# Health Consultation

COLONIE SITE
(Aliases: COLONIE INTERIM STORAGE SITE and
FORMERLY NATIONAL LEAD INDUSTRIES)

COLONIE, ALBANY COUNTY, NEW YORK

EPA FACILITY ID: NY0890137854

OCTOBER 5, 2004

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 document has previously been 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 health consultation has now been reissued. This concludes the health consultation process for this site, unless additional information is obtained by ATSDR which, in the Agency's opinion, indicates a need to revise or append the conclusions previously issued.

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Prepared by:

Federal Facilities Assessment Branch
Division of Health Assessment and Consultation
Agency for Toxic Substances and Disease Registry

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## List of Acronyms

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|---|---|
| ACE | US Army Corps of Engineers |
| ACHD | Albany County Health Department |
| AEC | Atomic Energy Commission |
| ATSDR | Agency for Toxic Substances and Disease Registry |
| CDC | Centers for Disease Control and Prevention |
| CERCLA | Comprehensive Environmental Response, Compensation, and Liability Act |
| cis-1,2-DCE | cis-1,2-dichloroethene |
| DOE | US Department of Energy |
| DU | depleted uranium |
| EPA | US Environmental Protection Agency |
| FDA | US Food and Drug Administration |
| FS | Feasibility study |
| FUSRAP | Formerly Utilized Sites Remedial Action Program |
| ICRP | International Commission on Radiological Protection |
| IEUBK | EPA's Integrated Exposure Uptake Biokinetic Model for Lead |
| mg/kg | Milligram per kilogram |
| mg/kg/day | Milligram per kilogram per day |
| NCRP | National Council on Radiation Protection and Measurements |
| NESHAP | National Emissions Standards Hazardous Air Pollutants |
| NL | National Lead Industries |
| NYSDEC | New York State Department of Environmental Conservation |
| NYSDOH | New York State Department of Health |
| ORNL | Oak Ridge National Laboratory |
| PbB | Blood lead levels |
| PCE | tetrachloroethene |
| PP | Proposed plan |
| PRG | Preliminary remediation goal |
| TCE | trichloroethene |
| TI | Teledyne Isotopes |
| VC | vinyl chloride |
| VOCs | volatile organic compounds |
| WHO | World Health Organization |
| WIC | Women, Infants and Children |
| µg/dL | microgram per deciliter |
| $\mu g/m^3$ | microgram per cubic meter |

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## Summary

Between 1958 and 1984, National Lead Industries (NL) used materials consisting mostly of depleted uranium (DU) in manufacturing processes at its Colonie, NY facility. Prior to 1960, the site was used as a brass and lead foundry.

NL obtained the depleted uranium under a license from what is now the U.S. Department of Energy. NL reduced depleted uranium tetrafluoride to depleted uranium metal, with which it manufactured shielding components, ballast weights, and projectiles. In addition, from 1966 to 1972, NL processed fuel from enriched uranium for use in experimental nuclear reactors (ACE 2001b). These operations generated stack emissions, which released DU into the air. Some of these stack emissions eventually settled on residential and commercial properties and structures near the plant. At a July 11, 2001 public meeting held by the U.S. Army Corps of Engineers (ACE), several community members expressed concern about potentially adverse health effects from past operations at NL's Colonie facility.

In response to those concerns, ACE requested that the Agency for Toxic Substances and Disease Registry (ATSDR) conduct an independent public health evaluation of potential exposures to the community from past Colonie Site operations.

In that evaluation ATSDR identified three issues regarding how people were exposed or might be exposed to contamination from the Colonie Site.

1. *In the past, could people have potentially been exposed to harmful levels of DU by breathing air emissions from NL's chip burner and other on-site sources, by contacting DU-contaminated soil when playing or gardening, and eating fruits and vegetables grown in DU-contaminated soil?*

   Although the US Environmental Protection Agency (EPA) did not have air regulations for DU while the plant was operating, ATSDR compared the 1979–1984 stack emissions to EPA's current National Emissions Standards Hazardous Air Pollutants (NESHAP) guidelines for radionuclides. The highest stack releases of uranium exceeded the NESHAP guidelines by a large margin. Given the levels of DU found in soil off site, and the fact that the NL plant scaled down operations during the late 1970s and early 1980s, the earlier air emissions were probably higher than the 1979–1984 documented emissions. Therefore, DU emissions at these high levels could have increased the risk of health effects—especially kidney disease—for people living near the plant. In addition, the combination of inhaling DU dust and cigarette smoke could have increased the risk of lung cancer. This is because of the irritant effect of the dust particles combined with the cigarette smoke. Although how much the risk was increased is unknown, ATSDR concludes that in the past, the uncharacterized emissions from the NL plant were a public health hazard to the community surrounding the Colonie Site. It is, however, important to note that when the plant stopped operating in the 1980s, the DU emissions stopped as well.

   Moreover, contacting DU-contaminated soil when playing or gardening, or eating fruits and vegetables grown in DU-contaminated soil would not be expected to cause illness in people. In addition, the soil removal from DU-contaminated properties during the mid-1980s would have further reduced or eliminated exposures.

2. *Were people exposed to harmful levels of lead in the past, currently, or in the future by breathing air emissions from the NL plant, contacting soil when playing or gardening, and eating fruits and vegetables grown in lead-contaminated soil?*

As stated, NL operated a brass foundry until 1960. The operations of the foundry emitted lead to the air. While the foundry operated, no air emissions were measured at the plant. Because of the absence of any NL data on lead emissions in the air, ATSDR cannot draw any conclusions about the health effects from breathing lead-air emissions from the NL plant in the past. Also as stated, it is again important to note that when the foundry stopped operating, the lead emissions stopped as well.

During the 1980s the soil removal from DU-contaminated properties would likely have removed lead-contaminated soil as well; but lead contamination could remain at properties that were not cleaned up. In May 2003, NYSDOH and NYSDEC sampled soil in the Yardboro Avenue area for lead and other metals. ATSDR reviewed the data and found that the levels of lead in these areas are not at levels that would cause adverse health effects for those who contact soil when playing or gardening, or for those who might eat fruits and vegetables grown in the lead-contaminated soil.

In addition, NYSDEC and NYSDOH are planning additional soil sampling for lead in areas surrounding the Colonie Site. This sampling is anticipated to take place later this year.

3. *Currently and in the future, could people potentially breathe indoor air containing volatile organic compounds (VOCs) from contaminated groundwater?*

Because groundwater contamination had migrated off the Colonie Site, the ACE took two rounds of samples of indoor air from five nearby homes. The results of these samples showed no current public health effect from exposure to VOCs in the indoor air. In addition, a model that uses the highest values found in the groundwater to predict indoor air concentrations suggests that in the future, VOCs in indoor air would not be expected to reach levels that would cause health effects.

ACE conducted a third round of sampling in the five homes in late February 2004. The results were provided to the homeowners. NYSDOH reviewed the data discussed their evaluation with the community and ACE. In addition, ACE will conduct a fourth round of sampling in the winter of 2004/2005.

**ATSDR also addressed the following five community concerns:**

1. *The community is concerned that past emissions from the site have caused adverse health effects such as various types of cancer, birth defects, Down syndrome, rashes, thyroid diseases, and endometriosis.*

ATSDR reviewed the available scientific information about the health effects associated with both uranium and lead. Using this information and the data available for the Colonie Site, ATSDR concluded that the levels of DU from the NL plant could have increased the risk of certain health effects in the community surrounding the plant. Nevertheless, as discussed previously, the extent to which these risks were increased is unknown. The uranium used at the plant was water-insoluble and would not have been easily absorbed by the body. In addition, many studies of uranium miners, millers, and processors have shown no damage to

skin after touching uranium. No currently available studies show a link between uranium and birth defects, Down syndrome, thyroid diseases, or endometriosis.

