeks/year, 4 year exposure duration; 67 kg body weight; 100 mg/day ingestion rate;
(c) Adult faculty exposure assumptions: 5 days/week, 36 weeks/year, 30 year exposure duration; 70 kg body weight; 100 mg/day ingestion rate;
(d) Cancer Slope Factor; (e) Lifetime Excess Cancer Risk; Values in parenthesis based on maximum concentrations; NA - Not Available

(Footnote) Surface soil was not sampled for this area. Potential past exposures to students and faculty have been interpreted using subsurface contaminant concentrations to offer the reader a tentative evaluation of this area. The reader is cautioned that the interpretation of LECRs for past exposures provided for this area area not evidence-based due to the lack of surface soil data necessary to justify exposures. Therefore, incidental ingestion of contaminated soil is not considered a completed exposure pathway for this area.

Table 24: Calculated LECR with Contaminants in Soil at North Brunswick High School: High School Building Perimeter and Areas Outside the Waste-Fill Boundary; Football Field - Surface Soil Contact Layer.

Contaminant of Concern	DHHS Cancer Class (a)	Average (Maximum) (mg/kg)	Exposure Dose (mg/kg/day)		CSF (d) $(mg/kg/d)^{-1}$	LECR (e)	
			Student (b) Avg. (Max.)	Adult (c) Avg. (Max.)		Student Avg. (Max.)	Adult Avg. (Max.)
METALS							
Arsenic	1	5 (11)	2.11E-07 (4.65E-07)	2.01E-06 (4.43E-06)	1.5	3.17E-07 (6.98E-07)	3.02E-06 (6.64E-06)
					LECR Sum=	**3.17E-07 (6.98E-07)**	**3.02E-06 (6.64E-06)**

(a) Department of Health and Human Services Cancer Class: 1 = known human carcinogen; 2 = reasonably anticipated to be a carcinogen; 3 = not classified; (b) Student exposure assumptions: 5 days/week, 36 weeks/year, 4 year exposure duration; 67 kg body weight; 100 mg/day ingestion rate; (c) Adult faculty exposure assumptions: 5 days/week, 36 weeks/year, 40 year exposure duration; 70 kg body weight; 100 mg/day ingestion rate; (d) Cancer Slope Factor; (e) Lifetime Excess Cancer Risk; Values in parenthesis based on maximum concentrations; NA - Not Available

It is noted that the arsenic concentrations detected were below the NJDEP RDCSCC of 20 mg/kg for areas outside the waste-fill boundary area, including the football field. Therefore, as arsenic exists naturally in the environment, concentrations detected at these locations are considered to be part of background concentrations and not associated with past landfill activities. However, for the purposes of the PHA, contaminants which exceed an Environmental Guideline CV they are established as COCs and are considered for further evaluation regardless of the locations from which environmental samples are collected, in this case from areas outside the waste-fill boundary.

Table 25: Calculated LECR with Contaminants in Surface Soil at Judd Elementary School: Unpaved Areas - Surface Soil Contact Layer.

Contaminant of Concern	DHHS Cancer Class [(a)]	Average (Maximum) (mg/kg)	Exposure Dose (mg/kg/day)		CSF [(d)] $(mg/kg/d)^{-1}$	LECR [(e)]	
			Child [(b)] Avg. (Max.)	Adult [(c)] Avg. (Max.)		Child Avg. (Max.)	Adult Avg. (Max.)
METALS							
Arsenic	1	4.5 (7.1)	1.31E-06 (2.06E-06)	1.82E-06 (2.87E-06)	1.5	1.96E-06 (3.09E-06)	2.72E-06 (4.30E-06)
					LECR Sum=	**1.96E-06 (3.09E-06)**	**2.72E-06 (4.30E-06)**

(a) Department of Health and Human Services Cancer Class: 1 = known human carcinogen; 2 = reasonably anticipated to be a carcinogen; 3 = not classified; (b) Child student exposure assumptions: 5 days/week, 36 weeks/year, 6 year exposure duration; 29.21 kg body weight; 200 mg/day ingestion rate; (c) Adult faculty exposure assumptions: 5 days/week, 36 weeks/year, 40 year exposure duration; 70 kg body weight; 100 mg/day ingestion rate; (d) Cancer Slope Factor; (e) Lifetime Excess Cancer Risk; Values in parenthesis based on maximum concentrations; NA - Not Available

It is noted that the arsenic concentrations detected were below the NJDEP RDCSCC of 20 mg/kg and that the Judd Elementary School is outside the waste-fill boundary area. Therefore, as arsenic exists naturally in the environment, concentrations detected at these locations are considered to be part of background concentrations and not associated with past landfill activities. However, for the purposes of the PHA, contaminants which exceed an Environmental Guideline CV they are established as COCs and are considered for further evaluation regardless of the locations from which environmental samples are collected, in this case from areas outside the waste-fill boundary.

Table 26: Calculated LECR with Contaminants in Surface Soil at Veteran's Park/PSE&G Easement - Surface Soil Contact Layer.

Contaminant of Concern	DHHS Cancer Class [(a)]	Avg. (Max.) (mg/kg)	Exposure Dose (mg/kg/day)		CSF [(c)] (mg/kg/d) $^{-1}$	LECR [(d)]	
			Child [(a)] Avg. (Max.)	Adult [(b)] Avg. (Max.)		Child Avg. (Max.)	Adult Avg. (Max.)
METALS							
Arsenic	1	18 (37)	5.24E-06 (1.08E-05)	2.36E-06 (4.85E-06)	1.5	7.86E-06 (1.62E-05)	3.54E-06 (7.27E-06)
Lead	2	108 (1,640)			NA		
SEMI-VOLATILE ORGANIC COMPOUNDS							
Benzo(a) pyrene	2	0.144 (NA)	4.19E-08	1.89E-08	7.30	3.06E-07	1.38E-07
					LECR Sum=	**7.86E-06 (1.62E-05)**	**3.54E-06 (7.27E-06)**

(a) Department of Health and Human Services Cancer Class: 1 = known human carcinogen; 2 = reasonably anticipated to be a carcinogen; 3 = not classified; (b) Child exposure assumptions: 3 days/week; 26 weeks/year; 21 kg body weight; 200 mg/day ingestion rate, 10 year exposure duration; (c) Adult exposure assumptions: 3 days/week; 26 weeks/year; 70 kg body weight; 100 mg/day ingestion rate, 38 year exposure duration; (d) Cancer Slope Factor; (e) Lifetime Excess Cancer Risk; Values in parenthesis based on maximum concentrations; NA - Not Available

Table 27: Calculated LECRs Based on TCE Concentrations in Indoor Air - Nearby Residential Area
Sample Data: June 2004 through June 2007

Sample Location	Exposed Population	Exposure Duration (years) [(a)]	Average of Detected TCE Concentrations ($\mu g/m^3$) [(b)]	USEPA CSFi [(c)] $(mg/kg/day)^{-1}$	Exposure Dose (mg/kg/day)	LECR
Six Residences	Adult [(d)]	10	1.3	0.40	5.22E-05	2.09E-05
	Child [(e)]				6.71E-05	2.68E-05

Notes:

(a) - Based on the maximum length of residency for current residents.

(b) - micrograms per cubic meter.

(c) - Cancer slope factor for human inhalation exposure.

(d) - Adult Exposure Assumptions: 20 m^3/day, 365 days a year exposure frequency, 70 years averaging time, 70 kg body weight (USEPA 2002d)

(e) - Child Exposure Assumptions: 12 m^3/day inhalation rate, 365 days a year exposure frequency, 70 years averaging time, 32.7 kg body weight (USEPA 2002d)

Table 28: Cumulative LECRs for Area Residents

Pathway	Area of Concern	Lifetime Excess Cancer Risk (LECR) [a]	
		Child Resident Average Exposure Conditions	38 Year Resident Average Exposure Conditions
Surface Soil	North Brunswick Township High School	N/A	3.17E-07
	Veteran's Park/PSE&G Easement [b]	7.86E-06 [c]	7.86E-06 [d]
			3.54E-06 [e]
	Judd Elementary School	1.96E-06	1.96E-06
	Average LECR Cumulative Sum =	**9.82E-06**	**1.37E-05**
Indoor Air	Six Nearby Residences (under investigation)	2.68E-05	N/A
	Average LECR Cumulative Sum = (for six nearby residences)	**3.66E-05**	N/A [f]

(a) Employee exposures at North Brunswick Township High School and Judd Elementary School not included in LECR calculations as employee residency is unknown; (b) - Exposure period based on time park open for public use 1967 - 2005; (c) - 10 year exposure; (d) - first 10 years of 38 year exposure as a child; (e) balance 28 years of 38 year exposure as an adult; (f) - Exposure time for adults living at residences currently under investigation is less than 38 years. LECR for this group would equal those calculated for adults in Table 27; N/A - Not Applicable.

Figure 2: Site location showing North Brunswick Township High School, PSE&G easement, Veteran's Park, Judd Elementary School and surrounding residential areas.

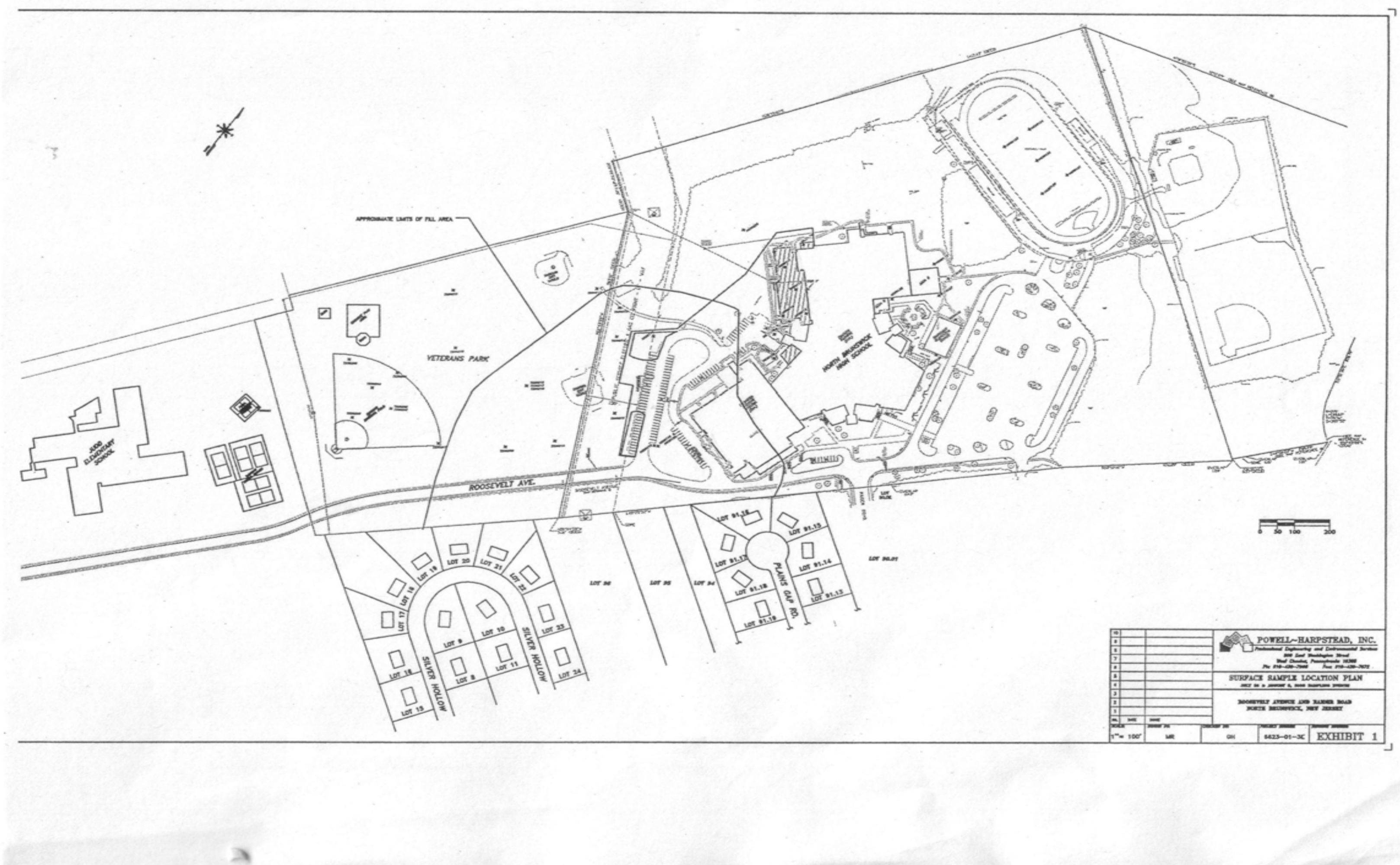


Figure 3: Approximate boundary of the buried waste material area encompassing the North Brunswick Township High School (NBTHS) , PSE&G easement, and Veteran's Park properties. New building addition to the NBTHS is depicted on the southwest corner of the high school (formerly "The Oval").

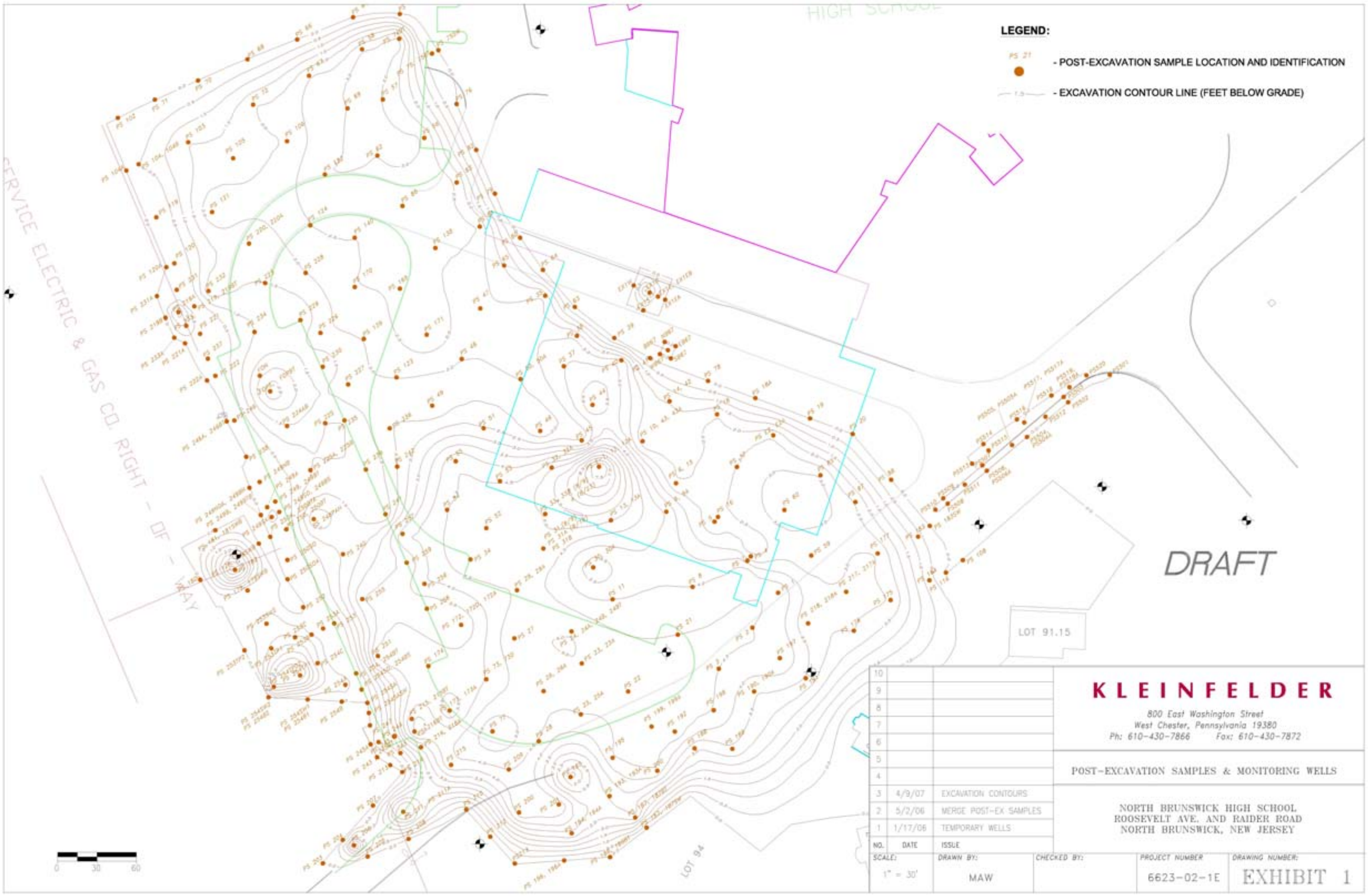


Figure 4: Excavation contour (contaminated soil removal) of the area formerly known as "The Oval" located in the southwest corner of the North Brunswick Township High School property. Presently a storm water catch basin.