2. *Residents are concerned that possible lead contamination in their yard could harm children.*

In May 2003, NYSDOH and NYSDEC sampled soil in the Yardboro Avenue area for lead and other metals. ATSDR reviewed the data and found that the levels of lead in these areas would not cause adverse health effects. In addition, NYSDOH obtained the test results of children who were born between 1994 and 1997 and tested for lead prior to age two in the three ZIP Codes surrounding NL Industries: 12203, 12205, and 12206. The addresses were located on a map, and those children who lived within one mile of NL Industries were selected for further analysis. Four out of 206 children in the area (1.9%) had blood lead levels greater than or equal to 10 micrograms per deciliter (mcg/dL). Given these results, children living in the neighborhood near NL Industries do not appear to be at increased risk of lead exposure.

Even though the data do not indicate excessive levels of lead or other chemicals in soil around the NL facility, following safety measures to prevent exposure is always a good idea. These measures should include: (1) using ground cover/grass in your yard, particularly in children's play areas; (2) using sandboxes that contain solid bottoms, top covers, and clean sand; (3) using doormats for wiping feet before entering the house; (4) reducing household dust by wet mopping and dusting; (5) having children wash hands thoroughly after playing outside and before eating; and (6) washing and peeling all home grown vegetables before eating.

The biggest source of lead exposure for children is paint in older homes. Before 1978, paints contained high amounts of lead. Interior and exterior lead-based paint can flake off as chips or dust, making it accessible to children. You can prevent children's exposure by keeping the paint in older homes in good repair and using dust-control measures during remodelling of older homes. ATSDR recommends that parents concerned about their children's exposure to lead have their children's blood lead levels tested by their health care provider.

3. *Several community members are concerned that children playing on the NL property could have been exposed to contaminants in the past. A citizen's group is also concerned that children played with pellets of DU and abandoned drums on the property.*

Unfortunately, no information is available concerning the contents of any drums on the property while NL was in operation. However, we do know that the contact would have likely been short-term. Typically, illness as a result of exposure to chemicals comes from long-term daily exposure over many years. This would have been unlikely considering that most children would have played in the area for brief periods during the week (i.e., on weekends and after school in non-winter months) during their childhood years. Short-term, or acute, exposures to chemicals will generally result in immediate illnesses only if the dose is very high.

ATSDR reviewed information from DOE's 1991 soil remediation investigation for the Colonie Site. The levels of both lead and depleted uranium in the on-site soil are high. ATSDR calculated exposure doses from incidental ingestion based on the average value for a

child playing on the NL property one day per week, 32 weeks per year. The doses were well below levels that would be of health concern.

4. *A community group is concerned about exposure to DU, lead, and other possible contaminants in the surface water and sediment while swimming and wading in areas of the Patroon Creek watershed, including in and around the Patroon Reservoir and Tivoli Preserve.*

The Patroon Creek watershed is located in an industrial area and is subject to contamination from several point and non-point sources of pollution. Although not classified by New York State for primary contact recreation, it is reported that some parts of the Patroon Creek and Patroon Reservoir have been used for many years for swimming and wading by people living nearby. ATSDR has not heard reports of people fishing in Patroon Creek for food.

A local university researcher collected one continuous 3-meter sediment core from the Patroon Reservoir, which is a little more than ½ mile downstream from the Colonie Site and the MerCo state superfund site. A second sediment core was collected adjacent to the first in order to overlap any breaks in the first core. Uranium, lead, cadmium, and mercury were found in the core sample taken from below the sediment surface (Arnason and Fletcher 2003). Although the maximum concentrations for uranium and lead exceed the EPA Region 9 Preliminary Remediation Goals (PRGs), it is important to note that the PRGs are health-protective concentrations for residential soil; they are not applicable to sediments under approximately 2.5 meters (or 8.2 feet) of water. The maximum concentrations were found in samples approximately 0.8 to 1.9 meters (or 2.6 to 6.2 feet) below the sediment/water interface. This means that although the levels of contaminants are high, people cannot presently encounter these contaminants in the sediment. The contaminant levels at the sediment/water interface are approximately 2 mg/kg of uranium, 90 mg/kg of lead, 1 mg/kg of cadmium, and 0.6 mg/kg of mercury. In addition, researchers have found no evidence of sediments resuspended from the bottom of the Patroon Reservoir (Arnason and Fletcher 2003). This means that the contaminants will not be resuspended in the water and do not currently pose a health risk. It is important to remember, however, that the Patroon Creek watershed is located in an industrial area and is subject to contamination from several point and non-point pollution sources.

Past contamination levels in the water and in the sediment are unknown. The Patroon Creek watershed was in an industrialized area with few environmental safeguards. The ACE sampled sediments in the unnamed tributary leaving the Colonie Site and parts of Patroon Creek and found all samples to be below the 35 picocuries per gram (pCi/g) cleanup level.

5. *Several community members requested that ATSDR conduct a community health survey to assess the impacts of exposure from NL on their health.*

ATSDR does not believe that conducting a community health survey will answer the community's questions about whether or not the NL plant impacted their health. A door to door health survey could help to describe the health status of a particular community but would not explain why the health effects occurred. Designing a health study to determine the risk factors that contributed to the occurrence of disease in the community near the former NL would be difficult. A health study designed to evaluate the relationship between chemical releases from NL and health effects would not likely answer the question for several reasons.

First, reliable information on past exposure is not known. Second, the small population would make it difficult to reach a statistically reliable conclusion. Finally, kidney disease, a health effect shown to be related to uranium exposure in the scientific literature, would likely not be seen in the community currently since releases into the air stopped in 1984. The New York State Department of Health has conducted three reviews of cancer incidence in the area around the former NL. These analyses have shown elevations in lung cancer. A health study in a small population would make it very difficult to evaluate lung cancer further since smoking is a strong causal factor and past analyses by New York State Department of Health indicated that a large proportion of people with lung cancer were also smokers.

**Where can I find more information?**

Documents related to the Colonie Site, including reports prepared by the DOE, the ACE, and ATSDR, are available at the public repository in the William K. Sanford Town Library, 629 Albany-Shaker Road, Colonie, NY, (518) 458-9274.

Information about the Colonie Site can also be found on the U.S. Army Corps of Engineers' Colonie FUSRAP website: www.fusrapcolonie.com

Residents can contact ATSDR representatives by dialing the agency's toll free number, 1-888-42ATSDR (1-888-422-8737).

## Introduction

**What is a public health evaluation?**

A public health evaluation assesses data and information to determine whether releases of hazardous substances into the environment affect public health. Public health evaluations also identify actions needed to reduce or eliminate exposures that could cause human health effects.

At a July 11, 2001 public meeting held by the U.S. Army Corps of Engineers (ACE), several community members expressed concern about potential adverse health effects from past operations at the Colonie Site. In response to those concerns, ACE requested that the Agency for Toxic Substances and Disease Registry (ATSDR) conduct an independent public health evaluation of potential exposures to the community from past Colonie Site operations. ACE's original request focused on past exposure depleted uranium (DU) emissions.

During September 9–13, 2002, ATSDR conducted a site visit of the Colonie Site. The purpose of the visit was to begin collection of information necessary for conducting a public health evaluation. During the visit ATSDR staff met with local community groups and discussed community health concerns. ATSDR staff also met with representatives of the New York State Department of Health (NYSDOH), the New York State Department of Environmental Conservation (NYSDEC), Albany County Health Department (ACHD), and the New York State Department of Labor (NYSDOL). ATSDR staff toured the Colonie Site with representatives from ACE. In addition, ATSDR staff reviewed and copied many documents related to the site. ATSDR staff attended the ACE's September 12, 2002 public meeting and spoke with several members of the community about their health concerns. On November 21, 2002, ATSDR staff attended a community meeting to discuss a preliminary lead-soil sampling plan under development by the NYSDOH and the NYSDEC for properties surrounding the former NL plant.

After reviewing numerous documents and data, discussing health concerns with community members, and meeting with federal, state, and local agencies, ATSDR identified three issues regarding how people were exposed or might be exposed to contamination from the Colonie Site, as well as five community concerns. The three main exposure issues are:

1. In the past, could people have potentially been exposed to harmful levels of DU by breathing air emissions from NL's chip burner and other onsite sources, by contacting soil when playing or gardening, and by eating fruits and vegetables grown in DU-contaminated soil?
2. Were people exposed to harmful levels of lead in the past, currently, or in the future by breathing air emissions from the NL plant, contacting soil when playing or gardening, and eating fruits and vegetables grown in lead-contaminated soil?
3. In the future could people potentially breathe indoor air with volatile organic compounds (VOCs) from contaminated groundwater?

The five identified community concerns are below:

1. The community is concerned that past emissions from the site have caused adverse health effects such as various types of cancer, birth defects, Down syndrome, rashes, and endometriosis.

2. Residents are concerned that possible lead contamination in their yard could harm children.
3. A citizen's group is concerned that people, especially children, could have been exposed to DU in the past by playing with pellets and abandoned drums on the property.
4. A community group is concerned about exposure to DU, lead, and other possible contaminants in the surface water and sediment while swimming and wading in areas of the Patroon Creek watershed, including in and around the Patroon Reservoir and Tivoli Preserve.
5. Several community members requested that ATSDR conduct a community health survey to assess the impacts of exposure from NL on their health.

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## Background

The 11.2-acre Colonie Site is at 1130 Central Avenue in Colonie, Albany County, New York (Figure 1). The boundary between Colonie and the city of Albany is just south of the site. The former NL property is bounded by a wooded lot on the northwest, Consolidated Rail Corporation railroad tracks on the southwest and south, commercial property on the east, Central Avenue on the northeast, and a Niagara Mohawk electrical substation on the north (DOE 1995).

### History of the Colonie Site

The Embossing Company began manufacturing wood products and toys at the site in 1923. In 1927 Magnus Metal Company purchased the property and began operating a brass foundry for manufacturing railroad parts, including brass components cast in sand molds and brass-bearing housings with surfaces of babbitt metal (an alloy of lead, copper, and antimony) (ACE 2001b).

In 1937 National Lead Industries purchased the facility and an adjacent lot which included a portion of the former Patroon Lake. NL continued operating the brass foundry—and began filling Patroon Lake with casting sand—some time before 1941. After World War II, NL began casting aluminum mainframes for airplanes. Under a license from the Atomic Energy Commission (AEC—this agency was split into the U.S. Nuclear Regulatory Commission (civilian programs) and the U.S. Department of Energy (government/military programs)), the nuclear division of NL began producing items manufactured from uranium and thorium in 1958. In 1960 NL discontinued brass foundry operations (ACE 2001b).

From 1958 to 1984 NL used materials consisting mostly of depleted uranium (DU), although between 1960 and 1972 smaller amounts of thorium and enriched uranium were also used. NL reduced depleted uranium tetrafluoride to depleted uranium metal, which was then made into shielding components, ballast weights, and projectiles. In addition, from 1966 to 1972, NL manufactured fuel from enriched uranium for experimental nuclear reactors (ACE 2001b).

Other NL processes included an electroplating operation for plating uranium with nickel and cadmium. Chemicals used included nickel sulfamate, sodium cyanide, ferric chloride, nitric acid, silicate phosphate, iridite (a chromium brightener), cadmium metal, nickel metal, boric acid, and perchloroethylene (PCE). Because there are no disposal records, little or no information is available regarding how or where most of these materials were disposed of. Nevertheless, letters from NL to the AEC indicate that in 1961 about 55 cubic yards of graphite, slag, refractory material, uranium oxide, insoluble oil, metal scrap, and combustible trash were buried in the Patroon Lake, as per NL's license. Other chemical wastes and packaged chemicals used at the site included acids, bases, degreasing agents, carbon tetrachloride, benzene, polychlorinated biphenyls (PCBs), cyanide, heavy metals, and asbestos (ACE 2001b).

In February 1980, because of NL's airborne releases of uranium compounds, the New York State Supreme Court issued a temporary restraining order shutting down NL operations. In May 1980, the order was amended to allow limited operations. The amended order also required the company to begin an independent investigation assessing all adverse environmental conditions in on-site soil and on the off-site vicinity properties that might have been caused by NL airborne discharges. Independent contractor Teledyne Isotopes (TI) was hired to perform a radiological survey of the NL property and surrounding properties. Because airborne releases continued to exceed state standards, state officials closed NL again in 1984 (ACE 2001b).

**Soil Remediation at the Colonie Site**

In 1980 TI surveyed the neighborhood surrounding the NL plant for radioactivity. TI determined that the uranium released into the air through stack emissions had deposited on residential and commercial properties and structures. The survey showed that the majority of the contamination was north/northwest and southeast of the plant, in the direction of prevailing summer and winter winds (Teledyne Isotopes 1980).

After the 1984 closure of the NL plant, Congress authorized the U.S. Department of Energy (DOE) to remediate the property under the Formerly Utilized Sites Remedial Action Program (FUSRAP). The Secretary of Energy accepted an offer from NL to donate the land, buildings, and equipment to expedite the cleanup (ACE 2001b). From 1984 to 1997, DOE managed the Colonie Site. Between 1984 and 1988, Oak Ridge National Laboratory (ORNL) performed radiological surveys of over 200 individual properties surrounding the former NL property. Of these, ORNL found that 56 vicinity properties were contaminated with concentrations of radioactive material either exceeding 35 picocuries per gram of soil (pCi/g) for uranium-238 (U-238) (when averaged over the top 2 inches of soil), or had a sample exceeding 100 pCi/g. Between 1984 and 1988, 53 of the 56 vicinity properties were cleaned up by removal of DU-contaminated soil. DU typically concentrated in the upper 2 inches of soil (DOE 1995). The waste soil was held in interim storage on the Colonie Site within an on-site building. In 1995, this material was bagged and shipped to an off-site disposal facility (ACE 2001a). A 1995 DOE finalized Engineering Evaluation/Cost Analysis outlined the remediation of the former NL property and the remaining three vicinity properties.

By Congressional action in 1997, ACE assumed control of the Colonie Site and the responsibility for the remaining cleanup activities. ACE has remediated one of the three vicinity properties and the major portions of the Colonie Site property (ACE 2002b).

**Groundwater Remediation at the Colonie Site**

As a result of historical waste handling operations at the Colonie Site, volatile organic compounds were released in—and have been detected in—groundwater. ACE has conducted three separate phases of groundwater investigation at the Colonie Site. ACE completed Phase I in the winter of 1999. This work involved the initial collection of groundwater screening samples to determine whether contamination had migrated to the southern boundary of the site. The Phase II work, which involved additional groundwater screening and geophysical surveys, was completed in the summer of 2001. As part of Phase II, and to characterize more fully the underlying geology, ACE used a seismic survey and electrical resistance profiling techniques.

Phase III involved a variety of groundwater and soil sampling to define further the subsurface geology and the extent of groundwater contamination. As a means of defining the extent of groundwater contamination, Phase III work included the installation of additional monitoring wells located downgradient of the site along Yardboro Avenue. The groundwater contamination delineation is now complete. ACE semi-annually conducts comprehensive groundwater sampling of all monitoring wells at the site. The sampling data are included in the Groundwater Remedial Investigation Report.

The draft final Risk Assessment for the Colonie FUSRAP Site was released to NYSDEC and NYSDOH for review in early April 2004. The final Risk Assessment was released to the public in September 2004.

A Feasibility Study (FS) evaluating alternatives to clean up on-site and off-site groundwater contaminated with chlorinated volatile organic solvents is currently on hold. The FS will integrate the data and findings from both the groundwater Remedial Investigation Report and the Risk Assessment Report. The FS will identify potential remedial technologies that can be used to remediate the contaminated groundwater. The groundwater at the site is in constant flux due to the on-going soil removal action. Recent groundwater monitoring reports are showing that chlorinated volatile organic solvent concentrations on-site have been decreasing, as the soil source areas are being removed. The FS has been postponed until the soil removal has been completed so that the appropriate remedial alternatives can be evaluated consistent with current groundwater contamination levels. The FS Report is now expected to be released to the public in fiscal year 2006.