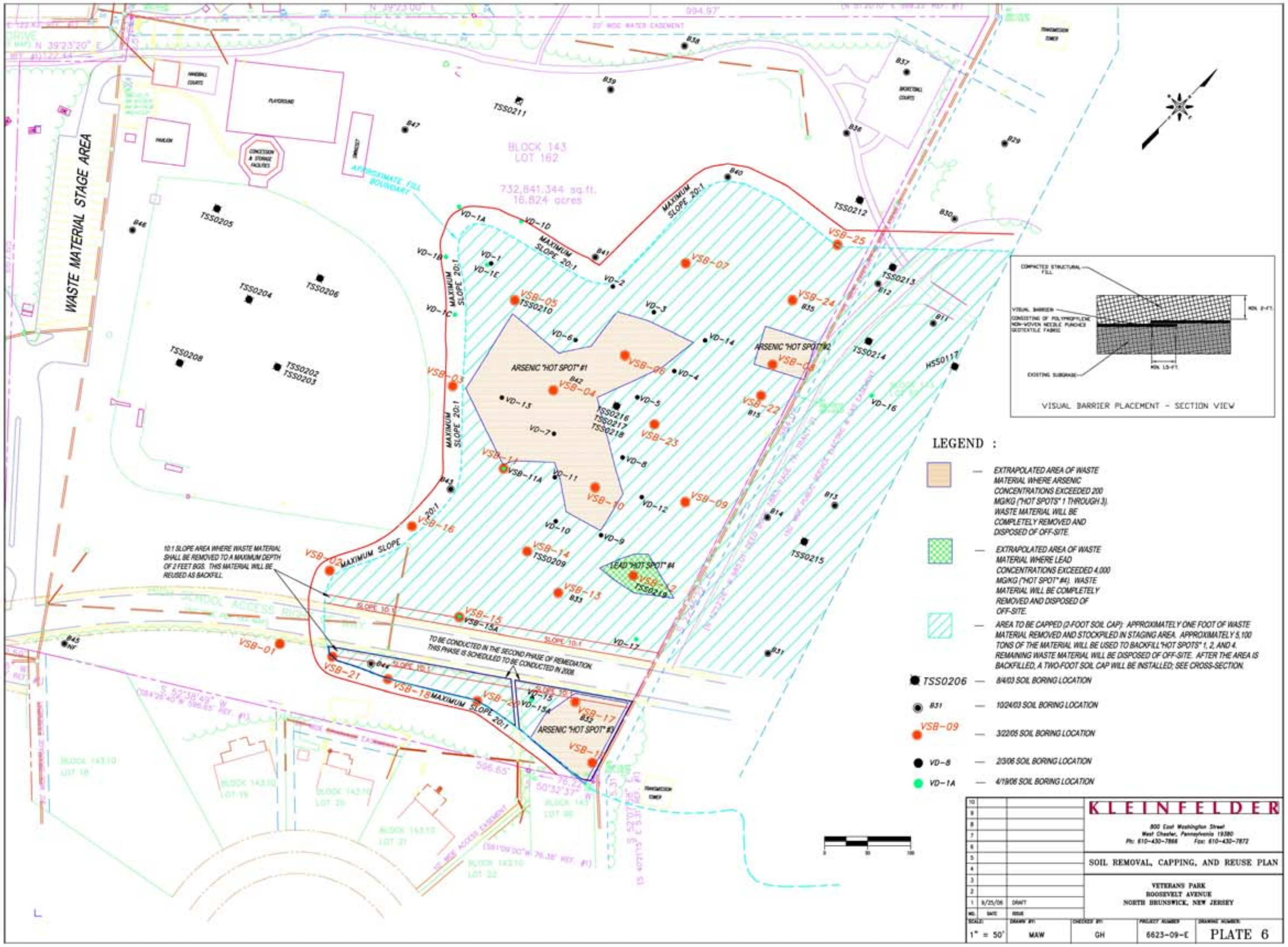
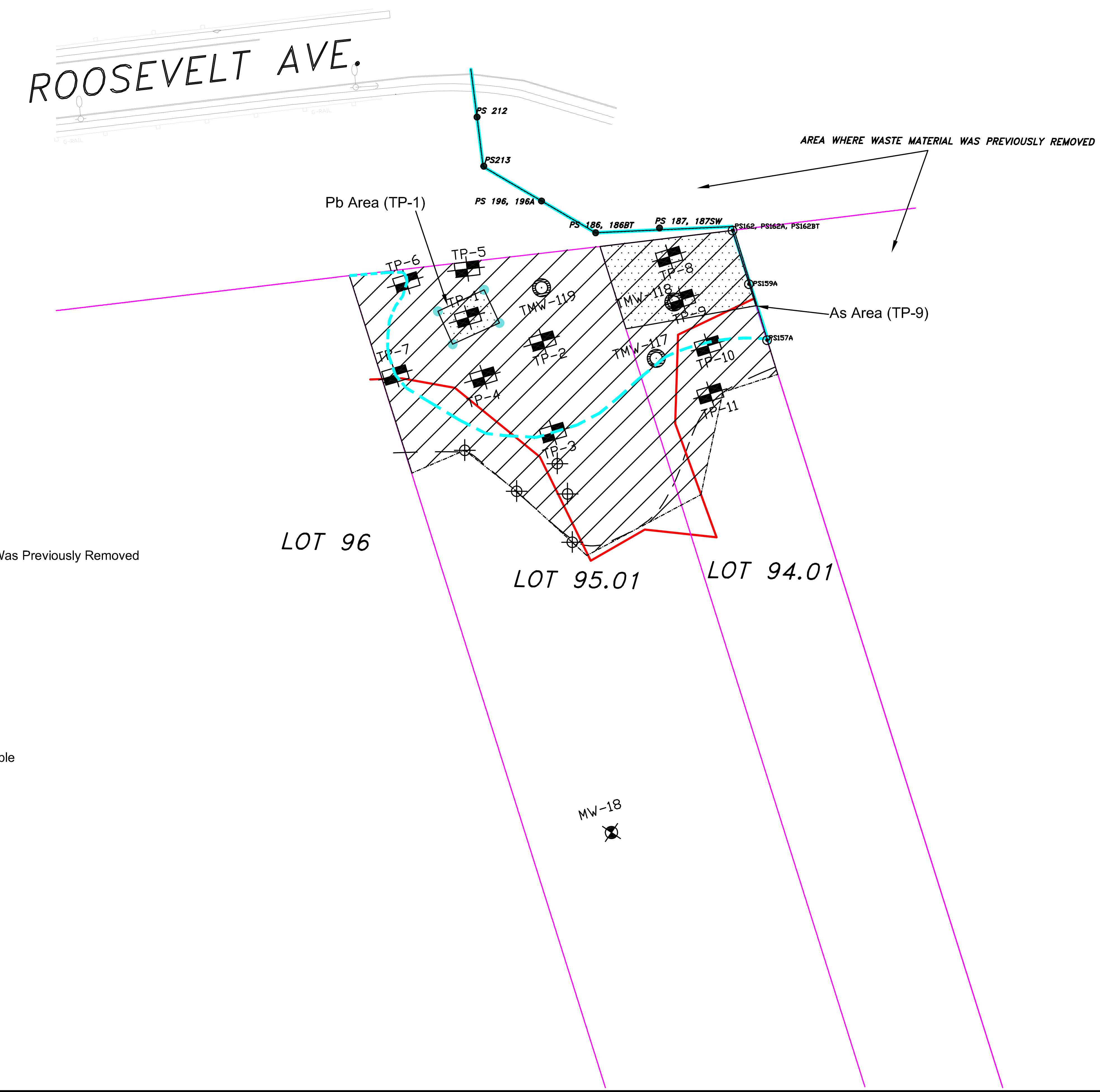
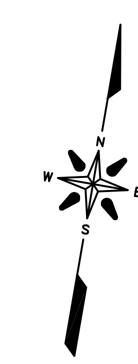


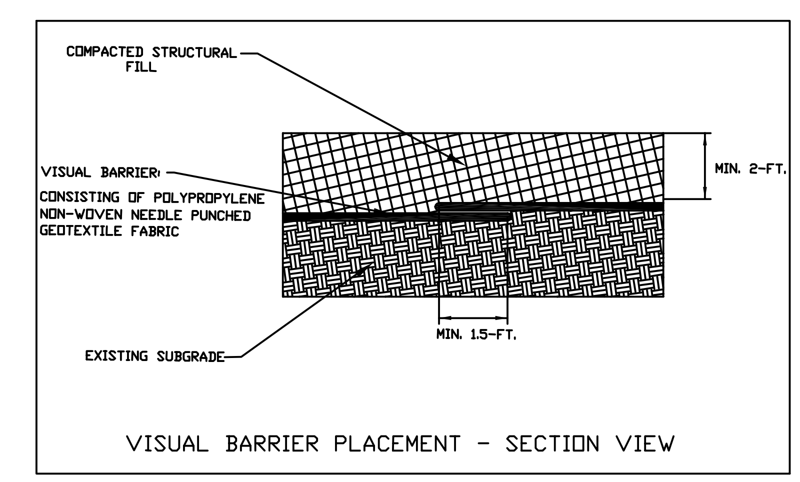
Figure 5: Soil "hot-spot" lead and arsenic removal areas, capping area, and reuse plan for Veteran's Park, PSE&G easement, and area to the south of Roosevelt Avenue.

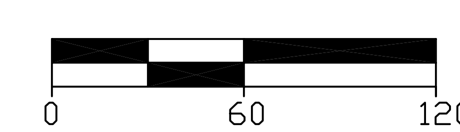
6623-09-1E

DRAWN BY: MAW REVISED BY: CHECKED BY: GH	**SITE LAYOUT PLAN**	KLEINFELDER	PLATE
DATE: 4/26/07 — APPROVED BY:	LOT 94.01 & 95.01, BLOCK 143 NORTH BRUNSWICK TOWNSHIP NORTH BRUNSWICK, NEW JERSEY	800 East Washington Street West Chester, PA 19380 PH. (610) 430-7866 FAX. (610) 430-7872 www.kleinfelder.com	2
	6623-09-1E — FILE NAME:		









LEGEND:

- Approximate Test Hole Location
- Approximate Fill Boundary
- Property Boundary
- Approximate 2005 Hand Probe Location
- Approximate Excavation Boundary Where Waste Material Was Previously Removed
- Approximate Wetlands Boundary as per DPK Consulting, L.L.C. Drawing 01-1253 Base Map-2
- Approximate Limit of Elevated Arsenic
- Approximate Location of Temporary Monitoring Well
- Approximate Location of Monitoring Well
- PS159A - Approximate Location of Lot 91.17 Post Excavation Sample
- PS 187, 187SW - Approximate Location of High School Post Excavation Sample
- Approximate Location of Engineering Cap Limit
- Approximate Area to Be Treated and Capped
- Approximate Area Where Waste Will Be Removed
- Approximate 2006 Delineation Hand Probe Location

NO.	DATE	ISSUE
10		
9		
8		
7		
6		
5		
4		
3	5/8/07	REVISION
2	4/30/07	REVISION
1	6/1/05	TEST PIT LOCATIONS

KLEINFELDER
800 East Washington Street
West Chester, Pennsylvania 19380
Ph: 610-430-7866 Fax: 610-430-7872

WASTE REMOVAL, TREATMENT AND CAPPING PLAN

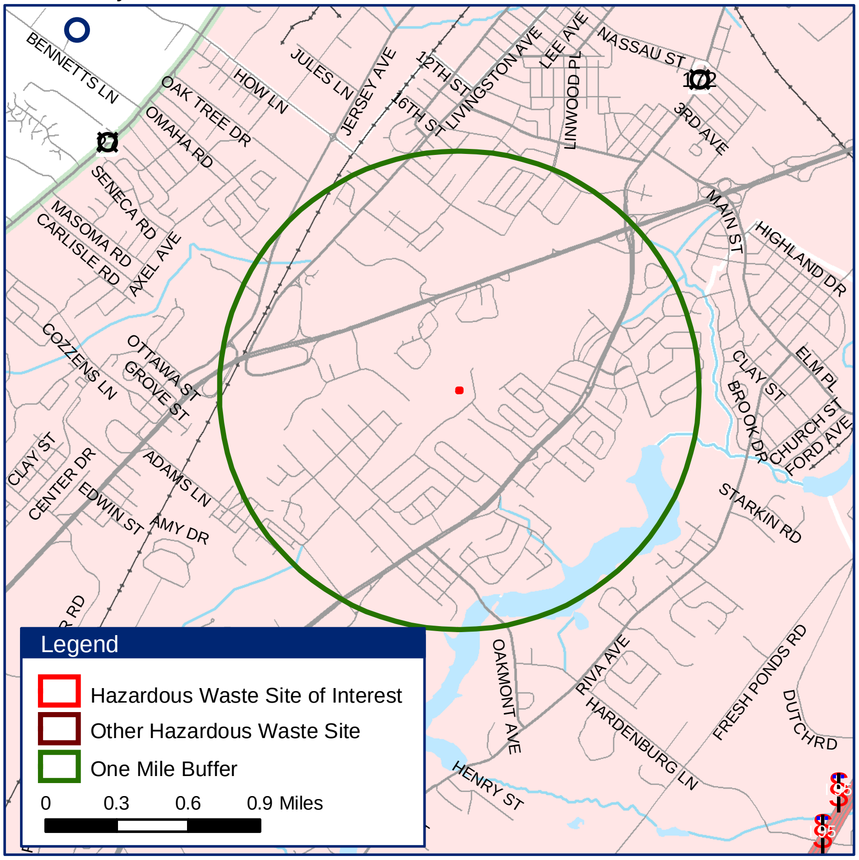
LOT 94.01 & 95.01, BLOCK 143
NORTH BRUNSWICK TOWNSHIP
MIDDLESEX COUNTY
NEW JERSEY

SCALE:	DRAWN BY:	CHECKED BY:	PROJECT NUMBER	DRAWING NUMBER:
1"= 60'	MAW	GH	6623-09-1E	PLATE 6

North Brunswick High School

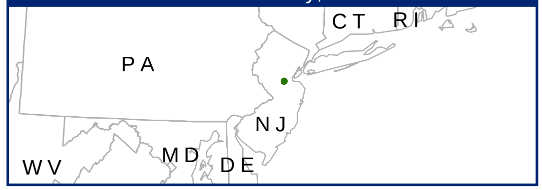
North Brunswick, NJ

EPA Facility ID: NJD103805370



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 New Jersey FIPS 2900 Feet

Site Location: Middlesex County, NJ



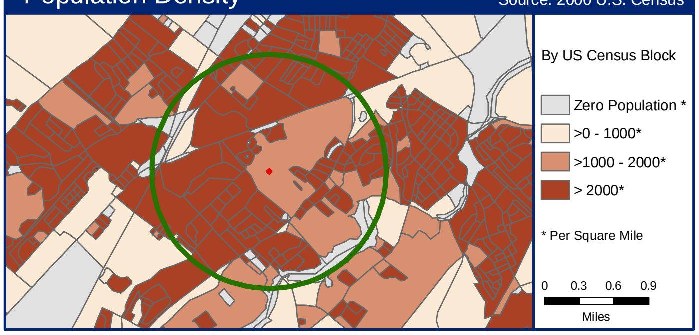
Demographic Statistics
Within One Mile of Site*

Total Population	11,326
White Alone	7,027
Black Alone	1,890
Am. Indian & Alaska Native Alone	8
Asian Alone	1,507
Native Hawaiian & Other Pacific Islander Alone	2
Some Other Race Alone	508
Two or More Races	384
Hispanic or Latino**	1,232
Children Aged 6 and Younger	1,105
Adults Aged 65 and Older	1,003
Females Aged 15 to 44	2,744
Total Housing Units	4,312

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.

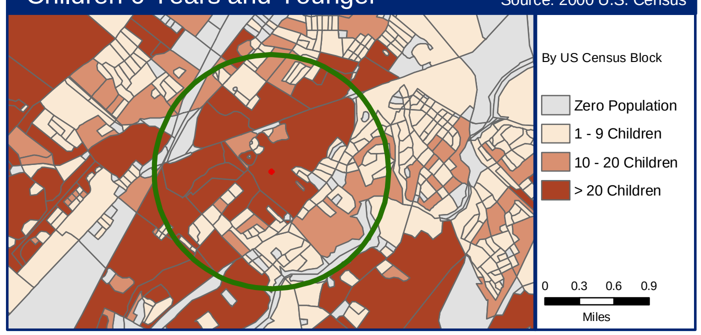
Population Density

Source: 2000 U.S. Census



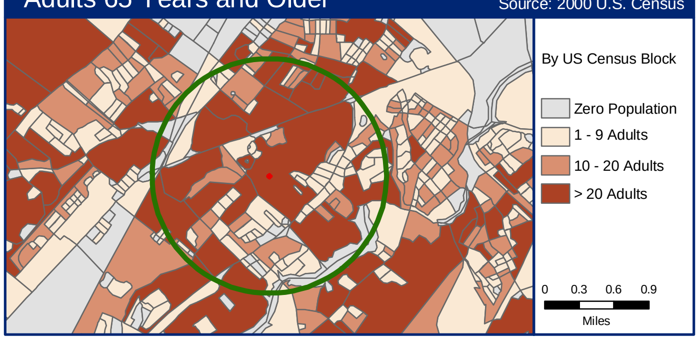
Children 6 Years and Younger

Source: 2000 U.S. Census



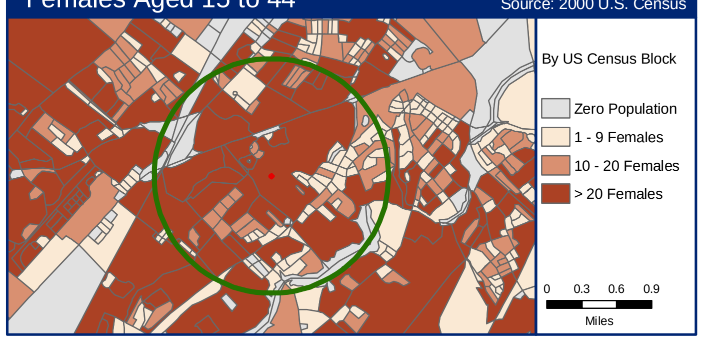
Adults 65 Years and Older

Source: 2000 U.S. Census



Females Aged 15 to 44

Source: 2000 U.S. Census



GRASPMASTER 1.3 - GENERATED: 04-25-2007

Figure 9: Trichloroethylene contaminant plume in groundwater to the south of the North Brunswick Township High School and north of the depicted residential area.

Photograph 1: View of new school addition from south side of North Brunswick Township High School (NBTHS).

Photograph 2: View of construction area on northwest side of NBTHS.

Photograph 3: Former "The Oval" area located to southwest of NBTHS. Presently a storm water catch basin. Previously an open grass covered area used for marching band practice and other school social activities.

Photograph 4: Drainage swale to south of high school. Monitoring well in background. View facing northwest towards Raider Road.

Photograph 5: Typical classroom window on second floor of NBTHS were interior wipe sampling was conducted in July 2003 and November 2005.

Photograph 6: View of PSE&G easement (overhead power lines) with North Brunswick High School new construction area in background.

Photograph 7: View of walking path through Veterans Park leading to the North Brunswick Manor apartments to north of NBTHS.

Photograph 8: View of Veteran's Park with groundwater monitoring well in foreground.

Appendix A

Health Consultation
Site-Related Contamination At Three Nearby Residences
August 11, 2005

Health Consultation

SITE-RELATED CONTAMINATION AT THREE NEARBY RESIDENCES

NORTH BRUNSWICK TOWNSHIP HIGH SCHOOL SITE

NORTH BRUNSWICK, MIDDLESEX COUNTY, NEW JERSEY

EPA FACILITY ID: NJD103805370

AUGUST 11, 2005

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

Health Consultation: A Note of Explanation

An ATSDR health consultation is a verbal or written response from ATSDR to a specific request for information about health risks related to a specific site, a chemical release, or the presence of hazardous material. In order to prevent or mitigate exposures, a consultation may lead to specific actions, such as restricting use of or replacing water supplies; intensifying environmental sampling; restricting site access; or removing the contaminated material.

In addition, consultations may recommend additional public health actions, such as conducting health surveillance activities to evaluate exposure or trends in adverse health outcomes; conducting biological indicators of exposure studies to assess exposure; and providing health education for health care providers and community members. This concludes the health consultation process for this site, unless additional information is obtained by ATSDR which, in the Agency's opinion, indicates a need to revise or append the conclusions previously issued.

HEALTH CONSULTATION

SITE-RELATED CONTAMINATION AT THREE NEARBY RESIDENCES

NORTH BRUNSWICK TOWNSHIP HIGH SCHOOL SITE

NORTH BRUNSWICK, MIDDLESEX COUNTY, NEW JERSEY

EPA FACILITY ID: NJD103805370

Prepared by:
New Jersey Department of Health and Senior Services
Public Health Protection and Emergency Preparedness
Under a Cooperative Agreement with the
Agency for Toxic Substances and Disease Registry

Summary

During a July 2003 excavation for a major renovation/expansion project at the North Brunswick Township High School, North Brunswick, Middlesex County, New Jersey, debris and fill material, including hazardous waste, were discovered in the soil. Construction activities at the school were suspended and the New Jersey Department of Environmental Protection was notified. An engineering services firm hired on behalf of the North Brunswick Township Board of Education, and the Township of North Brunswick initiated a Site Remedial Investigation of the site in the autumn of 2003. Findings of the investigation indicated site-related contamination (i.e., arsenic) in the surface soil of three nearby residential properties above state Residential Direct Contact Soil Cleanup Criteria. Arsenic contamination was also detected in the interior dust of one of the three residences. Residents were advised to refrain from any activities which may disturb exterior soil (e.g., gardening, landscaping).

At each of the three residences with site-related soil contamination, water samples from basement sumps were collected and analyzed for volatile organic compounds, selected metals, and polycyclic aromatic hydrocarbons. Indoor air samples were collected and analyzed for volatile organic compounds, and dust wipe samples were collected from indoor surfaces throughout the residences for metals analysis. Trichloroethylene was detected in the sumps of two residences, and one residence had indoor air trichloroethylene concentrations above the U.S. Environmental Protection Agency Risk-Based Concentration. A number of other volatile organic compounds were also detected in the indoor air of the residences; some of these volatile organic compounds may be constituents of products commonly stored in homes such as fuels, solvents, cleaners, and paints. Arsenic contaminated dust was detected in one of the residences tested.