Upon completion of the groundwater FS Report, ACE will prepare a Proposed Plan (PP) that will identify to the public the preferred groundwater cleanup alternative for the site. The main purpose of the PP is to obtain public participation in the remedy selection process and to ensure that regulatory requirements are fulfilled. The PP provides a brief summary of all alternatives studied in the detailed analysis phase of the Remedial Investigation/Feasibility Study, as well as the key factors that lead to the selection of the preferred alternative. The PP does not select the remedial action; it merely sets forth the preferred alternative. The PP is scheduled to be released in fiscal year 2006 upon completion of the FS Report and will be made available for public comment.

ACE will prepare a site-wide Record of Decision (ROD) that will take into consideration new information and comments received during the PP public comment period. The ROD will document the selected remedy for groundwater, as well as serve to certify the current soil removal action is the final remedy for the main site and vicinity properties. The ROD is expected to be submitted to NYSDEC for review and written approval in fiscal year 2007. Once signed, ACE will publish a notice of availability and make the ROD available to the public before beginning the response action for groundwater.

**Land Use and Natural Resource Use**

Because people use land and natural resources in many different ways, ATSDR examines land and natural resource uses to determine whether any of them might put people at risk for exposure. This information is important; controlling the types and frequencies of activities in contaminated areas affects exposure to contamination.

Land use around the Colonie Site is primarily residential and commercial. The site is bordered by a railway track, residences, and several businesses. Interstate 90 is to the south of the site. No plan for future land use has been developed, but one suggestion has been to use the land for a ramp to connect Central Avenue to Interstate 90.

The groundwater around the Colonie Site is not used for drinking water or for any other domestic purpose. Residents do not have private drinking water or irrigation wells; the municipal system supplies all residents of Colonie and Albany with their water. The Town of Colonie drinking water comes from the Mohawk River, the Stony Creek Reservoir, and five wells located several miles away from the Colonie Site. The City of Albany drinking water comes from the Alcove Reservoir, occasionally supplemented by the Basic Creek Reservoir. None of the water supplies for Colonie or Albany are currently affected by the groundwater contamination from the Colonie Site, nor are they likely to be affected in the future.

Downstream from the Colonie Site, the Patroon Creek watershed, including the Tivoli Preserve, is used for recreational purposes.

**Demographics**

ATSDR examines demographic data (i.e., information about population) to determine the number of persons potentially exposed to environmental chemicals. Demographic data is also used to determine the presence of sensitive populations, such as children (age 6 and younger), women of childbearing age (age 15–44), and the elderly (age 65 and older). Demographic data provides details on population mobility which, in turn, helps ATSDR evaluate how long residents might have been exposed to environmental contaminants.

Figure 2 summarizes demographic data for the area surrounding the Colonie Site, based on data compiled from the 2000 U.S. Census. According to the data, 10,045 persons live within 1 mile of the site property line and all are within the limits of the Town of Colonie or the City of Albany. Figure 1 also specifies the number of residents in three potentially sensitive populations for environmental exposures: children, women of childbearing age, and the elderly.

Changes in population in an area over time are also important information. Table 1 lists the population growth of Albany County, NY from 1950 to 2000.

**Table 1: Population Growth in Albany County, NY, 1950-2000**

| Year | 1950 | 1960 | 1970 | 1980 | 1990 | 2000 |
|---|---|---|---|---|---|---|
| Population | 239,386* | 272,926* | 286,742* | 285,909* | 292,594* | 294,565† |
| % change | ------- | +14 | +5 | -0.2 | +2 | +0.6 |

* New York State Department of Economic Development 2000
† US Bureau of the Census 2000

**Quality Assurance and Quality Control**

In preparing this health evaluation ATSDR reviewed and evaluated information provided in the referenced documents. Although this facility is not on EPA's National Priorities List, ACE is following the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) guidelines to remediate the Colonie Site (ACE 2002b). The U.S. Environmental Protection Agency established the CERCLA process to regulate contaminated site cleanups. Documents prepared for the CERCLA program must meet specific standards for adequate quality assurance and must meet control measures for chain-of-custody procedures, laboratory procedures, and data reporting. The validity of the analyses and conclusions drawn in this evaluation are determined by the availability and reliability of the referenced information. Based on our evaluation, ATSDR has determined that the quality of environmental data available in Colonie Site-related documents prepared by DOE and ACE is adequate to make public health decisions. Some historical data, including data collected by NL Industries and NYSDOH, lacks information relating to quality assurance and quality control. ATSDR believes, however, that the data are still adequate for use in this evaluation.

## Discussion

**1. In the past, could people have potentially been exposed to harmful levels of DU by breathing air emissions from NL's chip burner and other on-site sources, contacting DU- contaminated soil when playing or gardening, and eating fruits and vegetables grown in DU-contaminated soil?**

*Although EPA did not have air regulations for DU while the plant was operating, the highest stack releases of uranium for the period from 1979 to 1984 exceeded EPA's current National Emissions Standards Hazardous Air Pollutants (NESHAP) guidelines for radionuclides by a large margin. Based on the levels of DU found in soil off-site, and the fact that the NL plant scaled down operations during the late 1970s and early 1980s, the earlier air emissions were probably higher than those emissions documented between 1979 and 1984. Therefore, DU emissions at these high levels could have increased the risk of health effects—especially kidney disease—for people living near the plant. In addition, the combination of inhaling DU dust and cigarette smoke could have increased risk of lung cancer. This is because of the irritant effect of the dust particles combined with the cigarette smoke. In the past, the uncharacterized emissions from the NL plant were a public health hazard to the community surrounding the NL plant.*

*ATSDR reviewed data for DU in the soil around the Colonie Site. Based on the levels of DU in the soil, contacting DU-contaminated soil when playing or gardening, or when eating fruits and vegetables grown in DU-contaminated soil would not be expected to cause illness in people.*

***What is uranium?***

Uranium is a natural and commonly occurring radioactive element. Natural uranium is actually a mixture of three types (or isotopes) of uranium: U-234, U-235, and U-238. All three isotopes behave the same chemically but have different radioactive properties (ATSDR 1999b). Radioactivity is the spontaneous emission of radiation, or energy, from the nucleus of an unstable atom. For more information about radioactivity and radiation, please see Appendix B.

**What is natural uranium?**
Natural uranium is mixture of 0.01% U-234, 0.72% U-235, and 99.27% U-238, by weight. Natural uranium is more radioactive than depleted uranium and less radioactive than enriched uranium (ATSDR 1999b).

**What is depleted uranium (DU)?**
Depleted uranium is uranium with decreased fractions of U-234 and U-235. DU is less radioactive than both enriched and natural uranium (ATSDR 1999b).

**What is enriched uranium?**
Enriched uranium is uranium with an increased fraction of U-234 and U-235. Enriched uranium is more radioactive than both natural and depleted uranium (ATSDR 1999b).

Depending on the percentages of U-234, U-235, and U-238, uranium can be depleted, natural, or enriched (see text box). Depleted and natural uranium are only weakly radioactive. In fact, DU is three million times less radioactive than radon, a highly radioactive naturally-occurring gas (Bleise et al 2003). Because DU is so weakly radioactive, the major concern for exposure is from chemical toxicity.

***What kinds of health effects are caused by uranium?***

Several factors can determine whether someone will become ill from coming into contact with, or being exposed to, uranium. These include how much of the chemical gets into the body (dose), how often someone is exposed (frequency), and the length of time someone is exposed (duration). In addition, the toxicity of uranium varies with its chemical form (i.e., depleted,

natural, or enriched, and water-soluble or water-insoluble) and with the route of exposure (i.e., eating, touching, and breathing).

The major concern for exposure to uranium is from chemical toxicity. Depleted, natural, and enriched uranium all have the same chemical effect on the body. Animal studies have shown that water-soluble forms of uranium can cause kidney problems. Kidney effects have been seen in humans from acute poisoning incidents, although studies of uranium miners and mill workers have not shown unusual rates of kidney disease (ATSDR 1999b).

**Why is DU considered weakly radioactive?**

One way in which radiation causes cancer is that an energetic particle is released, passes through tissue and hits DNA in a cell that is dividing. The more rapidly cells in tissue divide, the more likely that the cell in the tissue is a target for an effect by the radiation. The rate at which particles are released from DU is extremely low. The rate at which cells in the lung tissue divide and, therefore are susceptible, is also very low. The combination of these biological factors may be reasonably assumed to be the reason that uranium or DU has not been considered as a human carcinogen.

Although radiation has been shown to cause cancer, no human cancer has been directly linked to the radiological properties of natural or depleted uranium. This is because, as previously stated, natural and depleted uranium are only weakly radioactive (see text box to the right). Studies of uranium miners, millers, and processors have shown that the main risk of developing lung cancer is associated with breathing other cancer-causing substances such as radon and cigarette smoke (Whittemore and McMillan 1983; Polednak and Frome 1981; Scott et al 1972; Hadjumichael et al 1983; Cragle et al 1988). Much of the radon that miners were exposed to was in the mines themselves. It takes thousands of years for uranium to break down enough for radon to be formed. In addition, the process of manufacturing natural uranium into depleted uranium removes the radon and "resets" the breakdown. Since the DU used at the Colonie Site was made in the past 50 years, radon has not had enough time to build up.

**Reproductive toxicit**y: The occurrence of adverse effects on the reproductive system that may result from exposure to a chemical. Results of such toxicity may include changes in sexual behavior, fertility, and pregnancy outcomes.

**Developmental Toxicity:** The occurrence of adverse effects on the developing fetus that may result from exposure to a chemical or radiation prior to conception (either parent), during prenatal development, or post-natally to the time of sexual maturation.

**Genotoxicity:** The occurrence of damage to cellular DNA that may result form exposure to a chemical. Results of such toxicity may include genetic mutations or cancer.

A recent study looking at lung cancer rates in 1991 Persian Gulf War veterans found no excess risk of cancer overall or of site specific cancers. However, because the veterans were only followed for 11 years, researchers indicate that the long latent period for cancer necessitates the continued follow up of these cohorts (Macfarlane et al 2003).

Although cancer due to radioactivity may not expected from exposure to depleted uranium, there are scientific studies that indicate that inhalation of respirable dust is a risk factor for lung cancer in people, and that risk can increase with smoking (Knutsson *et al* 2000; Wild *et al* 2000; Szadkowska-Stanczyk and Szymczak

2001). ATSDR believes that there could have been significant amounts of respirable particles in NL's airborne emissions. ATSDR believes that the combination of inhaling DU dust and cigarette smoke could have increased risk of lung cancer because of the irritant effect of the dust particles combined with the cigarette smoke.

Community members have expressed concern that they could have passed on health effects to their children and grandchildren because of exposure to DU from the NL plant. ATSDR researched the scientific literature for information about reproductive, developmental, and genotoxic health effects associated with exposure to DU (see text box for definitions).

Numerous studies of humans and animals have looked at both reproductive and developmental health effects and the existing data does not associate these effects with exposure to DU (WHO 2001; ATSDR 1999b). Only limited information is available about the genetically toxic effects of DU in both humans and animals. The results of DU exposure *in vitro* to immortalized human osteoblast cells indicated that DU caused mutations to these cells (Miller 2002). However, immortalized human osteoblast cells are cancerous bone cells and are not reflective of healthy human cells. Also, *in vitro* exposure involves exposing the cells in an artificial environment outside the living organism. There have been several epidemiological studies of workers who inhaled uranium and cancer has not been linked to DU or natural uranium (WHO 2001; ATSDR 1999b). These studies are more representative of the types of exposures to residents near the NL plant.

***What happens to DU in the body?***

About 98% of uranium entering the body by ingestion is not absorbed, but is eliminated in the feces. Typical gut absorption rates for uranium in food and water are about 2% for water-soluble and 0.2% for water-insoluble uranium compounds.

The fraction of uranium absorbed into the blood is generally greater following inhalation than following ingestion of the same chemical form. This fraction will also depend on the particle size distribution. Inhaled larger particles (greater than 10 μm) are transported out of the lungs by mucocilliary action, swallowed, and then eliminated in the feces. The International Commission on Radiological Protection (ICRP) lists water-insoluble forms of uranium, such as those used at NL, with a biological half-life (meaning the time that it takes for half of the material to be eliminated by biological processes) of 100 to 500 days (ICRP 1979). In addition, a study of German workers showed a biological half-life of uranium in the lungs estimated at 109 days (Shieferdecker et al. 1985).

Of the uranium that is absorbed into the blood, approximately 70% will be filtered by the kidney and excreted in the urine within 24 hours; this amount increases to 90% within a few days.

***Is there a medical test to determine whether I have been exposed to uranium?***

Yes. DU can normally be measured in urine samples. Most people have some amount of uranium in their body because food and water have small amounts of natural uranium. Most DU leaves the body within a few days. If your exposure to DU ended more than a week before urine sampling, there will likely be very little DU left in the urine. If intake of DU is large over a long period of time, urine levels may be high for a long period of time. However, because DU emissions from the NL plant stopped twenty years ago, current urine sampling would not likely show levels of DU in people who lived near the facility.

Although these tests may show the amount of DU in your body, they cannot tell you whether you will have any health problems. Also these tests cannot tell you where the DU came from.

***Have there been any studies of health effects on the community from the NL plant?***

In 1979, the NYSDOH and the ACHD collected urine samples from several residents near the NL plant and took several dust samples from nearby homes. The residents varied in both age (5 to 73 years) and length of years residing in their homes (3 to 50 years). The results of all the urine sampling showed no traces of uranium.

Six of these individuals were then chosen to undergo body scans to measure lung burdens of uranium. These individuals ranged in age from 5 to 62 years, and resided in their homes for 5 to 28 years. The candidates were chosen based on the following criteria: resided in areas where soil, dust, and wipe sampling showed highest uranium deposition, resided in the area for a period exceeding 2 years, covered a variety of age distribution, and spent a large portion of time at home (NYSDOH 1979a). The body scans were done at New York University Medical Center, Institute of Environmental Medicine in Tuxedo, NY. The whole body counts were taken with one NaI(T1) detector and two 15.2 cm thin crystal phoswich detectors (NaI-CsI(T1)). In addition, whole body counts were done on four unexposed people who were chosen on the basis of physical similarities to the Colonie residents in order to act as background controls for each measurement. The results of the body scans showed *no measurable activity from uranium* in any of the Colonie residents (IEM 1979).

The NYSDOH conducted two investigations looking at cancer and other health effects in the area around the NL plant. The first (1981) investigation identified four census tracts near the plant and looked at both the New York State Cancer Registry data from 1970 to 1976 and NYSDOH Office of Vital Statistics data from 1972 to 1978. NYSDOH then compared these data with data from three nearby census tracts. NYSDOH found statistically elevated number of lung cancer cases in males 65 to 74 years old. A follow up on these lung cancer patients found that most had a history of smoking. In addition, there was no geographic clustering of lung cancer cases near the plant or near known areas of contamination. No increased number of kidney disease deaths, spontaneous fetal deaths, or kidney cancer was detected (NYSDOH 1981).

The second (1993) NYSDOH investigation looked at the cancer incidence in five ZIP Code areas in Colonie from 1978 to 1987. These data were compared with the expected cancer incidence for suburban areas in New York State (excluding New York City). The results showed an increased number of males with colon and rectal cancer and an increased number of females with cancer of the oral cavity (NYSDOH 1993). That said, however, this investigation covered a very large area with an estimated population in 1980 of 58,187 persons. Therefore, it can only provide information about the overall cancer incidence in this population; it can not provide any conclusions about the health of those who lived near the NL plant.