At the July 2004 request of affected residents, township officials, and the New Jersey Department of Environmental Protection, the New Jersey Department of Health and Senior Services, through a cooperative agreement with the federal Agency for Toxic Substances and Disease Registry, completed evaluations of potential health risks associated with site-related contamination detected at the three residences. The evaluations were enclosed with February 2005 correspondence to residents which summarized conclusions and recommendations specific to the individual households. It was determined that past exposures to residents had posed a ***Public Health Hazard*** because remediation was necessary to prevent further exposures which could lead to potential adverse health effects. In the autumn of 2004, contaminated soil at all three residences was removed and the soil exposure pathway appears to have been eliminated. Trichloroethylene was detected in the sump of two of the three residences, and indoor air samples for volatile organic compounds (including trichloroethylene) were collected at one of the three residences. Following sump remediation activities at all three residences, indoor air sampling was conducted; results indicated that trichloroethylene concentrations at all three residences were below the practical quantitation limit. Although exposures appear to have been partially interrupted, there is a potential health risk associated with future trichloroethylene exposures constituting an ***Indeterminate Public Health Hazard***.

Arsenic detected in the dust of one household has not been remediated to date, and exposures may present a health concern for children. Since no children currently reside in this household, there is ***No Apparent Public Health Hazard*** at the present time at this residence for arsenic.

In response to cancer cluster concerns expressed by the community in May and September of 2004, the New Jersey Department of Health and Senior Services, Cancer Epidemiology Program reviewed cancer incidence data from 1979 through 2001 for North Brunswick Township and Middlesex County. No unusual number or distribution of cancer types were determined for the township or county.

Recommendations include: 1) the remediation of arsenic contaminated household dust and the collection of additional dust data to ensure that arsenic levels have been successfully reduced; 2) the characterization and delineation of the contaminated groundwater plume at the site; 3) the collection of groundwater and soil gas sampling at the three residences for use in the evaluation of the vapor intrusion pathway; and 4) the collection of additional indoor air samples at all three residences so that current and future health risks may be better understood and evaluated.

Since February 2005, additional environmental sampling and remedial actions have been conducted at the residences and will be discussed in a Public Health Assessment being prepared for the site.

Statement of Issues

In the summer of 2004, private citizens, township officials, and the New Jersey Department of Environmental Protection (NJDEP) requested assistance from the New Jersey Department of Health and Senior Services (NJDHSS) in the interpretation and public health evaluation of site-related metal and volatile organic compound (VOC) contamination detected at three residences during an investigation of the North Brunswick Township High School site, Raider Road, North Brunswick, Middlesex County.

Through a cooperative agreement with the Agency for Toxic Substances and Disease Registry (ATSDR), the NJDHSS reviewed environmental data available for each residence and evaluated public health implications; findings were provided confidentially to each residence in February 2005 (see Appendix 1 for details of the evaluations). The purpose of this health consultation was to summarize and present the results of the evaluations for public availability and to provide clarification where additional information was provided to the NJDHSS.

Since February 2005, additional environmental sampling and remedial actions have been conducted at the residences and will be discussed in a public health assessment being prepared for the site.

Background

During a July 2003 excavation for a major renovation/expansion project at the North Brunswick Township High School, North Brunswick, Middlesex County, New Jersey, difficulty was experienced in achieving soil compaction. A test pit was excavated, and visual inspection revealed fill material extending from the surface to a depth of 1.5 feet. The fill consisted of medical wastes, glass vials and bottles, and an unidentified dark brown material. Construction activities were suspended and the NJDEP was notified. On behalf of the North Brunswick Township Board of Education and the Township of North Brunswick, the engineering services firm of Powell-Harpstead, Inc., West Chester, Pennsylvania initiated a Site Remedial Investigation (SRI) of the site in the autumn of 2003. A primary purpose of the SRI was to delineate the extent of soil contamination. Areas initially investigated were the construction site itself on the school grounds, stockpiles of material that had already been excavated, athletic fields, an adjacent recreational park, and a nearby elementary school. Subsequently, site-related contamination was detected at three nearby residential properties.

Site Visit

On August 11, 2004, a site visit of the three residences located in the vicinity of the North Brunswick Township High School site was conducted. Individuals present were Christa Fontecchio and Sharon Kubiak of the NJDHSS, and representatives of the NJDEP and Powell-Harpstead, Inc. The site visit commenced at 9:00 am. Weather conditions were sunny, with temperatures in the low to mid 70s. Information collected during the site visit included the number and age of residents, years of occupancy, gardening and landscaping activities, home-gardened fruit and vegetable consumption (see Appendix 2), and time spent in the basement. This information was utilized in estimating past exposures and assessing the potential for health effects.

Past ATSDR/NJDHSS Activities

Please see Discussion, Health Outcome Data section below.

Environmental Contamination

Environmental sampling data reviewed for this Health Consultation were provided by Powell-Harpstead, Inc. (2004) through the NJDEP.

Surface Soil

Results of surface (0 – 0.5 foot depth) soil samples collected from the three residences indicated arsenic contamination above NJDEP Residential Direct Contact Soil Cleanup Criteria (RDCSCC):

Residence	No. Samples Collected for Metals Analysis	Average Arsenic Concentration (mg/kg)*	Maximum Arsenic Concentration (mg/kg)	NJDEP RDCSCC (mg/kg)
A	13	49.9	150	20
B	6**	14.79	45.2	
C	13	16.67	46.1	

*milligrams of contaminant per kilogram of soil
**five samples were collected at a depth of 0 - 0.5 feet, one sample at a depth of 0.3 – 0.8 feet

Household Dust

Dust wipe samples were collected from the indoor surfaces of the three residences. Arsenic was detected in one of the three residences (A) at concentrations ranging from not detected to 53.6 micrograms of arsenic per square foot ($\mu g/ft^2$) of surface tested. There is no comparison value available for arsenic in household dust. Since the main route of exposure associated with settled dust is ingestion, an exposure dose can be calculated and compared with the health guideline comparison value for the oral route of exposure.

Sump Water

At each of the three residences, a water sample was collected from the basement sump. Trichloroethylene (TCE) was detected in two of the three sumps (residences A and C) at concentrations ranging from 4 to 140 micrograms of TCE per liter of water (μg/L). The presence of TCE in the sump water suggests TCE contamination of area groundwater; the NJDEP Groundwater Quality Criteria for TCE is 1 μg/L.

Indoor Air

On April 7 and 14, 2004, screening for VOCs was conducted at the three residences using a photoionization detector. Based on the results of this screening, indoor air samples were collected from the basement and first floor of residence A on April 15, 2004; results indicated TCE contamination:

<table>
<tr><th>Residence</th><th>Basement TCE (μg/m^3)*</th><th>First Floor TCE (μg/m^3)</th><th>USEPA Region 3 Risk-Based Concentration (RBC)** (μg/m^3)</th><th>NJDEP Indoor Air Guidance (μg/m^3)</th></tr>
<tr><td>A</td><td>12</td><td>5.4</td><td rowspan="3">0.016</td><td rowspan="3">2.68***</td></tr>
<tr><td>B</td><td colspan="2">Not sampled</td></tr>
<tr><td>C</td><td colspan="2">Not sampled</td></tr>
</table>

*micrograms of TCE per cubic meter of air
**RBCs are contaminant concentrations corresponding to a fixed level of risk (i.e., a Hazard Index of 1, or lifetime excess cancer risk of one in one million, whichever results in a lower concentration) in water, air, biota, and soil\
***practical quantitation limit (PQL) for TCE which is the lowest concentration that can be measured accurately

Discussion

Assessment Methodology

An exposure pathway is a series of steps starting with the release of a contaminant in environmental media and ending at the interface with the human body. A completed exposure pathway consists of five elements:

1. source of contamination;
2. environmental media and transport mechanisms;
3. point of exposure;
4. route of exposure; and
5. receptor population.

Generally, the ATSDR considers three exposure categories: 1) completed exposure pathways, that is, all five elements of a pathway are present; 2) potential exposure pathways, that is, one or more of the elements may not be present, but information is insufficient to eliminate or exclude the element; and 3) eliminated exposure pathways, that is, one or more of the elements is absent. Exposure pathways are used to evaluate specific ways in which people were, are, or will be exposed to environmental contamination in the past, present, and future.

Completed Exposure Pathways

In the past, household members of residences A, B, and C were likely to have come in contact with site-related contaminants in soil and indoor air. Residents of residence A are also likely to come in contact with arsenic contaminated household dust. With NJDEP oversight, contaminated soil at all three residences was removed in the autumn of 2004. At residence A, the basement sump pump was replaced, the sump covered and sealed, and a fan installed to exhaust headspace vapors through an existing radon remediation system. At residence C, the basement sump was covered and sealed. Although no TCE was detected in the sump at residence B, the top of the sump was sealed to minimize the potential for vapor intrusion (M. Searfoss, NJDEP, personal communication, May 2005). Following sump remediation activities, air sampling was conducted at all three residences on June 4, 2004; results indicated that TCE concentrations were below the practical quantitation limit (PQL):

<table>
<tr><th colspan="5">Indoor Air TCE Concentrations Following Sump Remediation</th></tr>
<tr><th>Residence</th><th>Basement TCE ($\mu g/m^3$)*</th><th>First Floor TCE ($\mu g/m^3$)</th><th>USEPA Region 3 RBC ($\mu g/m^3$)</th><th>NJDEP Indoor Air Guidance ($\mu g/m^3$)</th></tr>
<tr><td>A</td><td>0.75 J</td><td>Not detected</td><td rowspan="3">0.016</td><td rowspan="3">2.68**</td></tr>
<tr><td>B</td><td>0.42 J</td><td>Not detected</td></tr>
<tr><td>C</td><td>0.32 J</td><td>0.30 J</td></tr>
</table>

*micrograms of TCE per cubic meter of air
**practical quantitation limit for TCE
J = estimated value

A number of other VOCs detected in the residences may be associated with the use and storage of gasoline and/or cleaning products (see Appendix 3).

Therefore, exposures from the soil pathway (residences A, B, and C) appear to have been eliminated. TCE was detected in the sump water at residence C, but no indoor air sample results are available for this residence prior to the sump being sealed. Additionally, although no TCE was detected in the sump of residence B and no indoor air sample results are available for this residence prior to the sump being sealed, TCE may have entered the basement through other ways (e.g., cracks in foundation or floor). Taking this into consideration, exposures from the indoor air pathway (residences A, B, and C) appear to have been partially interrupted for household members. Since typical household cleaning methods may not adequately abate the arsenic contamination detected in residence A, this exposure pathway continues to be a concern (see Table 1).

Potential Exposure Pathways

There are no indoor air TCE exposures to household members of residence B since the basement is currently used for storage only. However, this may change in the future, and as such, presents a future potential exposure pathway (see Table 1).

Table 1 - Exposure Pathway Elements and Time Frames					
Pathway Name	**Point of Exposure**	**Route of Exposure**	**Past Pathway Status**	**Present Pathway Status**	**Future Pathway Status**
Surface Soil	Residential Yards A, B, C	Ingestion	Complete	Eliminated	Eliminated
Indoor Air	Indoor Air, Residences A, B, C	Inhalation	Complete	Potential	Potential
Household Dust	Household Dust, Residence A	Ingestion	Complete	Complete	Complete

Public Health Implications

Health effects data reported in ATSDR Toxicological Profiles for site-specific contaminants were examined and interpreted to evaluate non-cancer and cancer health effects. A summary of the public health implications is as follows; please refer to Appendix 1 for details of the evaluations conducted for each residence.

Residence	Summary of Assessed Non-Cancer and Cancer Health Effects
A	For non-cancer health effects, arsenic in soil and household dust were determined to pose a potential health concern for children. No young children reside at this residence. For cancer health effects in adults, the risk associated with arsenic in soil (based on the average concentration) and indoor air concentrations of TCE were approximately eight excess cancer cases per 100,000 individuals.
B	Based on the average arsenic concentration detected in the surface soil, non-cancer health effects are not expected for adults and children. For cancer health effects in adults, the risk associated with arsenic in soil (based on the average concentration) was approximately five excess cancer cases per 10,000,000 individuals.
C	Based on both maximum and average arsenic concentrations detected in the surface soil and the TCE concentrations in the indoor air, non-cancer health effects are not expected for adults and children. For cancer health effects in adults, the combined risk associated with arsenic in soil (based on the average concentration) and indoor air concentrations of TCE were approximately six excess cancer cases per 1,000,000 individuals.

Health Outcome Data

In May and September of 2004, North Brunswick residents contacted the NJDHSS Cancer Epidemiology Program regarding several individuals who live near or attended North Brunswick Township High School who had been diagnosed with cancer in the past several years. In response to this concern, the Cancer Epidemiology Program reviewed cancer incidence data from 1979 through 2001 for North Brunswick Township and Middlesex County. According to the Cancer Epidemiology Program, the number and distribution of cancer types in Middlesex County did not appear to be unusual when compared to the state; in addition, a review of North Brunswick Township data by gender and age group did not indicate an unusual occurrence of any type of cancer (see Appendix 4).

Child Health Considerations

Arsenic was detected in dust samples collected from the interior of residence A. Young children, especially those less than six years of age, spend a great deal of time on the floor and put non-food items in their mouths. Although no young children currently reside at residence A, this may change in the future. A hypothetical dose was calculated based on the maximum dust concentration detected at residence A. The estimated dose (0.0032 milligrams per kilogram per day, or mg/kg/day) was above the health guideline value of 0.003 mg/kg/day for non-cancer health effects. As such, this contaminated household dust may present a health concern for children.

Conclusions

Through a cooperative agreement with the ATSDR, the NJDHSS completed evaluations of potential health risks associated with site-related contamination detected at three residences located near the North Brunswick Township High School site. The evaluations were enclosed with February 2005 correspondence to residents which summarized conclusions and recommendations specific to the individual households. It was determined that past exposures to residents had posed a ***Public Health Hazard*** because remediation was necessary to prevent further exposures which could lead to potential adverse health effects. In the autumn of 2004, contaminated soil at all three residences was removed and the soil exposure pathway appears to have been eliminated. TCE was detected in the sump of two of the three residences, and indoor air samples for VOCs (including TCE) were collected at one of the three residences. Following sump remediation activities at all three residences, indoor air sampling was conducted; results indicated that trichloroethylene concentrations at all three residences were below the practical quantitation limit. Although exposures appear to have been partially interrupted, there is a potential health risk associated with future trichloroethylene exposures constituting an ***Indeterminate Public Health Hazard***. Arsenic detected in the dust of one household has not been remediated to date, and exposures may present a health concern for children. Since no children currently reside in this household, there is ***No Apparent Public Health Hazard*** at the present time at this residence for arsenic.

In response to cancer cluster concerns expressed by the community, the NJDHSS Cancer Epidemiology Program reviewed cancer incidence data from 1979 through 2001 for North Brunswick Township and Middlesex County. No unusual number or distributions of cancer types were determined for the township or county.

A summary of ATSDR conclusion categories are provided in Appendix 5.

Recommendations

1. Although there are presently no small children residing in residence A, this may change in the future. As such, arsenic in household dust should be remediated. Following remediation, additional household dust data should be collected to ensure that arsenic levels have been reduced.

2. Based on VOC analysis of indoor air samples collected following sump remediation activities, TCE concentrations persist at all three residences, albeit they are below the current practical quantitation limit. Since there is a continuing source of contamination, the NJDEP should characterize and delineate the contaminated groundwater plume at the site as soon as feasible.

3. With NJDEP oversight, groundwater and soil gas sampling should be conducted at all three residences. Results of this sampling will assist the NJDHSS in the evaluation of the vapor intrusion pathway.

4. Evaluations provided to residents in February 2005 for the indoor air pathway were based on very limited data. Additional indoor air sampling should be conducted at all three residences to better understand and evaluate current and future health risks.

Public Health Action Plan

The purpose of a Public Health Action Plan is to ensure that this health consultation not only identifies public health hazards, but also provides a plan of action designed to mitigate and prevent adverse human health effects resulting from exposure to hazardous substances in the environment. Included is a commitment on the part of the ATSDR and the NJDHSS to follow-up on this plan to ensure that it is implemented. The public health actions to be implemented by the ATSDR and NJDHSS are as follows:

Public Health Actions Taken

1. Representatives of the NJDHSS conducted a site visit of three residences located in the vicinity of the North Brunswick Township High School site on August 11, 2004.

2. An evaluation of potential public health risks associated with contamination detected at the three residences was provided to residents and the NJDEP on February 15 and 17, 2005 (see Appendix 1).

Public Health Actions Planned

1. This health consultation will be provided to residents, board of education and township officials, NJDEP, and the Middlesex County Public Health Department. Representatives of the ATSDR and NJDHSS are available to discuss the results of this report with interested parties.

2. In cooperation with the ATSDR, a public health assessment is being prepared by the NJDHSS for the North Brunswick Township High School site.

References

Powell-Harpstead, Inc. 2004. 2004 Site Remedial Investigation Report. June 2, 2004 letter to Mark Searfoss, NJDEP

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Trenton, New Jersey 08625-0369

CERTIFICATION

The Health Consultation for the North Brunswick High School, North Brunswick, New Jersey, was prepared by the New Jersey Department of Health and Senior Services under a cooperative agreement with the Agency for Toxic Substances and Disease Registry (ATSDR). It is in accordance with approved methodology and procedures existing at the time the health consultation was initiated.

____

Gregory V. Ulirsch
Technical Project Officer, CAT, SPAB, DHAC
Agency for Toxic Substances and Disease Registry (ATSDR)

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

____

Alan Yarbrough
Team Leader, CAT, SPAB, DHAC, ATSDR

Appendix 1

State of New Jersey

DEPARTMENT OF HEALTH AND SENIOR SERVICES
DIVISION OF PUBLIC HEALTH PROTECTION AND EMERGENCY PREPAREDNESS
CONSUMER AND ENVIRONMENTAL HEALTH SERVICES
PO BOX 369
TRENTON, N.J. 08625-0369

www.nj.gov/health

RICHARD J. CODEY
Acting Governor

FRED M. JACOBS, M.D., J.D.
Acting Commissioner

February 15, 2005

Dear Residence A:

Thank you for your request for assistance in evaluating potential health risks associated with contamination detected at your residence during an investigation of the North Brunswick Township High School site, Raider Road, North Brunswick, Middlesex County. We have reviewed the environmental data for your residence provided by the New Jersey Department of Environmental Protection and have prepared the enclosed evaluation.

For non-cancer health effects, arsenic in soil and household dust were determined to pose a potential health concern for children. For cancer health effects in adults, the risk associated with arsenic in soil (based on the average concentration) and indoor air concentrations of trichloroethylene were approximately eight excess cancer cases per 100,000 individuals. This increase in cancer risk attributable to site-related contamination is small when compared with the background cancer risk in the United States. Recommendations for your household include the remediation of arsenic contaminated household dust and the sampling of groundwater and soil gas so that the vapor intrusion pathway can be evaluated.

Please feel free to contact me by telephone at 609-584-5367 or via e-mail at Julie.Petix@doh.state.nj.us if you have any questions or concerns.

Sincerely,

Julie R. Petix, M.P.H., C.P.M., H.O.
Project Manager
Health Assessment and Consultation Unit

Enclosures
Attachment I, Evaluation of Contaminant Exposures at Residence A
Connecticut Department of Public Health Fact Sheet
ToxFAQs for arsenic and trichloroethylene

c: Jerald A. Fagliano, M.P.H., Ph.D., Program Manager
Mark Searfoss, Case Manager, NJDEP
Gregory Ulirsch, M.S., Technical Project Officer, ATSDR
Arthur Block, Senior Regional Representative, ATSDR

Attachment 1

Evaluation of Contaminant Exposures at Residence A
North Brunswick, Middlesex County, New Jersey
February 15, 2005

During excavation for a major renovation/expansion project at the North Brunswick Township High School in July 2003, debris and fill material, including hazardous waste, were discovered in the soil. Construction activities at the school were suspended and the New Jersey Department of Environmental Protection (NJDEP) was notified.