More recent data on cancer incidence for this ZIP Code are available from the NYSDOH Cancer Surveillance Improvement Initiative, also known as the cancer mapping project. Information from this project, which tabulated observed and expected numbers of the four most frequently diagnosed cancers in the state by ZIP Code (breast, lung, prostate, and colorectal cancers), shows an elevation in lung cancer incidence in both males and females in ZIP 12205 in the years 1993-1997 (NYSDOH 2003). Again, this information is from the entire ZIP Code and can only provide information about the overall cancer incidence in this population; it can not provide any conclusions about the health of those who lived near the NL plant.

***Will ATSDR conduct a community health survey?***

ATSDR does not plan to conduct a community health survey. The Colonie community has concerns about several diseases that are not expected to be caused by depleted uranium. NYSDOH has evaluated health statistics in the area near the former NL site and found elevated rates of lung cancer. A health study to explore the relationship between DU exposure and lung cancer for the area near the former NL site would likely not provide meaningful results considering the small size of the community and other known risk factors for lung cancer such as smoking. A study of the area would be likely to miss any difference in disease rates between the area near the former NL site when compared with a reference population.

Another important consideration is whether a health study will provide scientifically useful results related to exposure and health effects. The small population of the Colonie community would make reaching a statistically reliable conclusion about health effects from the NL site very difficult. Large numbers are required to reliably detect small differences in the rates of disease. A study of the small area near the NL site is likely to miss a small difference (higher or lower) in disease rates when compared with a reference population. Also, other potential risk factors (e.g., heredity, diet, smoking, alcohol consumption, and other underlying health conditions) have an influence on the findings.

***What levels of DU air emissions were released from the NL plant?***

The levels of stack emissions from the NL plant are only available for 1979–1984. Although the plant used DU beginning in 1958, ATSDR does not have emissions data for operations before 1979. ATSDR staff reviewed records at several state and local agencies while looking for this information, including NYSDEC Headquarters and Region 4 offices, NYSDOH, ACHD, and NYSDOL. ATSDR also contacted the New York State Office of the Attorney General. ATSDR found limited data for uranium stack emissions from the former NL plant during 1979–1984 (NL Industries, unpublished data, 1979–1984). Because strict environmental regulations and enforcement did not occur in the United States until the 1970s, it is very likely that air emissions data were not collected prior to 1979.

ATSDR reviewed daily air data from stack emissions that were collected by NL and submitted to NYSDEC during 1979–1984. These stacks refer to emissions points outside the building, typically located on the roof. A summary of this data is presented in Table 2. Although there are gaps in the data during the 5-year period, there are over 1000 emissions samples. The concentration of DU emissions ranged from not detected to 17,792 x $10^{-12}$ micro curies per milliliter of air (or 0.000000018 µCi/mL) (NL Industries, unpublished data, 1979–1984). Using the levels of DU found in the soil in the properties surrounding the Colonie Site, and the fact that the NL plant scaled down operations during the late 1970s and early 1980s (DOE 1989b), it is probable that the levels of stack emissions before 1979 were higher than those found in the 1979–1984 data. In addition, ATSDR reviewed the stack data in comparison with the soil data, and found that the air emissions would probably not have been high enough to produce the levels of DU found in the soil of some of the adjacent properties.

| Table 2: DU air emissions data from the NL Plant: 1979-1984* | | | | | |
|---|---|---|---|---|---|
| **Stack number** | **Stack description** | **Number of samples** | **Average ($\mu Ci/mL \times 10^{-12}$)** | **Minimum ($\mu Ci/mL \times 10^{-12}$)** | **Maximum ($\mu Ci/mL \times 10^{-12}$)** |
| 1 | Boiler room | 106 | 2.6 | 0.011 | 43 |
| 2 | Grinding booth | 114 | 2.3 | ND† | 23 |
| 3 | Surface grinder | 0 | ---‡ | --- | --- |
| 4 | Rolling mill – salt pot | 6 | 33 | 6.2 | 76 |
| 5 | Paint booth | 119 | 2.5 | 0.047 | 48 |
| 6 | Plating | 4 | 3.2 | ND | 10 |
| 7 | Plating | 216 | 0.55 | ND | 36 |
| 8 | Aerojet lathes | 6 | 7.5 | ND | 30 |
| 9 | Heat Treat and grinders | 0 | --- | --- | --- |
| 10 | Grinders and big wheel | 5 | 2.2 | ND | 5 |
| 11 | Grinder and sharpener | 4 | 1.1 | 0.07 | 2 |
| 12 | Hollow mill | 3 | 5.8 | 0.12 | 15 |
| 13 | Honeywell lathes | 5 | 3.2 | ND | 6.3 |
| 14 | 50 KW vacuum furnace | 40 | 5.3 | ND | 162 |
| 15 | 200 KW vacuum furnace | 40 | 3.8 | ND | 102 |
| 16 | 100 KW vacuum furnace | 37 | 7.8 | ND | 173 |
| 17 | Graphite burner | 0 | --- | --- | --- |
| 18 | Chip melt bypass | 40 | 1759 | ND | 17,792 |
| 19 | Chip melt | 102 | 15 | 0.05 | 218 |
| 20 | Reduction area baghouse | 11 | 40 | 2.2 | 197 |
| 21 | Burn-out crucible - lead pot | 1 | --- | ND | --- |
| 22 | Ceramic area | 6 | 6.6 | 0.23 | 12 |
| 23 | Boiler room | 87 | 1.9 | 0.072 | 99 |
| 24 | Central vacuum cleaning | 0 | --- | --- | --- |
| | unknown | 50 | --- | --- | --- |

***NL Industries, unpublished data, 1979–1984**
**† Not detected**
**‡ No data available**

It is important to note that when the NL plant was closed in 1984 the emissions stopped; it is also important to note that in the Colonie Site vicinity there is no current exposure to DU from air emissions.

***Did people breathe harmful levels of DU in the past?***

ATSDR reviewed the 1979–1984 data and input the data into a simple modeling program, CAP-88. The EPA developed the CAP-88 program for its guidance on National Emissions Standards Hazardous Air Pollutants (NESHAP). CAP-88 was used to generate risk estimates for the risk assessment supporting this rule. The CAP88-PC software has been approved for demonstrating compliance with the requirements in 40 CFR 61.93a for Department of Energy facilities. For more information about the CAP-88 model, please see Appendix C

For the model, ATSDR used the maximum stack release from the 1979–1984 data. This value came from the chip melt bypass. This release was from the burning of leftover DU and represents the largest emission by at least two orders of magnitude (see Table 2). The model showed that the highest 1979–1984 stack release exceeded the current NESHAP guidelines by a large margin. Based on the levels of DU found in soil off-site, and the fact that the NL plant scaled down operations during the late 1970s and early 1980s (DOE 1989b), the earlier (pre-1979) air emissions were probably higher. ATSDR believes that breathing the DU emissions at these high levels could have increased the risk of health effects—especially kidney disease—for people living near the plant. In addition, the combination of inhaling DU dust and cigarette smoke could have increased risk of lung cancer. This is because of the irritant effect of the dust particles combined with the cigarette smoke (Knutsson *et al* 2000; Wild *et al* 2000; Szadkowska-Stanczyk and Szymczak 2001). *Although the extent to which these risks were increased is unknown, ATSDR concludes that in the past, the uncharacterized emissions from the NL plant were a public health hazard to the community surrounding the Colonie Site.*