On behalf of the North Brunswick Township Board of Education, the engineering services firm of Powell-Harpstead, Inc., West Chester, Pennsylvania initiated a Site Remedial Investigation (SRI) of the site in the autumn of 2003. A primary purpose of the SRI was to delineate the extent of soil contamination. Based on SRI findings, site-related contamination was detected at three residential properties located on Plains Gap Road. Results of surface soil (0 – 0.5 foot depth) samples collected from your residence indicated arsenic and polycyclic aromatic hydrocarbon (PAH) contamination above NJDEP Residential Direct Contact Soil Cleanup Criteria (RDCSCC):

Contaminant	Average Concentration (mg/kg)*	Maximum Concentration (mg/kg)	NJDEP RDCSCC (mg/kg)
Metals**			
Arsenic	49.9	150	20
PAHs***			
Benzo[a]anthracene	0.141	1.3	0.9
Benzo[a]pyrene	0.187	1.5	0.66
Benzo[b]fluoranthene	0.301	2.2	0.9
Benzo[g,h,i]perylene	0.088	0.7	No criteria available

*milligrams of contaminant per kilogram of soil
**13 soil samples were collected for metals analysis
**10 soil samples were collected for PAHs analysis

Although the source of PAH contamination is uncertain, arsenic was determined to be site-related (M. Searfoss, NJDEP, personal communication, 2004). Powell-Harpstead, Inc. recommended that property owners refrain from any activities which may disturb these soils (e.g., gardening, landscaping) to prevent contact with contaminated soil.

A water sample was also collected from your basement sump. At the time of sampling, the sump pump was broken and had not been functional for several months. Trichloroethylene (TCE) was detected in this sample at a concentration of 140 micrograms of TCE per liter of water (µg/L). The presence of TCE in the sump water suggests TCE contamination of area groundwater.

Volatile organic compounds (VOCs) such as TCE in soil and groundwater can emit vapors that may migrate through subsurface soils and into indoor air spaces of overlying buildings. The vapor intrusion pathway may be important for buildings with or without a basement. Vapors can accumulate in occupied spaces to concentrations that may pose safety hazards, health effects, or aesthetic problems (e.g., odors). Consequently, indoor air samples from the basement and first floor of your home were collected and analyzed. Results indicated the presence of a number of VOCs, including TCE, benzene, methyl t-butyl ether, and chloroform. Some of these VOCs may be constituents of household products commonly stored in homes such as fuels, solvents, cleaners, and paints. Since groundwater and soil gas data are unavailable, the source of the VOCs, with the exception of TCE, cannot be identified. TCE results were above the U. S. Environmental Protection Agency (USEPA) Risk-Based Concentration (RBC) for TCE:

Location	**TCE ($\mu g/m^3$)***	**USEPA Region 3 RBC ($\mu g/m^3$)**
Basement	12	0.016
First Floor (kitchen)	5.4	0.016

*micrograms of TCE per cubic meter of air

Dust wipe samples were also collected from indoor surfaces throughout your residence. Of the nine samples collected, arsenic was detected at concentrations ranging from not detected to 53.6 micrograms of arsenic per square foot ($\mu g/ft^2$) of surface tested.

On August 11, 2004, the NJDHSS conducted a site visit of your home. The purpose of the site visit was to assess current site conditions and collect information potentially related to individual exposures to contaminants of concern. Information collected during the site visit included the number and age of residents, years of occupancy, gardening and landscaping activities, home-gardened fruit and vegetable consumption, and time spent in the basement. This information was utilized in estimating past exposures and assessing the potential for health effects.

Contaminants of Concern

As mentioned earlier, concentrations of arsenic and TCE detected at your residence were above the NJDEP RDCSCC and USEPA Region 3 RBC, respectively. For your reading, enclosed are ATSDR ToxFAQS for arsenic and TCE. ToxFAQs are prepared to provide environmental and health related facts about hazardous substances commonly found at hazardous waste sites.

Since arsenic and TCE were considered site-related contaminants, site-specific conditions were used to evaluate likely exposure scenarios for a given exposure pathway.

Assessment of Health Implications

The following is a summary of our findings for your residence. Generally, average contaminant concentrations are assumed to represent the more likely exposure scenario, while maximum contaminant concentrations are used conservatively to present a less likely, worst case scenario.

Soil and Dust Contamination

The main route of exposure to contaminated soil is by incidental ingestion from hand-to-mouth contact. This assessment evaluated the potential for both non-cancer and cancer health effects from exposures to the contaminants found at your property. Since children differ physiologically from adults and generally exhibit behaviors that increase exposure potential, their health risks were calculated separately.

Arsenic in Surface Soil

Factors taken into account included: maximum and average soil contamination concentrations; standard ingestion rates for adults and children; exposure duration (e.g., years of residency, seasonal considerations); and assumed body weight of adults and children. Arsenic exposure from eating home-grown fruits and vegetables is uncertain. However, arsenic and other contaminants may be taken up by root and leafy vegetables, but less so in fruiting vegetables. Enclosed is a fact sheet which discusses the safety of growing and eating fruits and vegetables from residential yards that may have soil contamination.

As previously discussed, the maximum surface soil concentration of arsenic detected at your residence was 150 mg/kg. Arsenic was also detected in four of the nine dust wipe samples collected throughout the interior of your residence. It was assumed that this dust contamination was associated with soil that was entrained in outdoor air and infiltrated into your residence via ventilation and/or tracked in on shoes or clothing.

<u>Non-cancer health effects</u>: Based on the average arsenic concentration detected in the surface soil at your residence, the exposure doses calculated for adults and children were below the health guideline value. The health guideline value for arsenic is set at a level meant to protect against non-cancer health effects, specifically dermal lesions. Based on the maximum arsenic concentration detected in the surface soil, the exposure dose calculated for your child (0.00034 milligrams per kilogram per day, or mg/kg/day) approximately equal to the health guideline value of 0.0003 mg/kg/day. An uncertainty factor of three was used by the ATSDR to derive the health guideline value to account for variations among individual sensitivity. It is important to note that a worst case exposure scenario is not considered representative for your child. As such, following long term exposure at the maximum arsenic concentration detected, non-cancer health effects are possible, although unlikely.

Cancer health effects: The site-specific lifetime excess cancer risk (LECR) indicates the cancer potential of contaminants. LECR estimates are usually expressed in terms of excess cancer cases in an exposed population in addition to the background rate of cancer. Based on the average arsenic concentration detected in the surface soil at your residence, a LECR for adults was estimated to be approximately eight excess cancer cases per 1,000,000 individuals; at the maximum arsenic concentration detected, the LECR was estimated to be approximately three excess cancer cases per 100,000 individuals. This increase in cancer risk attributable to site-related contamination is small when compared with the background cancer risk in the United States. For perspective, according to the American Cancer Society, one in three people are expected to get some form of cancer during their lifetime.

Arsenic in Household Dust

As previously mentioned, arsenic was detected in dust samples collected from the interior of your residence. Young children, especially those less than six years of age, spend a great deal of time on the floor and put non-food items in their mouths. It is our understanding that there are no young children residing at your residence. Since this may change in the future, a hypothetical dose was calculated based on the maximum dust concentration detected at your residence. The estimated dose (0.0032 mg/kg/day) was above the health guideline value (0.0003 mg/kg/day) for non-cancer health effects. As such, this contaminated household dust may present a health concern for children.

Indoor Air TCE Contamination

Factors taken into consideration included: indoor air concentrations; standard inhalation rates of adults and children; exposure duration (including consideration of time spent in the basement particularly during the summer months when family members slept in the basement); and assumed body weights of adults and children.

Non-cancer health effects: At the present time, there is no health guideline value available to compare with TCE exposures occurring for more than one year. There is, however, an “intermediate” health guideline value available for TCE exposures occurring for more than 14 days but less than a year. The TCE concentration detected in your basement is about 45 times less than the intermediate health guideline value for TCE. As such, non-cancer health effects are unlikely for both adults and children at the concentration detected.

Cancer health effects: Based on the TCE concentrations detected in the indoor air at your residence, a LECR for adults was estimated to be approximately seven excess cancer cases per 100,000 individuals. Again, this increase in cancer risk attributable to site-related contamination is small when compared with the background cancer risk in the United States. For perspective, according to the American Cancer Society, one in three people are expected to get some form of cancer during their lifetime.

Past and Current Status of Exposure Pathways

So far, health effects associated with the contaminants of concern detected at your residence were evaluated individually. Since the cumulative or synergistic effects of mixtures of contaminants may increase their public health impact, we also evaluated their cumulative health risks. For non-cancer health effects, arsenic was the only contaminant that posed a potential risk, and this was only at the maximum concentration detected. For cancer health effects in adults, the combined risk associated with arsenic in soil (based on the average concentration) and indoor air concentrations of TCE were approximately eight excess cancer cases per 100,000 individuals.

Under NJDEP oversight, contaminated soil at your residence was removed. Additionally, the basement sump pump was replaced, the sump covered and sealed, and a fan installed to exhaust headspace vapors through an existing radon remediation system. The results of a second air sampling round indicated that TCE concentrations were estimated to be below the NJDEP practical quantitation limit. Therefore, exposures from the soil and indoor air pathways appear to have been interrupted for household members. Since typical household cleaning methods may not adequately abate the arsenic contamination detected in your household dust, this exposure pathway continues to be a concern.

Recommendations

Based on the above assessment, our recommendations are as follows:

1. Although there are presently no small children residing at your residence, this may change in the future. As such, arsenic in household dust should be remediated. Following remediation, additional household dust data should be collected to ensure that arsenic levels have been reduced.

2. Groundwater and soil gas sampling should be conducted at your residence. Results of this sampling will assist the NJDHSS in the evaluation of the vapor intrusion pathway. If soil gas data indicate the potential for vapor intrusion, additional indoor air sampling should be conducted at your residence.

In cooperation with the ATSDR, a Public Health Assessment is being prepared by the NJDHSS for the North Brunswick Township High School site which will detail the process of evaluating and interpreting environmental data and public health risks. Additional environmental data that becomes available from the NJDEP will be reviewed and evaluated in the Public Health Assessment.

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RICHARD J. CODEY
Acting Governor

FRED M. JACOBS, M.D., J.D.
Acting Commissioner

February 15, 2005

Dear Residence B:

Thank you for your request for assistance in evaluating potential health risks associated with contamination detected at your residence during an investigation of the North Brunswick Township High School site, Raider Road, North Brunswick, Middlesex County. We have reviewed the environmental data for your residence provided by the New Jersey Department of Environmental Protection and have prepared the enclosed evaluation.

Based on the average arsenic concentration detected in the surface soil at your residence, non-cancer health effects are not expected for adults and children. For cancer health effects in adults, the risk associated with arsenic in soil (based on the average concentration) was approximately five excess cancer cases per 10,000,000 individuals. This increase in cancer risk attributable to site-related contamination is very small when compared with the background cancer risk in the United States. Typically, health guideline values developed for carcinogens are based on one excess cancer case per 1,000,000 individuals. Recommendations for your household include the sampling of groundwater and soil gas so that the vapor intrusion pathway can be evaluated and the identification and removal of potential household indoor air contamination sources.

Please feel free to contact me by telephone at 609-584-5367 or via e-mail at Julie.Petix@doh.state.nj.us if you have any questions or concerns.

Sincerely,

Julie R. Petix, M.P.H., C.P.M., H.O.
Project Manager
Health Assessment and Consultation Unit

Enclosures
Attachment I, Evaluation of Contaminant Exposures at Residence B
ToxFAQs for gasoline, arsenic, and trichloroethylene

c: Jerald A. Fagliano, M.P.H., Ph.D., Program Manager
Mark Searfoss, Case Manager, NJDEP
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Attachment 1

Evaluation of Contaminant Exposures at Residence B
North Brunswick, Middlesex County, New Jersey
February 15, 2005

During excavation for a major renovation/expansion project at the North Brunswick Township High School in July 2003, debris and fill material, including hazardous waste, were discovered in the soil. Construction activities at the school were suspended and the New Jersey Department of Environmental Protection (NJDEP) was notified.

On behalf of the North Brunswick Township Board of Education, the engineering services firm of Powell-Harpstead, Inc., West Chester, Pennsylvania initiated a Site Remedial Investigation (SRI) of the site in the autumn of 2003. A primary purpose of the SRI was to delineate the extent of soil contamination. Based on SRI findings, site-related contamination was detected at three residential properties located on Plains Gap Road. Results of surface soil samples collected from your residence indicated arsenic contamination above NJDEP Residential Direct Contact Soil Cleanup Criteria (RDCSCC):

Contaminant	Average Concentration (mg/kg)*	Maximum Concentration (mg/kg)	NJDEP RDCSCC (mg/kg)
Arsenic**	14.79	45.2	20

*milligrams of arsenic per kilogram of soil
**six surface soil samples were collected for metals analysis (five samples were collected at a depth of 0 – 0.5 feet, one sample was collected at a depth of 0.3 – 0.8 feet)

According to the NJDEP, arsenic contamination was determined to be site-related (M. Searfoss, NJDEP, personal communication, 2004). Powell-Harpstead, Inc. recommended that property owners refrain from any activities which may disturb these soils (e.g., gardening, landscaping) to prevent contact with contaminated soil.

A water sample was also collected from your basement sump. Although no contamination was detected, trichloroethylene (TCE) was detected in the sump water of neighboring residences. The presence of TCE in the sump water suggests TCE contamination of area groundwater.

Volatile organic compounds (VOCs) such as TCE in soil and groundwater can emit vapors that may migrate through subsurface soils and into indoor air spaces of overlying buildings. The vapor intrusion pathway may be important for buildings with or without a basement. Vapors can accumulate in occupied spaces to concentrations that may pose safety hazards, health effects, or aesthetic problems (e.g., odors). Consequently, indoor air samples from the basement and first floor of your home were collected and analyzed. Results indicated the presence of TCE as well as a number of other VOCs including benzene, chloroform, p-dichlorobenzene, methyl t-butyl ether, and 1,2,4-trimethylbenzene, at concentrations above US Environmental Protection Agency (USEPA) Risk-Based Concentrations (RBCs). Some of these substances, as well as others detected in your home at lower concentrations (such as toluene, ethylbenzene, and xylene) may be associated with the use and storage of gasoline and/or cleaning products. It is important to note that the highest concentrations of these contaminants were detected on the first floor of your home. For your reading, enclosed is an ATSDR ToxFAQS for gasoline. ToxFAQs are prepared to provide environmental and health related facts about hazardous substances commonly found at hazardous waste sites.

Since groundwater and soil gas data are unavailable, the source of the VOCs, with the exception of TCE, cannot be identified as being site related. TCE results were as follows:

Location	**TCE ($\mu g/m^3$)***	**USEPA Region 3 RBC ($\mu g/m^3$)**
Basement	0.42	0.016
First Floor (family room)	Not detected	0.016

*micrograms of TCE per cubic meter of air

Dust wipe samples were also collected from nine indoor surfaces throughout your residence. Results did not indicate the presence of any site-related contamination above applicable standards.

On August 11, 2004, the NJDHSS conducted a site visit of your home. The purpose of the site visit was to assess current site conditions and collect information potentially related to individual exposures to contaminants of concern. Information collected during the site visit included the number and age of residents, years of occupancy, gardening and landscaping activities, and time spent in the basement. This information was utilized in estimating past exposures and assessing the potential for health effects.

Contaminants of Concern

As mentioned earlier, concentrations of arsenic and TCE detected at your residence were above the NJDEP RDCSCC and USEPA Region 3 RBC, respectively. For your reading, enclosed are ATSDR ToxFAQS for arsenic and TCE. ToxFAQs are prepared to provide environmental and health related facts about hazardous substances commonly found at hazardous waste sites.

Since arsenic and TCE were considered site-related contaminants, site-specific conditions were used to evaluate likely exposure scenarios for a given exposure pathway.

Assessment of Health Implications

The following is a summary of our findings for your residence. Generally, average contaminant concentrations are assumed to represent the more likely exposure scenario, while maximum contaminant concentrations are used conservatively to present a less likely, worst case scenario.

Soil and Dust Contamination

The main route of exposure to contaminated soil is by incidental ingestion from hand-to-mouth contact. This assessment evaluated the potential for both non-cancer and cancer health effects from exposures to the contaminants found at your property. Since children differ physiologically from adults and generally exhibit behaviors that increase exposure potential, their health risks were calculated separately.

Arsenic in Surface Soil

Factors taken into account included: maximum and average soil contamination concentrations; standard ingestion rates for adults and children; exposure duration (e.g., years of residency, seasonal considerations); and assumed body weight of adults and children.

As previously discussed, the maximum surface soil concentration of arsenic detected at your residence was 45.2 mg/kg. Arsenic was not detected in any of the nine dust wipe samples collected throughout the interior of your residence.

<u>Non-cancer health effects</u>: Based on the average arsenic concentration detected in the surface soil at your residence, the exposure doses calculated for adults and children were below the health guideline value. The health guideline value for arsenic is set at a level meant to protect against non-cancer health effects, specifically dermal lesions. Based on the maximum arsenic concentration detected in the surface soil, the exposure dose calculated for your youngest child (0.00053 milligrams per kilogram per day, or mg/kg/day) exceeds the health guideline value of 0.0003 mg/kg/day. An uncertainty factor of three was used by the ATSDR to derive the health guideline value to account for variations among individual sensitivity. Following long term exposure at the maximum arsenic concentration detected, non-cancer health effects are possible. It is important to note that this worst case exposure scenario may not be representative for your child.

<u>Cancer health effects</u>: The site-specific lifetime excess cancer risk (LECR) indicates the cancer potential of contaminants. LECR estimates are usually expressed in terms of excess cancer cases in an exposed population in addition to the background rate of cancer. Based on the average arsenic concentration detected in the surface soil at your residence, a LECR for adults was estimated to be approximately five excess cancer cases per 10,000,000 individuals; at the maximum arsenic concentration detected, the LECR was estimated to be approximately two excess cancer cases per 1,000,000 individuals. This increase in cancer risk attributable to site-related contamination is very small when

compared with the background cancer risk in the United States. For perspective, according to the American Cancer Society, one in three people are expected to get some form of cancer during their lifetime.

Arsenic in Household Dust

Young children, especially those less than six years of age, spend a great deal of time on the floor and put non-food items in their mouths. As previously mentioned, arsenic was not detected in dust samples collected from the interior of your residence.

Indoor Air TCE Contamination

Factors taken into consideration included: indoor air concentrations; standard inhalation rates of adults and children; exposure duration (including consideration of time spent in the basement); and assumed body weights of adults and children. As previously stated, no TCE was detected in the indoor air sample collected from your family room. Although TCE was detected in the basement, you had indicated that other than the occasional storage visit, you and your family do not spend any time in the basement. As such, health effects associated with TCE exposures are not expected.

Past and Current Status of Exposure Pathways

Past exposures associated with the contaminants of concern detected at your residence were evaluated. Based on the average arsenic concentration detected in the surface soil at your residence (the likely exposure scenario), non-cancer health effects are not expected for adults and children. For cancer health effects in adults, the risk associated with arsenic in soil (based on the average concentration) was approximately five excess cancer cases per 10,000,000 individuals.

Under NJDEP oversight, contaminated soil at your residence has been removed. Therefore, exposures from the soil pathway appear to have been interrupted for household members. There are no TCE exposures to household members since the basement is currently used for storage only.

Recommendations

Based on the above assessment, our recommendations are as follows:

1. Groundwater and soil gas sampling should be conducted at your residence. Results of this sampling will assist the NJDHSS in the evaluation of the vapor intrusion pathway. If soil gas data indicate the potential for vapor intrusion, additional indoor air sampling should be conducted at your residence.

2. A large number of VOCs were detected in the indoor air of your home, and some of these contaminants were detected at higher concentrations on the first floor. It is possible that the sources of these substances are related to the use and/or storage of

gasoline, household cleaning products, and solvents. This contamination may be addressed by identifying and removing these products from your home.

In cooperation with the ATSDR, a Public Health Assessment is being prepared by the NJDHSS for the North Brunswick Township High School site which will detail the process of evaluating and interpreting environmental data and public health risks. Additional environmental data that becomes available from the NJDEP will be reviewed and evaluated in the Public Health Assessment.

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RICHARD J. CODEY
Acting Governor

FRED M. JACOBS, M.D., J.D.
Acting Commissioner

February 17, 2005

Dear Residence C:

Thank you for your request for assistance in evaluating potential health risks associated with contamination detected at your residence during an investigation of the North Brunswick Township High School site, Raider Road, North Brunswick, Middlesex County. We have reviewed the environmental data for your residence provided by the New Jersey Department of Environmental Protection and have prepared the enclosed evaluation.

Based on arsenic concentrations detected in the surface soil and the trichloroethylene concentrations in the indoor air at your residence, non-cancer health effects are not expected for adults and children. For cancer health effects in adults, the combined risk associated with arsenic in soil (based on the average concentration) and indoor air concentrations of trichloroethylene were approximately six excess cancer cases per 1,000,000 individuals. This increase in cancer risk attributable to site-related contamination is small when compared with the background cancer risk in the United States. Recommendations for your household include the sampling of groundwater and soil gas so that the vapor intrusion pathway can be evaluated and the identification and removal of potential household indoor air contamination sources.

Please feel free to contact me by telephone at 609-584-5367 or via e-mail at Julie.Petix@doh.state.nj.us if you have any questions or concerns.

Sincerely,

Julie R. Petix, M.P.H., C.P.M., H.O.
Project Manager
Health Assessment and Consultation Unit

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ToxFAQs for gasoline, arsenic, and trichloroethylene

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Attachment 1

Evaluation of Contaminant Exposures at Residence C
North Brunswick, Middlesex County, New Jersey
February 17, 2005

During excavation for a major renovation/expansion project at the North Brunswick Township High School in July 2003, debris and fill material, including hazardous waste, were discovered in the soil. Construction activities at the school were suspended and the New Jersey Department of Environmental Protection (NJDEP) was notified.

On behalf of the North Brunswick Township Board of Education, the engineering services firm of Powell-Harpstead, Inc., West Chester, Pennsylvania initiated a Site Remedial Investigation (SRI) of the site in the autumn of 2003. A primary purpose of the SRI was to delineate the extent of soil contamination. Based on SRI findings, site-related contamination was detected at three residential properties located on Plains Gap Road. Results of surface (0 – 0.5 foot depth) soil samples collected from your residence indicated arsenic contamination above NJDEP Residential Direct Contact Soil Cleanup Criteria (RDCSCC):

Contaminant	**Average Concentration (mg/kg)***	**Maximum Concentration (mg/kg)**	**NJDEP RDCSCC (mg/kg)**
Arsenic**	16.67	46.1	20

*milligrams of arsenic per kilogram of soil
**13 surface soil samples were collected for metals analysis

According to the NJDEP, arsenic contamination was determined to be site-related (M. Searfoss, NJDEP, personal communication, 2004). Powell-Harpstead, Inc. recommended that property owners refrain from any activities which may disturb these soils (e.g., gardening, landscaping) to prevent contact with contaminated soil.

A water sample was also collected from your basement sump. Trichloroethylene (TCE) was detected in this sample at a concentration of 4 micrograms of TCE per liter of water (µg/L). The presence of TCE in the sump water suggests TCE contamination of area groundwater.

Volatile organic compounds (VOCs) such as TCE in soil and groundwater can emit vapors that may migrate through subsurface soils and into indoor air spaces of overlying buildings. The vapor intrusion pathway may be important for buildings with or without a basement. Vapors can accumulate in occupied spaces to concentrations that may pose safety hazards, health effects, or aesthetic problems (e.g., odors). Consequently, indoor air samples from the basement and first floor of your home were collected and analyzed. Results indicated the presence of TCE as well as a number of other VOCs including benzene, chloroform, carbon tetrachloride, p-dichlorobenzene, and methyl t-butyl ether at concentrations above US Environmental Protection Agency (USEPA) Risk-Based Concentrations (RBCs). Some of these substances, as well as others detected in your home at lower concentrations (such as toluene, ethylbenzene, and xylene) may be associated with the use and storage of gasoline and/or cleaning products. It is important to note that the highest concentrations of these contaminants were detected in your basement. For your reading, enclosed is an ATSDR ToxFAQS for gasoline. ToxFAQs are prepared to provide environmental and health related facts about hazardous substances commonly found at hazardous waste sites.

Since groundwater and soil gas data are unavailable, the source of the VOCs, with the exception of TCE, cannot be identified. TCE results were as follows:

Location	**TCE ($\mu g/m^3$)***	**USEPA Region 3 RBC ($\mu g/m^3$)**
Basement	0.32	0.016
First Floor (living room)	0.30	0.016

*micrograms of TCE per cubic meter of air

Dust wipe samples were also collected from nine indoor surfaces throughout your residence. Results did not indicate the presence of site-related contamination above applicable standards.

On August 11, 2004, the NJDHSS conducted a site visit of your home. The purpose of the site visit was to assess current site conditions and collect information potentially related to individual exposures to contaminants of concern. Information collected during the site visit included the number and age of residents, years of occupancy, gardening and landscaping activities, and time spent in the basement. This information was utilized in estimating past exposures and assessing the potential for health effects.

Contaminants of Concern

As mentioned earlier, concentrations of arsenic and TCE detected at your residence were above the NJDEP RDCSCC and USEPA Region 3 RBC, respectively. For your reading, enclosed are ATSDR ToxFAQS for arsenic and TCE. ToxFAQs are prepared to provide environmental and health related facts about hazardous substances commonly found at hazardous waste sites.

Since arsenic and TCE were considered site-related contaminants, site-specific conditions were used to evaluate likely exposure scenarios for a given exposure pathway.

Assessment of Health Implications

The following is a summary of our findings for your residence. Generally, average contaminant concentrations are assumed to represent the more likely exposure scenario, while maximum contaminant concentrations are used conservatively to present a less likely, worst case scenario.

Soil and Dust Contamination

The main route of exposure to contaminated soil is by incidental ingestion from hand-to-mouth contact. This assessment evaluated the potential for both non-cancer and cancer health effects from exposures to the contaminants found at your property. Since children differ physiologically from adults and generally exhibit behaviors that increase exposure potential, their health risks were calculated separately.

Arsenic in Surface Soil

Factors taken into account included: maximum and average soil contamination concentrations; standard ingestion rates for adults and children; exposure duration (e.g., years of residency, seasonal considerations); and assumed body weight of adults and children.

As previously discussed, the maximum surface soil concentration of arsenic detected at your residence was 46.1 mg/kg. Arsenic was not detected in any of the nine dust wipe samples collected throughout the interior of your residence.

Non-cancer health effects: Based on both the maximum and average arsenic concentrations detected in the surface soil at your residence, the exposure doses calculated for adults and children were below the health guideline value. The health guideline value for arsenic is set at a level meant to protect against non-cancer health effects, specifically dermal lesions. As such, non-cancer health effects are not expected to occur.

Cancer health effects: The site-specific lifetime excess cancer risk (LECR) indicates the cancer potential of contaminants. LECR estimates are usually expressed in terms of excess cancer cases in an exposed population in addition to the background rate of cancer. Based on the average arsenic concentration detected in the surface soil at your residence, a LECR for adults was estimated to be approximately three excess cancer cases per 1,000,000 individuals; at the maximum arsenic concentration detected, the LECR was estimated to be approximately seven excess cancer cases per 1,000,000 individuals. This increase in cancer risk attributable to site-related contamination is small when compared with the background cancer risk in the United States. For perspective, according to the American Cancer Society, one in three people are expected to get some form of cancer during their lifetime.

Arsenic in Household Dust

Young children, especially those less than six years of age, spend a great deal of time on the floor and put non-food items in their mouths. As previously mentioned, arsenic was not detected in dust samples collected from the interior of your residence.

Indoor Air TCE Contamination

Factors taken into consideration included: indoor air concentrations; standard inhalation rates of adults and children; exposure duration (including consideration of time spent in the basement); and assumed body weights of adults and children.

Non-cancer health effects: At the present time, there is no health guideline value available to compare with TCE exposures occurring for more than one year. There is, however, an "intermediate" health guideline value available for TCE exposures occurring for more than 14 days but less than a year. The concentration detected in your living room is about 1,700 times less than the intermediate health guideline value for TCE. As such, non-cancer health effects are unlikely for both adults and children at the concentration detected.

Cancer health effects: Based on the TCE concentration detected in your living room, a LECR for adults was estimated to be approximately three excess cancer cases per 1,000,000 individuals. Again, this increase in cancer risk attributable to site-related contamination is small when compared with the background cancer risk in the United States. For perspective, according to the American Cancer Society, one in three people are expected to get some form of cancer during their lifetime.

Past and Current Status of Exposure Pathways

Potential health risks associated with the contaminants of concern detected at your residence were evaluated individually. Since the cumulative or synergistic effects of mixtures of contaminants may increase their public health impact, we also evaluated their cumulative health risks. As stated above, non-cancer health effects associated with arsenic and TCE exposures were not expected at the levels detected at your residence. For cancer health effects in adults, the combined risk associated with arsenic in soil (based on the average concentration) and indoor air concentrations of TCE were approximately six excess cancer cases per 1,000,000 individuals.

Under NJDEP oversight, contaminated soil at your residence has been removed. Additionally, the basement sump was covered and sealed. The results of a second air sampling round indicated that TCE concentrations were estimated to be below the NJDEP practical quantitation limit. Therefore, exposures from the soil and indoor air pathways appear to have been interrupted for household members.

Recommendations

Based on the above assessment, our recommendations are as follows:

1. Groundwater and soil gas sampling should be conducted at your residence. Results of this sampling will assist the NJDHSS in the evaluation of the vapor intrusion

pathway. If soil gas data indicate the potential for vapor intrusion, additional indoor air sampling should be conducted at your residence.

2. A large number of VOCs were detected in the indoor air of your home, and some of these contaminants were detected at higher concentrations in your basement. It is possible that the sources of these substances are related to the use and/or storage of gasoline, household cleaning products, and solvents. This contamination may be addressed by identifying and removing these products from your home.

In cooperation with the ATSDR, a Public Health Assessment is being prepared by the NJDHSS for the North Brunswick Township High School site which will detail the process of evaluating and interpreting environmental data and public health risks. Additional environmental data that becomes available from the NJDEP will be reviewed and evaluated in the Public Health Assessment.

Appendix 2

- Avoid working in the yard on windy days, when dust can be stirred up and possibly increase your exposure.
- Consider wearing a mask if you spend time in dusty areas.
- Wash your hands after gardening.
- Wash work clothes to remove dust and dirt.
- Take your shoes off at the door to avoid tracking soil into your home.

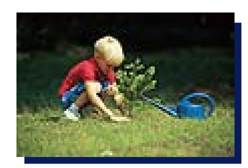
Preparing Fruits and Vegetables

- Clean your hands, cutting boards, and kitchen tools with hot, soapy water and rinse well before and after handling your fruits and vegetables.
- Soak garden produce in cool water and rinse thoroughly until the water runs clear. Commercial vegetable-cleaning products are available in supermarkets to help free soil residues from your produce. These products work well with leafy vegetables. Vinegar can also be used for cleaning produce.
- Scrub firm fruits and root crops with a vegetable-cleaning brush to remove dust and dirt before peeling or eating.
- Peel root crops like carrots, rutabagas, radishes, and turnips.
- Wash berry fruits like strawberries and blackberries, and remove the "caps" (the tops of the berries where the stem and leaves attach).

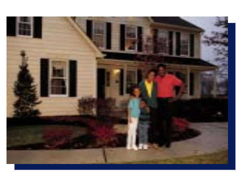
Buy Some, Grow Some

- Eat some fruits and vegetables from your garden and some from the farmer's market or grocery store. Eating a mix of homegrown and commercial products can help reduce your potential exposure.

Creating Play Areas for Children



- Fill sandboxes with sand or soil from an outside source such as a commercial gardening center.
- Cover bare soil with grass or other material such as mulch.
- Keep children from playing in contaminated soil. The most likely way for children to become exposed to arsenic is from ingesting (eating) dirt.
- Have children wash hands and faces after they play in the yard.



Cleaning Your Home

- Remove work and play shoes before entering your house.
- Damp-mop floors and wipe down counters, tables, and window ledges regularly.
- To reduce dust levels in the home, consider upgrading your vacuum cleaner bags to those that filter better or simply change your bags more often. Some persons may want to buy a vacuum cleaner with a HEPA (high-efficiency particulate air) filter to better reduce dust levels.
- Wash the soil from homegrown fruits and vegetables before bringing them into your home.
- Keep pets out of areas of contaminated soil. Dogs and cats carry contaminated soil on their feet and fur into the home. Bathe your pets frequently.

For more information about ATSDR's work at Spring Valley, visit our web site at www.atsdr.cdc.gov/sites/springvalley or contact any of ATSDR's Spring Valley Team members:

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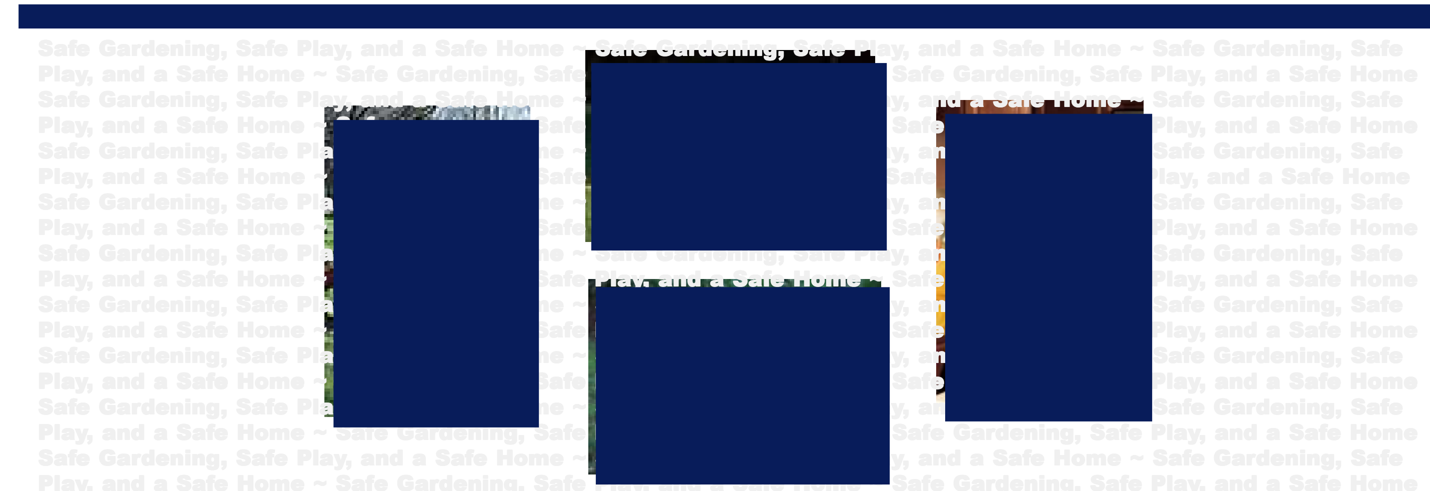
ATSDR AGENCY FOR TOXIC SUBSTANCES AND DISEASE REGISTRY

Safe Gardening, Safe Play, and a Safe Home

An interim guide to reducing arsenic exposure in Spring Valley

This pamphlet was designed for residents of Spring Valley. The purpose is to provide residents with good health practice tips for the home, lawn and garden work, and play. By following the tips in this pamphlet, residents can greatly reduce their exposure to arsenic as well as to other potentially harmful materials such as pesticides and germs that might be in the soil.



Introduction

Approximately 146 properties in the Spring Valley area have some soil arsenic levels greater than 20 parts per million (ppm), a level designated by local and federal officials as a clean-up level for this community. Although the levels of arsenic detected in this community are in some cases elevated in soil, limited exposure studies to date suggest that the arsenic is not getting into residents' bodies in any greater amounts than what you would find in the general public. Although this is reassuring, it is recognized that some residents may still be concerned until the cleanup of their yards has occurred. For those and other concerned residents, the good practice tips in this pamphlet will be effective in reducing exposures to arsenic, pesticides, and germs that might be present in the soil.

Enjoying Your Lawn and Garden

Eating fruits and vegetables and getting plenty of exercise are essential parts of a healthy lifestyle. People enjoy many activities on their lawn and in their garden, which provide places both for exercise and for growing fresh fruits and vegetables. The levels of arsenic found in the soil of most properties in Spring Valley are at or below background (natural) levels and present no health hazard for people doing lawn or garden activities. Still, some families have arsenic in their soil at levels higher than the clean-up level and wish to reduce their exposure to the lowest possible level. Activities such as playing, gardening, and working on your lawn can increase your opportunity for exposure even though they are healthful. The information in this pamphlet will help you understand how to reduce your chances of exposure so you do not feel you have to give up the outdoor activities that you and your family enjoy. Understand that each property is different. Some of the tips outlined may apply to your situation and some may not.

Arsenic

A major source of elevated arsenic in Spring Valley surface soils is from degradation of chemical warfare agents tested there during World War I (WWI).

The U.S. Environmental Protection Agency (EPA), Army Corps of Engineers (ACOE), and the D.C. Department of Health set an arsenic cleanup level of 20 ppm for yards in Spring Valley. ACOE has removed soil from some contaminated properties and is planning to continue soil removals over the next several years. Until the contaminated soil is replaced, residents may reduce their chances of exposure by following the guidelines in this pamphlet. Additional information about arsenic can be found at the ATSDR Spring Valley Information Repository at Palisades Library (4901 V Street N.W. at 49th Street N.W.) or through the ATSDR Spring Valley Web site at www.atsdr.cdc.gov/sites/springvalley.

Arsenic and Gardening

Arsenic is a naturally occurring element. Two types of arsenic are found in the environment. The first is **inorganic arsenic**, which is usually found in the environment combined with other elements such as oxygen, iron, and sulfur. The second type of arsenic is **organic arsenic**. Organic arsenic is formed by arsenic combined with carbon and hydrogen. It is found in plants, fish, and shellfish and is considered less harmful than inorganic arsenic.

For most properties in Spring Valley the soil arsenic levels are not high enough to cause any health problems associated with eating homegrown vegetables. Indeed, even for those areas showing elevated levels of arsenic, the uptake into home grown vegetables or fruits, is not likely to be sufficient to cause any health effects to persons gardening in the soil or eating vegetables grown in the garden. This will be explained below.

Gardening in soil with elevated levels of arsenic has two main issues: cleaning soil from the edible portion of the plant and absorption of arsenic by the plant. It is always a good health practice to wash all fruits and vegetables thoroughly whether they are bought or homegrown. Washing the soil from your homegrown fruits and vegetables is one of the most effective ways of reducing your exposure to not only arsenic but to pesticides and germs as well.