***How did DU enter the soil?***

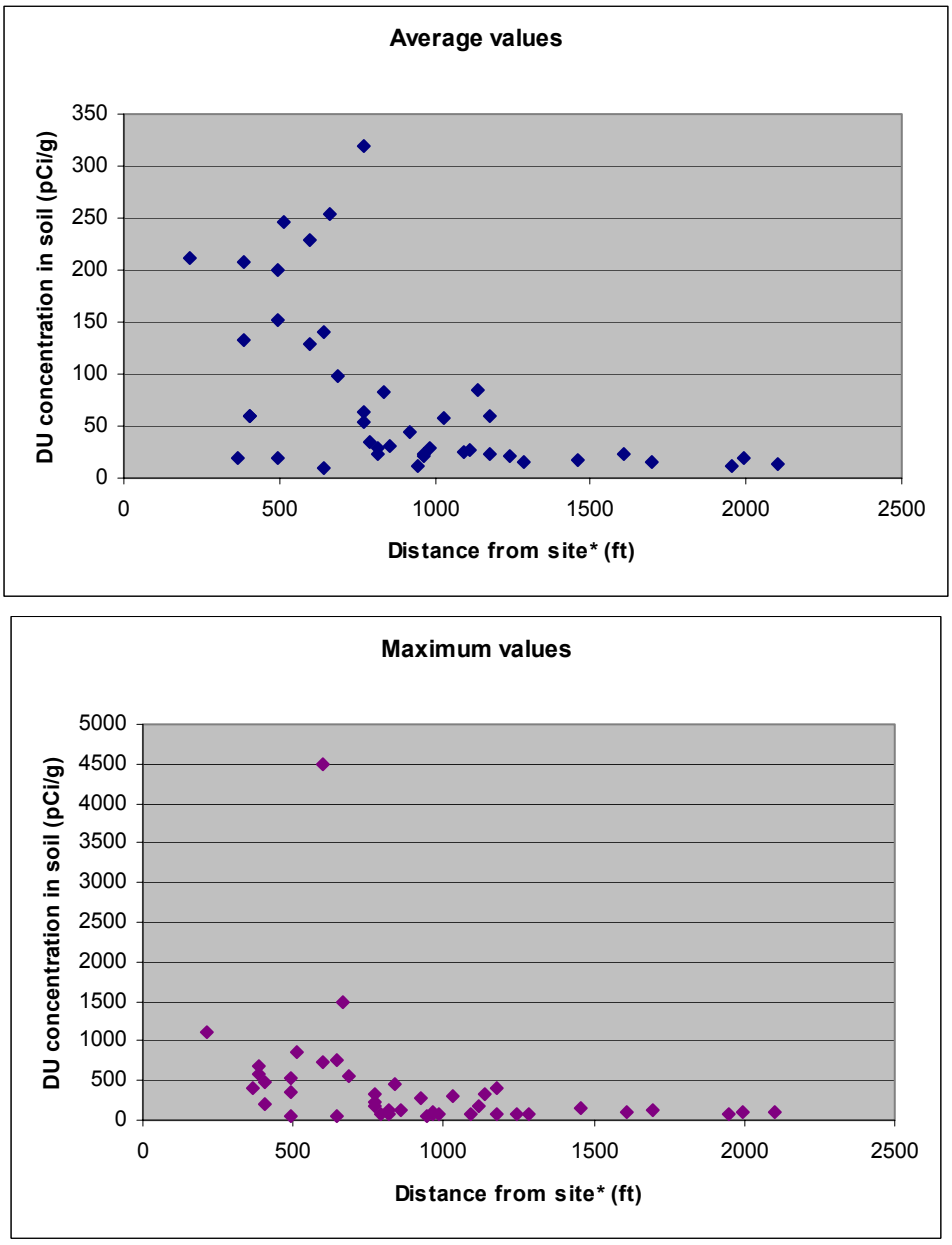
DU entered the soil from air emissions from the NL plant. In air, uranium takes on a dust-like form. Very small dust-like particles of uranium fall out of the air on surface water, on plant surfaces, and on soil, either by simple gravity or by rainfall (ATSDR 1999b).

In 1980, Teledyne Isotopes (TI) surveyed the neighborhood surrounding the NL plant for contamination from the NL plant. TI determined that the uranium released into the air through stack emissions had deposited on nearby residential and commercial properties and structures. The survey showed that the majority of the contamination was north/northwest and southeast of the plant in the direction of prevailing summer and winter winds. This area included parts of Central Avenue and Yardboro Avenue (Teledyne Isotopes 1980).

***What levels of DU were found in the soil?***

In 1983, ORNL performed detailed radiological surveys of the individual vicinity properties surrounding the NL plant (including private residences). These surveys were designed to locate all properties on which uranium contamination exceeded the guidelines developed by New York State and DOE, [i.e., 1) 35 pCi/g averaged over a 10-meter by 10-meter section, or 2) 100 pCi/g in a 5-cm by 5-cm section (DOE 1989a)]. The agencies surveyed 219 locations. The results indicated that 56 properties required remediation (DOE 1995). ATSDR reviewed the surveys for 43 of the 56 properties that required remediation and found that levels of DU in soil that exceeded either of the guidelines averaged from 9 to 320 pCi/g of soil, with a maximum on one property of 4500 pCi/g of soil. Figure 3 shows the average and maximum DU concentrations in soil in relation to distance from the site.

*Figure 3: Maximum and average DU soil concentrations in vicinity properties that required remediation in relation to distance from the site*—Colonie Site, Albany County, New York*




*Distances are approximate

***When and how was the soil cleaned up?***

Between 1984 and 1988, DOE cleaned up 53 vicinity properties of the 56 identified properties. Under its current program, ACE is cleaning up two additional properties: the town of Colonie property and the Consolidated Railroad Corporation property. Another adjacent area—the Niagara Mohawk property—requires no further remedial action for radiological contamination. The typical method of remediation for the contaminated properties involved the removal of siding, roofing materials, driveways and sidewalks, the excavation of soil, and the removal of shrubbery. After the vicinity properties were remediated, the properties were restored according

to the conditions of the access agreements. This included backfilling the excavated areas with clean fill material, replacing any removed shrubbery, and restoring any altered structures (e.g., fences and pavement).

***Would there have been health effects from touching DU-contaminated soil while playing or gardening?***

Scientists know that the skin does not easily absorb water-insoluble forms of uranium; the DU used at the NL plant was water-insoluble. Although some animal studies have found health effects such as skin irritation and dermal ulcers after exposure to different uranium compounds, a study on rats found that a 1-year exposure to uranium tetrachloride (a water-insoluble compound) did not affect the skin (Stokinger et al 1953). Dermal effects were not seen in studies of uranium miners, millers, and processors. The observed skin damage reported in animals dermally exposed to excessive quantities of uranium compounds is not expected to occur in human exposures at hazardous waste sites. Such exposures, if they do occur, are expected to be at or less than the levels at which uranium miners, millers, and processors are exposed, [i.e., levels at which no attributable dermal health effects were reported (ATSDR 1999b)]. ATSDR concludes that it would be very unlikely for people playing or gardening to absorb uranium into their bodies through the skin. Consequently, no health effects would results from touching the soil.

Concerns have been raised that children could have been playing in the soil with bare feet, arms, and legs during the summer months, thus increasing the area on their bodies that could contact contaminated soil. Because, however, the water-insoluble form of uranium is not very easily absorbed by the skin, ATSDR believes these children would not be at any higher risk of health effects.

***Would there be health effects from eating DU-contaminated soil?***

**ATSDR's Minimal Risk Levels (MRLs)**

The MRL is derived from the lowest observed adverse effect level (LOAEL) identified in the scientific literature. The LOAEL is the lowest dose at which an adverse health effect has been observed. It is divided by a safety factor to protect sensitive groups and to account for the differences between humans and animals in response to exposure. MRLs are protective by design and represent doses below which non-cancer adverse health effects are not expected to occur, even from daily exposure over a lifetime. *MRLs are not thresholds for harmful health effects. A dose that exceeds the MRL indicates only the increasing potential for toxicity and that further toxicological evaluation is needed.*

When people put their hands in their mouths, smoke cigarettes, or eat food after touching soil and before washing their hands, they can incidentally eat soil. Children are especially prone to this type of hand-to-mouth behavior. Some young children exhibit soil-pica behavior by intentionally eating large amounts of soil and other non-food items. Studies have shown that the water-insoluble compounds of uranium, like those used at the NL plant, are not easily absorbed by the body's gastrointestinal tract (i.e., stomach, small intestines, and colon). Many studies of animals exposed to high levels of uranium through ingestion have shown very few health effects. When incidentally ingested, uranium—especially the water-insoluble form—is not considered to be toxic (ATSDR 1999b). ATSDR reviewed the soil data from the properties surrounding the Colonie Site and calculated doses for the incidental ingestion of DU. The estimates were compared to ATSDR's minimal risk levels (MRLs). ATSDR found that adverse health effects would not be expected, even for children exhibiting

soil-pica behavior. Appendix D has information about ATSDR's calculations and assumptions for eating DU-contaminated soil.