Most edible plants absorb some small amounts of arsenic, but usually do not contain enough arsenic to be of health concern. The amount of arsenic absorbed by plants can depend on many factors. Some of the most important factors are soil acidity, nutrient content, iron, organic matter, and plant type. Plants can absorb more arsenic if you have acidic soil. Keeping your soil at a near-neutral range (pH 6–7) can help reduce the amount of arsenic absorbed in plants. Maintaining adequate levels of plant nutrients in your soil can help reduce arsenic absorption. Adding a balanced commercial fertilizer to soil can help maintain correct levels of key plant nutrients. Iron can prevent arsenic from being absorbed. The iron combines with arsenic to form iron arsenate, a form of arsenic that is not well absorbed by plants. Increased amounts of organic matter are also helpful; the organic matter binds to arsenic and reduces how much plants take up. Some lawn and garden products contain arsenic, so it is a good idea to check with your lawn and garden store for products that do not contain arsenic.

Another important thing to keep in mind is that arsenic deposited by the chemical weapons tests in Spring Valley has been in the soil for 80 years. The longer the arsenic stays in the soil, the more it becomes bound to the soil, making it less available to plants and humans.

Arsenic levels in garden areas tend to be lower than in other areas of the property because most gardeners add soil conditioners such as compost and topsoil. By adding these conditioners, the concentration of arsenic in the soil is diluted. Some gardeners might want to add additional compost or topsoil from an area of their yard that does not have elevated levels of arsenic. In some cases it may be best to remove the soil from the place you want to garden and replace it with topsoil from a commercial garden center.

Plants vary in the amount of arsenic they absorb from the soil and where they store arsenic. Some plants move arsenic from the roots to the leaves, while others absorb and store it in the roots only. Fruit-type vegetables such as tomatoes concentrate arsenic in the roots and very little arsenic is taken up in the edible portion of the plant. Leafy vegetables also store arsenic in their roots, but some is also stored in the stems and leaves. Lettuce and some members of the Brassica plant family such as collards, kale, mustard, and turnip greens store more arsenic in the leaves than do other crops, but not at concentrations high enough to cause concern. Root crops such as beets, turnips, carrots, and potatoes absorb most of the arsenic in the surface skin of the vegetable. By peeling the skins of root crops, you can eliminate the portion of the plant that contains arsenic. Again, garden vegetables grown in Spring Valley should not contain enough arsenic to be of health concern. Recommendations for conditioning your soil, washing vegetables, and peeling root crops are intended to provide you the property owner with additional options for reducing exposure to arsenic.

For some properties with limited space for gardens, a raised garden bed might be an option. Instructions for building a raised garden bed can be found in most gardening books. The raised beds can be filled with soil from commercial gardening centers or from an area of your yard that does not contain elevated levels of arsenic. Your local agricultural extension office is an excellent source of for all types of gardening information.

Can I Eat Fruits and Vegetables Grown in My Garden?

Yes. Homegrown fruits and vegetables are highly unlikely to contain arsenic levels that would affect your health. Vegetables grown in soils with arsenic will take up some small amounts of arsenic. However, we believe the benefits from the eating your homegrown fruits and vegetables outweigh the risk presented by their arsenic content. By following the recommendations in the Tips for Safe Gardening, Safe Play, and a Safe Home section, you can greatly reduce your exposure to arsenic from the soil.

Unknown Buried Material

As the result of activities performed at the American University Experimental Station during WWI, dangerous materials used in the war effort were often buried as a means of disposal. ACOE, using historical records, has identified several areas of concern and continues to investigate. Buried items already discovered include buried munitions (both conventional and those containing chemical warfare agents), chemical weapon agents in ceramic jugs, laboratory waste, and other related items. These items have been buried since WWI and many have rusted and deteriorated to a point that they pose little health risk but it is possible for some to contain chemical agents. There have been very few reports of these items being uncovered through normal yard work, but the possibility does exist. Existing gardens and flowerbeds that have already been tilled or dug in are considered very low risk, but you should follow precautions. If you dig up any suspicious glass or metal object, do not attempt to remove the item yourself. Call ACOE at 1-800-434-0988, 410-962-7522, or 202-686-3359 for assistance.

Tips for Safe Gardening, Safe Play, and a Safe Home

Preparing Your Garden Soil

We are all exposed to a little arsenic every day. The recommendations below are for people who want to keep their exposure to the minimum possible. These recommendations are intended to be on the safe side. Under normal circumstances, a lapse in following these recommendations will not, by itself, lead to health problems.

- Increase the organic matter in your soil by adding compost or manure from outside sources such as commercial garden centers.
- Keep soil pH in the near-neutral range (pH 6–7). For a soils test, check with your local agricultural extension office or purchase a soils test kits at a garden center.
- Maintain adequate levels of plant nutrients by using a balanced commercial fertilizer.
- Maintain adequate levels of iron in your soil.
- Consider building a raised-bed garden. Fill it with topsoil and compost from outside sources or areas of your yard that do not have elevated levels of arsenic.

Note: Do not use chromated copper arsenate (CCA)-treated wood to build your raised garden beds. CCA contains arsenic that can leach into your soil. Use a safer nonarsenic pressure-treated wood such as ammoniacal copper quaternary (ACQ). Bricks, stone, or other wood products such as cedar or redwood can be used to build a raised garden bed.

Working in the Garden and Yard

- Avoid eating or drinking while working in the yard or garden because contaminated soil and dust might get on your food and you could accidentally swallow it.
- Dampen soils with water before you garden to limit the amount of dust you inhale.

Appendix 3

ATSDR
AGENCY FOR TOXIC SUBSTANCES AND DISEASE REGISTRY

AUTOMOTIVE GASOLINE

CAS # 8006-61-9

Agency for Toxic Substances and Disease Registry ToxFAQs **September 1996**

This fact sheet answers the most frequently asked health questions (FAQs) about automobile gasoline. For more information, call the ATSDR Information Center at 1-888-422-8737. This fact sheet is one in a series of summaries about hazardous substances and their health effects. This information is important because this substance may harm you. The effects of exposure to any hazardous substance depend on the dose, the duration, how you are exposed, personal traits and habits, and whether other chemicals are present.

SUMMARY: Exposure to automotive gasoline most likely occurs from breathing its vapor at a service station while filling a car's fuel tank. At high levels, automotive gasoline is irritating to the lungs when breathed in and irritating to the lining of the stomach when swallowed. Exposure to high levels may also cause harmful effects to the nervous system. Automotive gasoline has been found in at least 23 of the 1,430 National Priorities List sites identified by the Environmental Protection Agency (EPA).

What is automotive gasoline?

(Pronounced ô′tə-mō′tĭv găs′ə-lēn′)

The gasoline discussed in this fact sheet is automotive used as a fuel for engines in cars. Gasoline is a colorless, pale brown, or pink liquid, and is very flammable.

Gasoline is a manufactured mixture that does not exist naturally in the environment. Gasoline is produced from petroleum in the refining process.

Typically, gasoline contains more than 150 chemicals, including small amounts of benzene, toluene, xylene, and sometimes lead. How the gasoline is made determines which chemicals are present in the gasoline mixture and how much of each is present. The actual composition varies with the source of the crude petroleum, the manufacturer, and the time of year.

What happens to automotive gasoline when it enters the environment?

- ❑ Small amounts of the chemicals present in gasoline evaporate into the air when you fill the gas tank in your car or when gasoline is accidentally spilled onto surfaces and soils or into surface waters.
- ❑ Other chemicals in gasoline dissolve in water after spills to surface waters or underground storage tank leaks into the groundwater.
- ❑ In surface releases, most chemicals in gasoline will probably evaporate; others may dissolve and be carried away by water; a few will probably stick to soil.
- ❑ The chemicals that evaporate are broken down by sunlight and other chemicals in the air.
- ❑ The chemicals that dissolve in water also break down quickly by natural processes.

How might I be exposed to automotive gasoline?

- ❑ Breathing vapors at a service station when filling the car's fuel tank is the most likely way to be exposed.
- ❑ Working at a service station.
- ❑ Using equipment that runs on gasoline, such as a lawn mower.
- ❑ Drinking contaminated water.
- ❑ Being close to a spot where gasoline has spilled or leaked into the soil.

How can automotive gasoline affect my health?

Many of the harmful effects seen after exposure to gasoline are due to the individual chemicals in the gasoline mixture, such as benzene and lead. Inhaling or swallowing large amounts of gasoline can cause death.

Inhaling high concentrations of gasoline is irritating to the lungs when breathed in and irritating to the lining of the stomach when swallowed. Gasoline is also a skin irritant. Breathing in high levels of gasoline for short periods or swallowing large amounts of gasoline may also cause harmful effects on the nervous system.

Serious nervous system effects include coma and the inability to breathe, while less serious effects include dizziness and headaches.

There is not enough information available to determine if gasoline causes birth defects or affects reproduction.

How likely is automotive gasoline to cause cancer?

The Department of Health and Human Services (DHHS) and the International Agency for Research on Cancer (IARC) have not classified automotive gasoline for carcinogenicity. Automotive gasoline is currently undergoing review by the EPA for cancer classification.

Some laboratory animals that breathed high concentrations of unleaded gasoline vapors continuously for 2 years developed liver and kidney tumors. However, there is no evidence that exposure to gasoline causes cancer in humans.

Is there a medical test to show whether I've been exposed to automotive gasoline?

Laboratory tests are available that can measure elevated blood or urine levels of lead (as an indication of exposure to leaded gasoline only), benzene, or other substances that may result from exposure to gasoline or other sources. These methods are sensitive enough to measure background levels and levels where health effects may occur. These tests aren't available in most doctors' offices, but can be done at special laboratories that have the right equipment.

Has the federal government made recommendations to protect human health?

The EPA has established many regulations to control air pollution. These are designed to protect the public from the possible harmful health effects of gasoline.

The American Conference of Governmental Industrial Hygienists (ACGIH) set a maximum level of 890 milligrams of gasoline per cubic meter of air (890 mg/m^3) for an 8-hour workday, 40-hour workweek.

Glossary

Carcinogenicity: Ability to cause cancer.

CAS: Chemical Abstracts Service.

Crude petroleum: Petroleum that has not been processed.

Dissolve: To disappear gradually.

Evaporate: To change into a vapor or a gas.

Irritant: A substance that causes an abnormal reaction.

Mixture: A combination of two or more components.

Refining process: The process by which petroleum is purified to form gasoline.

Tumor: An abnormal mass of tissue.

References

Agency for Toxic Substances and Disease Registry (ATSDR). 1995. Toxicological profile for automotive gasoline. Atlanta, GA: U.S. Department of Health and Human Services, Public Health Service.

Where can I get more information? For more information, contact the Agency for Toxic Substances and Disease Registry, Division of Toxicology, 1600 Clifton Road NE, Mailstop F-32, Atlanta, GA 30333. Phone: 1-888-422-8737, FAX: 770-488-4178. ToxFAQs Internet address via WWW is http://www.atsdr.cdc.gov/toxfaq.html ATSDR can tell you where to find occupational and environmental health clinics. Their specialists can recognize, evaluate, and treat illnesses resulting from exposure to hazardous substances. You can also contact your community or state health or environmental quality department if you have any more questions or concerns.

Appendix 4

FACT SHEET FOR NORTH BRUNSWICK CANCER INQUIRY

Cancer Unfortunately, cancer is very common; the National Cancer Institute estimates that the lifetime risk of being diagnosed with cancer is 46 percent among men and 38 percent among women. The risk of developing cancer increases with age, so more cancer would be expected in a community that is aging. Cancer consists of over 100 different diseases with different risk factors for each. Therefore, it is difficult to pinpoint one cause for many different types of cancer.

Cancer and the Environment Scientists believe that only about two percent of cancer cases are related to the environment. When cancer is due to contact with a cancer-causing agent, it usually takes 10 to 30 or more years for the cancer to develop.

Cancer Risk Factors Generally, cancer results from lifestyle factors including smoking cigarettes, lack of exercise, drinking heavily, and diet, communicable diseases, reproductive patterns, family history, genetics, and sexual behavior. For more information about risk factors for different types of cancers, you may wish to view *New Jersey Facts & Figures 2002* on our website http://www.state.nj.us/health/cancer/statistics.htm, the American Cancer Society website www.cancer.org or the National Cancer Institute website www.nci.nih.gov

Cancer Incidence As a result of your concern, we reviewed cancer incidence data from 1979 through 2001 for North Brunswick Township and Middlesex County. The number and distribution of cancer types in Middlesex County did not appear to be unusual when compared to the state. We examined the data we have for North Brunswick Township by gender and age group and did not see an unusual occurrence of any type of cancer. That is, the patterns of cancer incidence in North Brunswick Township appear to be consistent with state and county patterns.

North Brunswick High School Regarding your concerns about exposure to the contamination at the North Brunswick High School site, there must be a completed pathway from the contaminant to the body for an environmental contaminant to cause cancers or other diseases. This could occur through air, water, food, or direct contact with the skin. NJDEP is investigating the North Brunswick High School contamination site. They have found arsenic, beryllium and cadmium at higher levels than the NJDEP's Residential Cleanup Criteria in soil samples that were taken in October 2003. Generally, these substances have been found to cause cancer in individuals who work in certain occupations and are exposed to high amounts of chemicals over long periods of time. NJDEP determined that individuals might be exposed to these carcinogens through soil ingestion/absorption and inhalation. To reduce or eliminate these pathways of exposure, NJDEP will be removing, covering, and limiting access to the exposed material. You may want to contact the New Jersey Site Remediation Program (SRP) Office of Community Relations at 609-984-3081, to find more information about the site clean up and remediation.

Drinking Water The NJDEP does not consider groundwater ingestion as a potential pathway for contaminants from the North Brunswick High School site since the area is serviced by a public water system that is regularly monitored. For more information about drinking water in New Jersey you can contact the NJDEP Water Supply Administration at (609) 292-5550 or http://www.nj.gov/dep/watersupply/safedrnk.htm

For more information
Local Health Officer: David A. Papi, 732-745-3100
Cancer Epidemiology Services, NJ Department of Health & Senior Services: Lisa Paddock 609-588-3500

Appendix 5

Summary of ATSDR Conclusion Categories

Category	Definition
Urgent Public Health Hazard	Applies to sites that have certain physical hazards or evidence of short-term (less than 1 year), site-related exposure to hazardous substances that could result in adverse health effects and require quick intervention to stop people from being exposed.
Public Health Hazard	Applies to sites that have certain physical hazards or evidence of chronic, site-related exposure to hazardous substances that could result in adverse health effects.
Indeterminate Public Health Hazard	Applies to sites where critical information is lacking (missing or has not yet been gathered) to support a judgment regarding the level of public health hazard.
No Apparent Public Health Hazard	Applies to sites where exposure to site-related chemicals might have occurred in the past or is still occurring, but the exposures are not at levels expected to cause adverse health effects.
No Public Health Hazard	Applies to sites where no exposure to site-related hazardous substances exists.

Appendix B

Fact Sheet For North Brunswick Cancer Inquiry

FACT SHEET FOR NORTH BRUNSWICK CANCER INQUIRY

Cancer Unfortunately, cancer is very common; the National Cancer Institute estimates that the lifetime risk of being diagnosed with cancer is 46 percent among men and 38 percent among women. The risk of developing cancer increases with age, so more cancer would be expected in a community that is aging. Cancer consists of over 100 different diseases with different risk factors for each. Therefore, it is difficult to pinpoint one cause for many different types of cancer.

Cancer and the Environment Scientists believe that only about two percent of cancer cases are related to the environment. When cancer is due to contact with a cancer-causing agent, it usually takes 10 to 30 or more years for the cancer to develop.

Cancer Risk Factors Generally, cancer results from lifestyle factors including smoking cigarettes, lack of exercise, drinking heavily, and diet, communicable diseases, reproductive patterns, family history, genetics, and sexual behavior. For more information about risk factors for different types of cancers, you may wish to view *New Jersey Facts & Figures 2002* on our website http://www.state.nj.us/health/cancer/statistics.htm, the American Cancer Society website www.cancer.org or the National Cancer Institute website www.nci.nih.gov

Cancer Incidence As a result of your concern, we reviewed cancer incidence data from 1979 through 2001 for North Brunswick Township and Middlesex County. The number and distribution of cancer types in Middlesex County did not appear to be unusual when compared to the state. We examined the data we have for North Brunswick Township by gender and age group and did not see an unusual occurrence of any type of cancer. That is, the patterns of cancer incidence in North Brunswick Township appear to be consistent with state and county patterns.

North Brunswick High School Regarding your concerns about exposure to the contamination at the North Brunswick High School site, there must be a completed pathway from the contaminant to the body for an environmental contaminant to cause cancers or other diseases. This could occur through air, water, food, or direct contact with the skin. NJDEP is investigating the North Brunswick High School contamination site. They have found arsenic, beryllium and cadmium at higher levels than the NJDEP's Residential Cleanup Criteria in soil samples that were taken in October 2003. Generally, these substances have been found to cause cancer in individuals who work in certain occupations and are exposed to high amounts of chemicals over long periods of time. NJDEP determined that individuals might be exposed to these carcinogens through soil ingestion/absorption and inhalation. To reduce or eliminate these pathways of exposure, NJDEP will be removing, covering, and limiting access to the exposed material. You may want to contact the New Jersey Site Remediation Program (SRP) Office of Community Relations at 609-984-3081, to find more information about the site clean up and remediation.

Drinking Water The NJDEP does not consider groundwater ingestion as a potential pathway for contaminants from the North Brunswick High School site since the area is serviced by a public water system that is regularly monitored. For more information about drinking water in New Jersey you can contact the NJDEP Water Supply Administration at (609) 292-5550 or http://www.nj.gov/dep/watersupply/safedrnk.htm

For more information
Local Health Officer: David A. Papi, 732-745-3100
Cancer Epidemiology Services, NJ Department of Health & Senior Services: Lisa Paddock 609-588-3500

Appendix C

Toxicological Summaries

The toxicological summary provided in this appendix is based on ATSDR's ToxFAQs (http://www.atsdr.cdc.gov/toxfaq.html). Health effects are summarized in this section for the chemicals of concern found in soil for the North Brunswick Township High School, Veteran's Park, PSE&G easement, and Judd Elementary School and settled dust on interior surfaces for the North Brunswick Township High School and Judd Elementary School. The health effects described in the section are typically known to occur at levels of exposure much higher than those that occur from environmental contamination. The chance that a health effect will occur is dependent on the amount, frequency and duration of exposure, and the individual susceptibility of exposed persons.

Antimony Antimony is a silvery-white metal that is found in the earth's crust. Antimony ores are mined and then mixed with other metals to form antimony alloys or combined with oxygen to form antimony oxide. As alloys, it is used in lead storage batteries, solder, sheet and pipe metal, bearings, castings, and pewter. Antimony oxide is added to textiles and plastics as fire retardant. It is also used in paints, ceramics, and fireworks, and as enamels for plastics, metal, and glass.

Antimony is released to the environment from natural sources and from industry. In the air, antimony is attached to very small particles that may stay in the air for many days. Most antimony particles settle in soil, where it attaches strongly to particles that contain iron, manganese, or aluminum.

Breathing high levels for a long time can irritate eyes and lungs and can cause heart and lung problems, stomach pain, diarrhea, vomiting, and stomach ulcers. In short-term studies, animals that breathed very high levels of antimony died. Animals that breathed high levels had lung, heart, liver, and kidney damage. In long-term studies, animals that breathed very low levels of antimony had eye irritation, hair loss, lung damage, and heart problems. Problems with fertility were also noted. In animal studies, fertility problems were observed when rats breathed very high levels of antimony for a few months.

Ingesting large doses of antimony can cause vomiting. Other effects of ingesting antimony are unknown. Long-term animal studies have reported liver damage and blood changes when animals ingested antimony. Antimony can irritate the skin if it is left on it.

Lung cancer has been observed in some studies of rats that breathed high levels of antimony. No human studies are available. The DHHS, the International Agency for Research on Cancer, and the EPA have not classified antimony as to its human carcinogenicity.

Arsenic. Arsenic is a naturally occurring element widely distributed in the earth's crust. In the environment, arsenic is combined with oxygen, chlorine, and sulfur to form inorganic arsenic compounds. Arsenic in animals and plants combines with carbon and hydrogen to form organic arsenic compounds.

Inorganic arsenic compounds are mainly used to preserve wood. Breathing high levels of inorganic arsenic can give you a sore throat or irritated lungs. Ingesting high levels of inorganic arsenic can result in death. Lower levels of arsenic can cause nausea and vomiting, decreased production of red and white blood cells, abnormal heart rhythm, damage to blood vessels, and a sensation of "pins and needles" in hands and feet.

Ingesting or breathing low levels of inorganic arsenic for a long time can cause a darkening of the skin and the appearance of small "corns" or "warts" on the palms, soles, and torso. Skin contact with inorganic arsenic may cause redness and swelling.

Organic arsenic compounds are used as pesticides, primarily on cotton plants. Organic arsenic compounds are less toxic than inorganic arsenic compounds. Exposure to high levels of some organic arsenic compounds may cause similar effects as those caused by inorganic arsenic.

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 DHHS, and the EPA have determined that inorganic arsenic is a human carcinogen

Cadmium: Cadmium is a natural element in the earth's crust. All soils and rocks, including coal and mineral fertilizers, contain some cadmium. Most cadmium used in the United States is extracted during the production of other metals like zinc, lead, and copper. Cadmium does not corrode easily and has many uses, including batteries, pigments, metal coatings, and plastics. Exposure to high levels of cadmium severely damages the lungs and can cause death. Eating food or drinking water with very high levels severely irritates the stomach, leading to vomiting and diarrhea. Long-term exposure to lower levels of cadmium in air, food, or water leads to a buildup of cadmium in the kidneys and possible kidney disease. Other long-term effects are lung damage and fragile bones. Skin contact with cadmium is not known to cause health effects in humans or animals.

Chromium Chromium is a naturally occurring element found in rocks, animals, plants, soil, and in volcanic dust and gases. Chromium is present in the environment in several different forms: chromium (0), chromium (III), and chromium (VI). No taste or odor is associated with chromium compounds. The metal chromium, which is the chromium (0) form, is used for making steel. Chromium (VI) and chromium (III) are used for chrome plating, dyes and pigments, leather tanning, and wood preserving.

Chromium enters the air, water, and soil mostly in the chromium (III) and chromium (VI) forms. In air, chromium compounds are present mostly as fine dust particles which eventually settle over land and water. Chromium can strongly attach to soil and only a small amount can dissolve in water and move deeper in the soil to underground water. Fish do not accumulate much chromium from water.

Breathing high levels of chromium (VI) can cause nasal irritation, such as runny nose, nosebleeds, and ulcers and holes in the nasal septum. Ingesting large amounts of chromium (VI) can cause stomach upsets and ulcers, convulsions, kidney and liver damage, and even death. Skin contact with certain chromium (VI) compounds can cause skin ulcers. Allergic reactions consisting of severe redness and swelling of the skin have been noted.

Several studies have shown that chromium (VI) compounds can increase the risk of lung cancer. Animal studies have also shown an increased risk of cancer. The WHO has determined that chromium (VI) is a human carcinogen. The DHHS has determined that certain chromium (VI) compounds are known to cause cancer in humans. The EPA has determined that chromium (VI) in air is a human carcinogen.

It is unknown whether exposure to chromium will result in birth defects or other developmental effects in people. Birth defects have been observed in animals exposed to chromium(VI). It is likely that health effects seen in children exposed to high amounts of chromium will be similar to the effects seen in adults.

Copper. High levels of copper can be harmful. Breathing high levels of copper can cause irritation of nose and throat. Ingesting high levels of copper can cause nausea, vomiting, and diarrhea. Very-high doses of copper can cause damage to liver and kidneys, and can even cause death.

Exposure to high levels of copper will result in the same type of effects in children and adults. We do not know if these effects would occur at the same dose level in children and adults. Studies in animals suggest that the young children may have more severe effects than adults, but we don't know if this would also be true in humans. There are a very small percentage of infants and children who are unusually sensitive to copper.

Birth defects or other developmental effects of copper in humans are unknown. Animal studies suggest that high levels of copper may cause a decrease in fetal growth.

The most likely human exposure pathway is through drinking water, especially if the water is corrosive and copper pipes are used for plumbing. One of the most effective ways to reduce copper exposure is to let the water run for at least 15 seconds first thing in the morning before drinking or using it. This reduces the levels of copper in tap water dramatically.

Copper is found throughout the body; in hair, nails, blood, urine, and other tissues. High levels of copper in these samples can show copper exposures. However, these tests can not predict occurrence of harmful effects. Tests to measure copper levels in the body require special equipment.

Human carcinogenicity of copper is unknown. The EPA has determined that copper is not classifiable as to human carcinogenicity.

Lead. Lead is a naturally occurring metal found in small amounts in the earth's crust. Lead can be found in all parts of our environment. Much of it comes from human activities including burning fossil fuels, mining, and manufacturing. Lead has many different uses. It is used in the production of batteries, ammunition, metal products (solder and pipes), and devices to shield X-rays. Because of health concerns, lead from gasoline, paints and ceramic products, caulking, and pipe solder has been dramatically reduced in recent years. People may be exposed to lead by eating food or drinking water that contains lead, spending time in areas where lead-based paints have been used and are deteriorating, and by working in a job or engaging in a hobby where lead is used. Small children are more likely to be exposed to lead by swallowing house dust or soil that contains lead, eating lead-based paint chips or chewing on objects painted with lead-based paint.

Lead can affect many organs and systems in the body. The most sensitive is the central nervous system, particularly in children. Lead also damages kidneys and the reproductive system. The effects are the same whether it is breathed or swallowed. At high levels, lead may decrease reaction time, cause weakness in fingers, wrists, or ankles, and possibly affect the memory. Lead may cause anemia, a disorder of the blood. It can also damage the male reproductive system. The connection between these effects and exposure to low levels of lead is uncertain.

Children are more vulnerable to lead poisoning than adults. A child, who swallows large amounts of lead, for example by eating old paint chips, may develop blood anemia, severe stomachache, muscle weakness, and brain damage. A large amount of lead might get into a child's body if the child ate small pieces of old paint that contained large amounts of lead. If a child swallows smaller amounts of lead, much less severe effects on blood and brain function may occur. Even at much lower levels of exposure, however, lead can affect a child's mental and physical growth. Exposure to lead is more dangerous for young children and fetuses. Fetuses can be exposed to lead through their mothers. Harmful effects include premature births, smaller babies, decreased mental ability in the infant, learning difficulties, and reduced growth in young children. These effects are more common if the mother or baby was exposed to high levels of lead.

The DHHS has determined that two compounds of lead (lead acetate and lead phosphate) may reasonably be anticipated to be carcinogens based on studies in animals. There is inadequate evidence to clearly determine whether lead can cause cancer in people.

Polycyclic Aromatic Hydrocarbons (PAHs) Polycyclic aromatic hydrocarbons (PAHs) are a group of over 100 different chemicals that are formed during the incomplete burning of coal, oil and gas, garbage, or other organic substances like tobacco or charbroiled meat. PAHs are usually found as a mixture containing two or more of these compounds, such as soot. These include benzo(a)anthracene, benzo(b)fluoranthene, benzo(a)pyrene, benzo(g,h,i)perylene, indeno(1,2,3-cd0pyrene, phenanthrene, and naphthalene

Some PAHs are manufactured. These pure PAHs usually exist as colorless, white, or pale yellow-green solids. PAHs are found in coal tar, crude oil, creosote, and roofing tar, but a few are used in medicines or to make dyes, plastics, and pesticides. Mice that were fed high levels of one PAH during pregnancy had difficulty reproducing and so did their offspring. These offspring also had higher rates of birth defects and lower body weights. It is not known whether these effects occur in people. Animal studies have also shown that PAHs can cause harmful effects on the skin, body fluids, and ability to fight disease after both short- and long-term exposure. But these effects have not been seen in people.

The DHHS has determined that some PAHs may reasonably be expected to be carcinogens. Some people who have breathed or touched mixtures of PAHs and other chemicals for long periods of time have developed cancer. Some PAHs have caused cancer in laboratory animals when they breathed air containing them (lung cancer), ingested them in food (stomach cancer), or had them applied to their skin (skin cancer).

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. TCE dissolves a little in water, and can remain in groundwater for a long time. It quickly evaporates from water, so it is commonly found as a vapor in the air. People can be exposed to TCE by breathing air in and around the home which has been contaminated with TCE vapors from shower water or household products, or by drinking, swimming, or showering in water that has been contaminated with TCE. Breathing small amounts of TCE may cause headaches, lung irritation, dizziness, poor coordination, and difficulty concentrating. Breathing large amounts of TCE may cause impaired heart function, unconsciousness, and death. Breathing it for long periods may cause nerve, kidney, and liver damage. Drinking large amounts of TCE may cause nausea, liver damage, unconsciousness, impaired heart function, or death. Drinking small amounts of TCE for long periods may cause liver and kidney damage, impaired immune system function, and impaired fetal development in pregnant women, although the extent of some of these effects is not yet clear. Skin contact with TCE for short periods may cause skin rashes.

Some studies with mice and rats have suggested that high levels of TCE may cause liver, kidney, or lung cancer. Some studies of people exposed over long periods to high levels of TCE in drinking water or in workplace air have found evidence of increased cancer. The National Toxicology Program has determined that TCE is “reasonably anticipated to be a human carcinogen,” and the International Agency for Research on Cancer (IARC) has determined that trichloroethylene is “probably carcinogenic to humans.”

Thallium. Thallium is a bluish-white metal that is found in trace amounts in the earth's crust. It is used mostly in manufacturing electronic devices, switches, and closures, primarily for the semiconductor industry. It also has limited use in the manufacture of special glass and for certain medical procedures. Thallium enters the environment primarily from coal-burning and smelting, in which it is a trace contaminant of the raw materials. Exposure to thallium may occur through eating food contaminated with thallium, breathing workplace air in industries that use thallium, smoking cigarettes, or contact with contaminated soils, water or air.

Exposure to high levels of thallium can result in harmful health effects. A study on workers exposed on the job over several years reported nervous system effects, such as numbness of fingers and toes, from breathing thallium. Studies in people who ingested large amounts of thallium over a short time have reported vomiting, diarrhea, temporary hair loss, and effects on the nervous system, lungs, heart, liver, and kidneys. High exposures can cause death. It is not known what the reproductive effects are from breathing or ingesting low levels of thallium over a long time. Studies in rats exposed to high levels of thallium showed adverse reproductive effects, but such effects have not been seen in people. Animal data suggest that the male reproductive system may be susceptible to damage by low levels of thallium.

The DHHS, IARC, and the EPA have not classified thallium as to its human carcinogenicity. No studies are available in people or animals on the carcinogenic effects of breathing, ingesting, or touching thallium.

Zinc. Zinc is a naturally occurring element. Zinc has many commercial uses as coatings to prevent rust, in dry cell batteries, and mixed with other metals to make alloys like brass, and bronze. Acute health effects associated with ingesting large doses are stomach cramps, nausea, and vomiting. Low level chronic exposures to zinc can cause anemia and decrease the levels of good cholesterol. Effect of zinc on human reproductive system is unknown; infertility was observed in animal studies at large doses,

Inhaling large amounts of zinc (as dusts or fumes) can cause a specific short-term disease called metal fume fever. Chronic effects of breathing high levels of zinc are unknown. Zinc can cause skin irritation. The DHHS and the IARC have not classified zinc for carcinogenicity. Based on incomplete information from human and animal studies, the EPA has determined that zinc is not classifiable as to its human carcinogenicity.

Appendix D

ATSDR Conclusion Categories

Summary of ATSDR Conclusion Categories

Category	Definition
1: Urgent Public Health Hazard	Applies to sites that have certain physical hazards or evidence of short-term (less than 1 year), site-related exposure to hazardous substances that could result in adverse health effects and require quick intervention to stop people from being exposed.
2: Public Health Hazard	Applies to sites that have certain physical hazards or evidence of chronic, site-related exposure to hazardous substances that could result in adverse health effects.
3: Indeterminate Public Health Hazard	Applies to sites where critical information is lacking (missing or has not yet been gathered) to support a judgment regarding the level of public health hazard.
4: No Apparent Public Health Hazard	Applies to sites where exposure to site-related chemicals might have occurred in the past or is still occurring, but the exposures are not at levels expected to cause adverse health effects.
5: No Public Health Hazard	Applies to sites where no exposure to site-related hazardous substances exists.

Appendix E

ATSDR Glossary of Terms

ATSDR Glossary of 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 (EPA), 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, 1-888-422-ATSDR (1-888-422-8737).
The glossary can be accessed online at http://www.atsdr.cdc.gov/glossary.html

Other glossaries and dictionaries:
Environmental Protection Agency (http://www.epa.gov/OCEPAterms/)

National Center for Environmental Health (CDC)
(http://www.cdc.gov/nceh/dls/report/glossary.htm)

National Library of Medicine (NIH)
(http://www.nlm.nih.gov/medlineplus/mplusdictionary.html)

For more information on the work of ATSDR, please contact:
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Agency for Toxic Substances and Disease Registry
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Appendix F

Response to Public Comments

Response to Public Comments
North Brunswick Township High School Site
North Brunswick, New Jersey
September 29, 2008

The New Jersey Department of Health and Senior Services (NJDHSS) and the Agency for Toxic Substances and Disease Registry (ATSDR) had received public comments regarding the Draft Public Health Assessment for the North Brunswick Township High School Site on February 28, 2008. A total of 29 comments were submitted from various parties including the North Brunswick Township Board of Education (the Board), North Brunswick Township, the environmental consultant (Kleinfelder) representing the Board, and area residents.

Comment	Draft PHA Page/Line	Comments/Responses
1	1/23 & 34/4	**Comment:** Incorrect identification of abbreviation for TCE. TCE is the abbreviation for Trichloroethylene (or Trichloroethene). Tetrachloroethylene (PCE) is not the same as Trichloroethylene (TCE). Trichloroethylene (TCE) is the primary contaminant of concern (COC) for the groundwater at the Site. The misidentification of the abbreviation has created some confusion regarding the COC identified at the Site, and whether NJDHSS had evaluated TCE or PCE during NJDHSS' assessment. **Response:** The summary and conclusions have been corrected to reflect "Trichloroethylene (TCE)" where the above stated errors were present. The incorrect identification as Tetrachloroethylene was the extent of error in the report. The public health assessment evaluated TCE as the COC for public health exposures as provided in the draft document and relevant data tables.
2	Page 1 and throughout	**Comment:** Polycyclic aromatic hydrocarbons (PAHs) are semi-volatile compounds (SVOCs); Aroclor 1260 is not a SVOC. At the High School, Aroclor 1260 was detected below NJDEP's Residential Cleanup Criterion and should not be considered a COC at the High School. **Response:** For convenience Polychlorinated biphenyls (PCBs) (including Aroclor 1260) were grouped in the tables by their chemical classification rather than their laboratory analyte group. The gas-liquid partitioning constant, or Henry's law constant (KH), for Aroclor 1260 classifies this as a semi-volatile compound; therefore, it was included as a subset of SVOC compounds. To address this comment, PCB and organochlorine pesticides have been taken out as a subset of semi-volatile organic compounds throughout the report and tables. As this PCB was detected at the threshold of the CV it was included as a COC to be conservative regarding exposures. However, we agree that since this compound was detected below the applicable CV it has been removed as a COC from the Former "The Oval" Area for all associated text and tables of the report.

Comment	Draft PHA Page/Line	Comments/Responses
3	Page 2 and throughout	**Comment:** NJDEP does not define "Removal Criteria." This should be changed to "Project Removal Criteria." This is a criterion that is project specific and was approved by NJDEP, because engineering controls will be used to cover the impacted soils. **Response:** The report text has been modified to indicate "Project Removal Criteria" throughout the report.
4	2/23	**Comment:** [There is a concern] that NJDHSS will recalculate the hazard category for the areas that will be capped after the cap is constructed. It is [requested] that NJDHSS assess whether the cap is sufficient prior to construction of the cap. After the cap is constructed, if NJDHSS determines that the cap is not sufficient to lower the hazard category, the cap may need to be redesigned and replaced. Therefore, it would be pertinent to know prior to construction, whether the cap would be sufficient to lower the hazard category, so [the environmental consultant] could redesign the cap before it is constructed. **Response:** The engineering control is reviewed and approved under the direction of the NJDEP. It is the responsibility of the NJDEP to determine the effectiveness of the remedial action, in this case installation of a soil cap as an engineering control. The NJDHSS does not perform assessments of engineering controls for their intended effectiveness. The proposed engineering control design needs to be reviewed and approved by the NJDEP as per State of New Jersey regulations. If the engineering control fails during its effective period then the NJDHSS can be requested through public petition or through a governmental agency(s) to evaluate public health implications of exposure.
5	2/29 & 35/15	**Comment:** …are reduced to **either** NJDEP's regulatory cleanup criteria or **engineering controls are installed**... **Response:** The report has been modified to indicate the following "…to ensure exposures are reduced to below NJDEP's regulatory cleanup criteria through either soil removal and/or installation of engineering controls": This communicates that regardless of the remedial action implemented (i.e. soil removal or engineering controls), the remedial action needs to be effective in reducing exposures to below the NJDEP's regulatory cleanup criteria when considering the soil exposure contact horizon of 0-3 inches.

Comment	Draft PHA Page/Line	Comments/Responses
6	2/31 & 35/18	**Comment:** NJDEP should continue oversight….of TCE contamination in groundwater to reduce concentrations to below the NJDEP's regulatory cleanup criteria and to minimize/eliminate the threat of vapor intrusion. Is the cleanup criteria referred to 1 micrograms per liter or an alternative criteria based on vapor intrusion guidelines? **Response:** The report is referring to the applicable NJDEP regulatory cleanup criteria which in this case could be either the groundwater cleanup criteria or the groundwater vapor intrusion screening level listed in their vapor intrusion guidance manual for TCE. At the time the PHA Public Comment was released a ground water CEA was not established for the site. NJDEP has reviewed the document prior to Public Comment release and did not indicate they had an issue with the existing statement. Both the ground water vapor intrusion screening level and ground water cleanup criteria are 1 microgram per liter. As the groundwater screening levels are most appropriate in this case the report has been modified to indicate the following "…continued oversight of remedial activities regarding TCE contamination in groundwater to reduce concentrations to below the NJDEP's ground water vapor intrusion screening level, or a NJDEP approved alternative, to minimize or eliminate the threat of vapor intrusion to the surrounding community…"
7	7/2	**Comment:** NJDHSS should clarify which matrix (medium) contamination was identified at the three residences in 2003 (i.e. soils or groundwater) and what types of contamination were identified. **Response:** The report has been modified to state the following "Remedial investigations conducted in 2003 indicated site-related contamination (arsenic in surface soil and TCE in ground water) was…" The PHA report refers to the previous health consultation report containing all specific details of matrix contamination which has been included in its entirety as Appendix A. Additionally, these details are provided in the *Past ATSDR/NJDHSS Involvement* section of this PHA.

Comment	Draft PHA Page/Line	Comments/Responses
8	9/31	**Comment:** Environmental Guideline Comparison – it should be noted that NJDEP's Cleanup Criterion for arsenic are relatively unrelated to assessing risk. It should be noted that there is an order of magnitude difference between NJDEP's Cleanup Criterion for arsenic and the NJDHSS' value used in this assessment. The NJDHSS' value used in evaluation in assessing risk is more stringent than NJDEP's Cleanup Criterion. **Response:** The report indicates the following statement "The NJDEP RDCSCC are based on human health impacts and also consider environmental impacts and natural background concentrations." The RDCSCC for arsenic is based on natural background concentrations within New Jersey. The focus of the PHA is not to compare NJDEP Soil Cleanup Criteria (SCC) to health-based benchmarks as each contaminant has different criteria to establish their respective health-based or remedial-cleanup levels. In some instances the NJDEP SCC are equal or more stringent than other health-based benchmarks. The document clearly explains these distinctions. The SCC are provided to the reader so they are aware of the varying levels between each criteria for each contaminant. The report has been modified to state the following for clarification regarding arsenic "For example, the RDCSCC for arsenic at 20 mg/kg is based on natural background concentrations within New Jersey and is, in comparison, higher than the CREG value for arsenic at 0.5 mg/kg."

Comment	Draft PHA Page/Line	Comments/Responses
9	Pages 10, 19 and throughout	**Comment:** Many very conservative assumptions are included in the risk characterization process including weighting the settled dust exposure evaluation toward children, including compounds in the risk characterization at concentrations equal to one half the detection limit if the detection limit exceeds the media-specific comparison values (CVs) along with very conservative exposure durations and frequencies for students and staff. It is questionable whether ingestion of soil is a realistic or an appropriate pathway for adults. A more appropriate pathway may be inhalation. **Response:** Regarding settled dust, the COC identified for all sampled areas was lead in the NBTHS. The lead concentration marginally exceeded the settled dust screening value of 25 micrograms per square foot for one sample; therefore, no further evaluation was conducted. As there was an observed exceedance for lead, the recommendations pertaining to settled dust were to conduct routine cleaning of hard surfaces, specifically during future soil removal actions at Veteran's Park. An inhalation pathway can certainly be a concern; however, the areas of concern for this site indicate a very low potential to create an inhalation pathway. This pathway requires several site-specific conditions to warrant consideration. The main considerations would be the type of contaminant, the potential for the contaminant to become airborne, and the frequency the contaminant is airborne to create the potential for inhalation. For this site, inorganic compounds in dust or soil, such as lead and arsenic, would require repeated physical disturbance to create airborne conditions and, thus, create the potential for an inhalation pathway. When considering contaminants such as lead and arsenic in soil and settled dust mediums, the majority of the outside areas are paved or grass-covered making the potential to create frequent dust conditions very low. In order to properly characterize the inhalation exposures, air monitoring would be required to establish airborne dust concentrations where an inhalation exposure dose can be calculated. While settled dust is primarily created under airborne conditions, information provided from investigation reports does not indicate that excessive settled dust was observed on school surfaces; therefore, the formation of this dust is likely under normal conditions. Thus, incidental ingestion via the soil/settled dust pathway would be the most likely and most frequent form of potential exposure for this site.

<table>
<tr><th>Comment</th><th>Draft PHA Page/Line</th><th>Comments/Responses</th></tr>
<tr><td>10</td><td>Page 10 and 11</td><td>Comment:
NJDHSS should have included a figure identifying the various areas listed in the report because the area “High School Perimeter” includes areas that are over 200 feet away from the High School. Part of the waste area is included in this area. It is not known where the “Oval” ends and the “High School Perimeter” starts. Samples points used in the tables should be identified in this figure.

Response:
Several soil samples were collected outside the waste-fill boundary area with the majority being near the school building while others were further away from the school building. The description of this area has been modified as “High School Building Perimeter and Areas Outside the Waste-Fill Boundary” to identify the general area where soil samples outside the waste fill area where collected from non-specific areas. The sample locations around the building perimeter are depicted in Figure 3 of the draft PHA; however, due to the small size of the figure the sample locations are difficult to distinguish.

The draft PHA report which previously described the “Former The Oval Area”, which is within the waste-fill boundary, has been modified as “Former The Oval and Areas within the Waste-fill Boundary (NBTHS Property).” Note: Soil boring location S-28 is located within the waste fill area which was formerly included as a “High School Building Perimeter” sample. Soil samples associated with this boring have been moved to the “Former The Oval and Areas within the Waste-fill Boundary (NBTHS Property).”

There are no figures available showing soil sample locations and the “Former Oval Area.” Areas of concern, including the former “The Oval” area, is identified in Figure 1 within the report. The report has now been modified to include this area within the waste-fill area. Discussions with personnel from the environmental consultant, Kleinfelder, indicates a map showing all inclusive sample locations will be available with their final report for the site to be issued in the future.</td></tr>
</table>

Comment	Draft PHA Page/Line	Comments/Responses
11	Page 11	**Comment:** The Indoor Air discussion states that targeted VOCs were: 1,2-DCA, cis-1,2DCE, TCE and vinyl chloride. Table 15 lists additional COCs in groundwater as: benzene, 1,1-DCE and PCE. Not listed: cis-1,2-DCE. Were all COCs in groundwater tested in air? Pg 11 does not imply such. **Response:** Vapor intrusion investigation of volatile organic compounds (VOCs) conducted by Kleinfelder with oversight by the NJDEP identified 1,2-dichloroethane, cis-1,2-dichloroethene, TCE and vinyl chloride as the targeted COCs. Groundwater levels of benzene and 1,1-DCE were below the NJDEP Ground Water Screening Levels (GWSL), listed in the NJDEP Vapor Intrusion Guidance Manual, for vapor intrusion and, therefore, were not investigated as a vapor intrusion source. PCE was detected slightly above the GWSL of 1 microgram per liter (µg/L) at 3.8 µg/L and in only 2 of 59 samples. In contrast, TCE concentrations (GWSL also 1 µg/L) in ground water are significantly higher at 2,580 µg/L and in 52 of 71 samples. Additionally, in ground water, PCE will naturally degrade over time into it's dechlorinated daughter product TCE. As such, Kleinfelder and the NJDEP have identified TCE as the predominant COC in ground water below the residential area and the focus of the indoor air investigation. Cis-1,2 DCE was identified in Table 15 as 1,2-Dichloroethene (cis).
12	15/35	**Comment:** The presence of TCE in the sump water suggests TCE contamination of groundwater has likely infiltrated into the sumps." The statement may be interpreted that there is another source. **Response:** The above sentence has been modified as follows "As there are no other known or identified sources of TCE at the sampled residences, the presence of TCE in the sump water suggests TCE contamination in groundwater has infiltrated into the sumps."

Comment	Draft PHA Page/Line	Comments/Responses
13	17 & throughout	**Comment:** Table – Summary of COCs – In each investigation area, the COCs should be listed for each matrix. For example, for NBTHS, COCs should be listed for soil, groundwater, and then air. The Table is organized currently so that groundwater doesn't appear to be an issue. Also, the way it is organized creates confusion whether the COC in groundwater is associated with other media. Aroclor 1260 is below NJDEP's Residential Cleanup Criterion and should not be considered a COC at the NBTHS. Cadmium is mentioned as a COC and not discussed. Data tables should state the reference source of their information. References should be added to all tables in the document. Due to the absence of references and due to the inconsistencies with the Tables, the reliability of the report is in question. **Response:** The existing draft report identifies COCs for their respective matrix in each area of concern. Groundwater is identified in the existing draft PHA as an area of concern in the text section "NBTHS/Veteran's Park/Nearby Residential Area." Groundwater COCs were included for these areas collectively as COCs can migrate in the groundwater plume over time to other areas; therefore, the report summarizes the groundwater contamination issue as a whole for the above-identified areas. The COC tables accompany the text of the PHA. In the text section "Groundwater (NBTHS/Veteran's Park/Nearby Residential Area)" the report explains specifically that the groundwater investigation is focused in the area surrounding the buried waste material area and that COCs are associated with contaminants in this area. Aroclor 1260 has been removed from the report (see comment response # 2). The PHA has been modified to include a description of cadmium to address the former "The Oval" area where it was detected in subsurface soil. The source of all data within the report has been included in the references section of the PHA. The tables within the PHA reference the period when samples were collected (i.e. July 2004 through March 2007) to give the reader a general perspective of the timeframe of data being evaluated which can be identified in the *References* section. Sample results are grouped into concentration ranges for each contaminant and typically includes data from several sampling events in addition to the several qualifiers which require to be footnoted. Therefore, in order to keep the tables to a reasonable size of information, all data sources are placed in the PHA *References* section.

Comment	Draft PHA Page/Line	Comments/Responses
14	19/29	**Comment:** Based on the description of TCE in residence F, it should be stated that inhalation of air is a completed pathway for 5 residences and possible 6 (data is inconclusive for residence F). **Response:** Page 16 of the draft PHA indicates the basis for including residence F as an area of concern. As such, the report has been modified with the following statement in the "Completed Exposure Pathways" section "It is noted, however, that while concentrations of TCE were not detected for residence F it could not be excluded as a completed exposure pathway as ½ of the analytical detection limit for the sample from this residence exceeded the environmental guideline CV."
15	20/10	**Comment:** Current data not included. Prior to 2007, there have been no detections of TCE in indoor air at the sump location; thus no completed pathway. **Response**: The draft PHA was completed prior to the issuance of the June through December 2007 Air Sampling Results Summary Letter dated February 20, 2008. This data, in addition to remaining environmental sampling data generated after the draft PHA, will be included in a follow-up health consultation for this site in the near future.
16	20/23	**Comment:** Only considering surface (0 to 0.5 foot interval) for direct contact exposure hazard. The assessment does not consider public exposure prior to 1979. They did not include the student population from 1973 to 1978 and the population that would have direct exposure to the landfill during operation of the landfill and during the construction of the High School. **Response:** The PHA examined exposures from 1972 though 2002 for the active period the former "The Oval" was in use by NBTHS students. In 2003, the "Oval" area was no longer used as it was under construction for the high school expansion project then subsequent remediation activity. Exposures at Veteran's Park was assessed for a 30 year period which is based on the average length of residency as indicated by the US EPA Exposure Factors Handbook (1997). A use restriction has been in-place for the eastern portion of Veteran's Park (not to be used for recreational or other purposes) according to North Brunswick Township representatives since approximately 2005. Based on the current available sampling data obtained through investigations conducted from 2003 to the present, the exposure period has been extended to a 38-year period from 1967 (Veteran's Park opening) to the park closure in 2005. Exposures were not assessed prior to the development of the park as there is no environmental data to characterize surface soil when the area was operated as a landfill. As there is no environmental data for the period prior to 1967, potential

		exposures cannot be quantified.
Comment	**Draft PHA Page/Line**	**Comments/Responses**
17	20/29	**Comment:** Kleinfelder's well source information indicates there are wells downgradient of the Site. See Kleinfelder's Supplementary RIR/RAW for Lots 94.01 and 95.01. **Response:** The PHA has been modified to include the new well search information not available at the time the draft PHA was submitted for review.
18	20/35	**Comment:** The language "determined that individuals have or are likely to come in contact with site-related contaminants (i.e., a completed exposure pathway)" is incorrect. A completed pathway does not determine actual individual exposure, but it suggests it is possible. **Response:** The language within the report defining a completed exposure pathway follows the language within ATSDR's Public Health Assessment Guidance Manual (update January 2005) used to produce the PHA. A completed exposure pathway within this document is defined as "when there is direct evidence or, in the judgment of the health assessment team, a strong likelihood that people have in the past or are presently coming in contact with site-related contaminants. In other words, people have or are likely to come in contact with site-related contamination…" The language with the PHA remains unchanged.
19	22/30	**Comment:** The referenced uses of arsenic are limited. The report should mention past medical uses of arsenic. Since the landfill operated from approximately the early 1940s to the early 1960s, past uses of arsenic should be referenced, or the references to the uses of arsenic should be removed. There is no source reference to the statement regarding uses. **Response:** The PHA has been modified to include a description regarding past medical uses of arsenic as follows: "As it has been documented that the area was historically used as a municipal dump which received pharmaceutical/laboratory research wastes, elevated concentrations of arsenic in soil within the waste-fill area are presumed to have originated from the landfilled wastes. Inorganic arsenic has been historically used in the development of pharmaceuticals and as part of cancer treatment therapy. Arsenic was a constituent in Fowler solution, containing 1% potassium arsenite, which was a commonly used for treatment of psoriasis. Arsphenamine was historically used for as a standard treatment for syphilis. By the mid-1990s, the medicinal use of arsenic was limited primarily for the treatment of trypanosomiasis. The decline in the medicinal use of arsenic in the past 100 years is due to concerns about the toxicity and potential carcinogenicity of chronic arsenic therapy."

Comment	Draft PHA Page/Line	Comments/Responses
20	23/8	**Comment:** Lead occurring in metal form is a bluish-gray metal. However, naturally occurring lead is commonly complex and may take many forms and appearances (i.e. lead carbonate and chloride are white). Again, the referenced uses of lead are limited. The report should mention medical use and other uses, or the references to the uses of lead should be removed. **Response:** The PHA report states "Lead is used in various products such as solder, paint, some brass and bronze products, ceramic glazes, automobile batteries and firearm ammunition." While the PHA does not cite the vast historical and current sources of lead, the passage is sufficient to relay to the reader a general sense of these various sources and uses of lead. As the area of concern was used as a municipal dump, it is assumed the area received various wastes of which lead was a constituent.
21	24/7	**Comment:** Cadmium is listed as a COC. The text does not address it. **Response:** The PHA has been modified to include a description of cadmium to address the former "The Oval" area in the "Public Health Implications" section of the report.
22	25/26	**Comment:** "Surface soil samples were not collected from the PSE&G easement." This statement is not correct. Three surface samples (TSS0213, TSS0214, and TSS0215) were collected from the PSE&G easement. Surface sample HSS0117 was collected along the edge of the easement. (See P-H RIR/RAW). **Response:** The above mentioned samples were inadvertently included with surface soil samples from Veteran's Park. A table for the PSE&G area has been added in the report with the results from the above surface soil samples.

Comment	Draft PHA Page/Line	Comments/Responses
23	29/1	**Comment:** "COCs have been identified in the contaminated soil for the football field" – This statement is not correct. COCs were not detected above NJDEP's Residential Cleanup Criteria, and are below NJDEP's Background Concentrations. The testing that has been performed to date does not indicate that the soil is "contaminated." The samples collected to date north of the High School and in the football field were below NJDEP's Criteria and below NJDEP's Background Concentrations. The concentrations may be associated with naturally occurring breakdown of parent material, as the soil forms on top of the bedrock surfaces during normal weathering activities. NJDHSS should separate out the risks associated with elevated concentrations (background concentrations) due to weathering of bedrock rock material from the risk associated with elevated concentrations due to the past landfill activities. **Response:** The report has been revised to state "COCs have been identified in soil for the football field…" COCs are identified using the most stringent Environmental Guideline CVs, not the NJDEP Soil Cleanup Criteria (SCC); however, as this area and the Judd Elementary School are outside the waste-fill boundary the report has been revised as follows: "It is noted that arsenic concentrations in soil outside the waste-fill boundary are likely present due to natural background levels and not associated with historic landfill activities. The NJDEP RDCSCC for arsenic is 20 mg/Kg which is based on natural background concentrations. However, if a contaminant exceeds an Environmental Guideline CV it is established as a COC and is considered for further evaluation regardless of the locations from which environmental samples are collected, in this case from areas outside the waste-fill boundary. Judd Elementary School, the majority of the NBTHS building perimeter, and the NBTHS football field are outside the waste-fill boundary area (see Figure 3)."
24	29/1	**Comment:** It should be noted that the unpaved surfaces in proximity to the perimeter of the High School included areas over 200 feet from the High School within the defined waste area boundary, i.e. the area of B22. The sample obtained from this soil boring has an arsenic concentrations of 180 milligrams per kilogram. **Response:** The PHA report has been modified describing the "High School Perimeter" to the "High School Building Perimeter and Areas Outside Waste-Fill Boundary." The original delineation map identified soil boring B22 as outside the waste fill delineation boundary. A revised delineation map indicates B22 was included within the waste fill delineation boundary. Therefore, this location has been removed from the former "High School Perimeter" area of concern and moved to the revised "Former "The Oval" and Areas Within Waste-Fill Boundary" area of concern.

Comment	Draft PHA Page/Line	Comments/Responses
25	31/26	**Comment:** No evidence of a cancer cluster (no unusual number and distribution of cancer types) was found by the Cancer Epidemiology Program. The majority of compound-specific and cumulative risk characterizations by exposure pathway and receptor presented no expected adverse health effects or very low to low increases in adverse health effects when compared to background risk for all or specific cancers. The cumulative hazard indices (HI) used to quantify non-carcinogenic adverse health effects does not exceed the acceptable level of 1. The data does not include information before 1979 or after 2001. If available, this data should be included. If not available, NJDHSS should indicate that absence of the data is a limitation of the study. Also, it should mention what other States that NJDHSS has retrieved data. There is a concern in whether the population used in the analysis of the specific cancer rates for this assessment is relevant to the High School population. **Response:** The NJDHSS State Cancer Registry began in 1979; therefore, cancer incidence data for New Jersey does not pre-date 1979. State cancer registry data is currently complete through 2005. A request for an update to cancer incidence data for the New Brunswick High School Site area has been submitted which will be addressed in a follow-up health consultation for this site in the near future and will include a statement on the limitations of the data. This request also asked whether incidence of cancer to past and current residents who may have been students at NBTHS could be assessed. The PHA reflects the above statement within the *Community Health Concerns* section.
26	33/31	**Comment:** It should be clarified that the 2003 study identified **soil contamination related to metals and PAHs** at three residences. It could be construed that TCE was identified in soil at the three residences in the study. **Response:** PAH COCs were associated with only one of the three residences. As per NJDEP communication specified in the health consultation located in Appendix A, the source of the PAH contamination was inconclusive; therefore, arsenic was considered the only site-related COC for all three residences. Indicating the following "soil contamination related to metals and PAHs" could be construed as more than one metal and that PAHs were detected at all three residences. The report has been modified as follows "…site-related arsenic contamination in soil at all three residences was remediated…" As these residences have been addressed individually in a separate health consultation, the report has been modified to refer the reader to Appendix A for specifics concerning this area of concern.

Comment	Draft PHA Page/Line	Comments/Responses
27	35/1	**Comment:** Past, current, and planned remediation measures appear to be effective in limiting adverse human health effects to residents, student, and staff with the planned soil caps. It should be noted that a CEA will be established. Information regarding the CEA will be presented in the Groundwater RAW. **Response:** The *Conclusions* section has been modified to include planned actions for a CEA to address TCE contamination in groundwater.
28	35/22	**Comment:** "Powered ventilation systems installed at the residences should be operational…" Are they implying that all 6 residences should have a powered vent system? Blowers were only installed in 3 of the 6 residences. Only one residence needs the blower on continuously. **Response:** Indoor air data for samples collected on June 20, 2007 indicated TCE was detected in Residence D at 6.5 µg/m3. This residence has a power blower system to vent vapors which was not in operation at the time of sampling, thus necessitating operation of the blower unit and re-sampling indoor air for TCE vapors. This demonstrates that without the use of this mitigation system, TCE vapors can enter the basement area. Therefore, as a precaution to this and other residences with powered blower systems, it is recommended that these systems remain operational until the potential for vapor intrusion has been reduced where it no longer poses a threat to public health.
29	Tables 1 through 4	**Comment:** Tables 1 through 4 do not include detection limits (DLs). DLs are a critical piece of data, especially for compounds that have very low CVs, such as arsenic, thallium, TCE and many PAHs. The analytical summary tables also do not list the source, sample number, and analytical methodologies. **Response:** For the purposes of the PHA document, detection limits are used if Environmental CVs are less than the detection limit. Tables 1 through 4 use Environmental CVs to establish COCs for further evaluation to determine the extent of potential exposures using Health Guideline CVs (see Tables 17 through 20). Environmental CVs in Tables 1 through 4 exceed detection limits for all compounds; therefore, there is no advantage to adding them to the report. Detection limits have not been included in the report to keep the complexity of the tables to a minimum for understanding.