***Would there be health effects from DU in the soil being resuspended in the air?***

The resuspension and subsequent inhalation of DU-contaminated soil would be minimal compared to inhalation of DU air emissions from the NL plant. DU is a heavy metal and the particles in the soil are likely large particles that are hard to suspend. Lighter and smaller particles would likely have been dispersed and essentially diluted in the air from the initial emissions. In addition, the types of health effects expected from DU would have required large amounts of material to be inhaled and it is unlikely that there would have been a large enough volume of resuspended particles to cause health effects. The greatest risk would have come from inhaling the emissions from the plant.

***Would health effects result from eating fruits and vegetables grown in DU-contaminated soil or soil contaminated with DU from air emissions?***

Plants can absorb DU in the soil from the roots without absorbing it into the body of the plant. Because of this, root vegetables such as potatoes, radishes, and beets, tend to absorb slightly more uranium than other types of plants (ATSDR 1999b). Uptake of uranium is restricted to the root system and could actually represent adsorption to the outer root membrane rather than incorporation into the interior of the root system (Sheppard et al. 1983). Washing the vegetable surfaces will remove most of this uranium; peeling vegetables will essentially result in complete removal. No significant translocation of uranium from soil to the above-ground parts of plants has been observed (Van Netten and Morley 1983).

ATSDR's calculations for incidental soil ingestion found that over a 30-year period an adult eating 50 mg of soil per day and a child eating 100 mg of soil per day contaminated with 320 pCi/g of DU would not result in doses causing health effects. Similarly, contaminated dust from the air emissions landing on fruits and vegetables would not have caused health effects in people who ate those fruits and vegetables. The DU amount would have been small and, as discussed previously, ingesting small amounts of water-insoluble forms of uranium would not cause illness.

**2. Were people exposed to harmful levels of lead in the past, currently, or in the future by breathing air emissions from the NL plant, contacting soil when playing or gardening, and eating fruits and vegetables grown in lead-contaminated soil?**

*NL operated its foundry until 1960. During this time it is very likely that no air emissions were measured at the plant. Because no data on lead emissions in the air from the plant are available, ATSDR cannot draw any conclusions about the health effects of breathing the former lead-air emissions from the NL plant. That said, however, it is important to note as well that when the foundry stopped operating in 1960, the lead emissions also stopped.*

*In May 2003 NYSDOH and NYSDEC sampled soil in the Yardboro Avenue area for lead and other metals. ATSDR reviewed the data and found that the levels of lead found in these areas are not at levels that would cause adverse health effects. NYSDEC and NYSDOH will sample more areas for lead in soil during summer or fall of 2004.*

***What kinds of health effects are caused by lead?***

Studies on the health effects of lead are based on blood-lead levels (expressed as µg/dL or micrograms per deciliter), not the amount of lead detected in, for example, soil, air, or water. Several factors can determine whether someone will become ill from coming into contact with, or from being exposed to a chemical. These include how much of the chemical gets into the body (dose), the length of time someone is exposed (frequency), and for how long someone is exposed (duration).

Whether lead enters the body through breathing or eating, the effects are the same. In both adults and children the main target for lead is the central nervous system. Lead exposure can cause anemia. At high levels of exposure, lead can damage the kidneys and brain in both children and adults. In pregnant women, high levels of lead exposure can cause miscarriage.

Children are more sensitive to the effects of lead than are adults. Even low levels of exposure can affect a child's mental and physical growth.
Children are also more vulnerable to lead exposure. If their mothers have lead in their own bodies, children can be exposed to lead in the womb. Through breast milk, nursing mothers can pass the lead in their bodies to their babies. Children are also prone to hand-to-mouth behavior, which can increase their uptake of lead (CDC 1991). Fetuses exposed to lead in the womb, because their mothers had a lot of lead in their bodies, may be born prematurely and have lower weights at birth. Exposure in the womb, in infancy, or in early childhood may also slow mental development and lower intelligence later in childhood ATSDR 1999a).

**What is lead?**

Lead is a naturally occurring bluish-gray metal found in small amounts in the earth's crust. It has no characteristic taste or smell. It is often used in batteries, pipes, brass, solder, and paints. The amount and wide-ranging use of lead has decreased over the last several years because of the harmful neurotoxic effects of lead in people (ATSDR 1999a).

In the scientific community, whether lead is a carcinogen remains a debated issue. Some animal studies have shown positive results for the carcinogenic effects of lead. Questions remain, however, about the relevancy of the animal studies to humans. The extremely high cumulative doses of lead used in these studies are difficult to extrapolate to low-level exposure in humans, and thus do not provide a sufficient basis for quantitative risk assessment. It is possible that the high doses required to induce renal tumors may themselves have produced a carcinogenic effect that was independent of any direct effect of lead as a result of non-specific tissue damage. Furthermore, the relevance of male rat kidney tumors induced by some chemicals to humans has been questioned. There is some indication that the mechanism by which lead induces tumors in the rat kidney involves species-specific proteins that would not be relevant to humans (ATSDR 1999a).

In studies with well-documented, high occupational lead exposures, the evidence is somewhat suggestive of an association with lung, stomach and kidney cancer, but it remains limited. The lead compounds, exposure routes, and the levels of exposure were not always reported. Furthermore, concurrent exposure to other chemicals (including arsenic, particularly in lead smelters) and confounding variables, such as smoking, were often not evaluated. As a result, currently available studies in animals and exposed workers do not support an assessment of the

potential carcinogenic risk of lead for residents near the Colonie Site (ATSDR 1999a; Steenland and Boffeta 2000).

***Besides the former NL plant, are there other sources of lead exposure that community members should be aware of?***

In 1978, the U.S. government banned lead from use in paint; lead-based paint was shown to be a major contributor to lead poisoning in children. Many of the homes in the residential areas surrounding NL were built before 1950 and could contain both interior and exterior lead paint. In addition, burning leaded gasoline was a major, albeit former source of lead emissions. Since the mid-1980s the EPA has banned the use of lead in gasoline. Still, lead from these emissions could be present in soils near highways and major roads.

***How much lead was released in air emissions from the NL plant?***

As stated, NL terminated foundry operations in 1960. No information is available on the levels of air emissions of lead from NL's foundry operations; the foundry operated before many of the current air pollution control regulations were created. While searching for information about the NL plant ATSDR staff reviewed records at several state and local agencies, including NYSDEC Headquarters and Region 4 offices, NYSDOH, ACHD, and NYSDOL. ATSDR found no information about NL lead air emissions. ATSDR also reviewed many reports relating to the Colonie Site, but found little information about NL's processes that involved lead.

***In the past, did people breathe harmful levels of lead?***

Again as stated, because the NL plant operated when environmental regulations addressed only a small number of pollutants and emission sources, no information is available (e.g., stack test results, production data, and ambient air monitoring records) about what emissions were released. Therefore, ATSDR cannot draw any conclusions about the levels of lead to which people might have been exposed from air emissions.

If, however, lead was burned in a process similar to that used for DU, lead oxide would have been formed. Lead oxide is a form of lead readily absorbed by the body. If people breathed lead oxide, health effects could have included kidney disease, central nervous system effects, and impaired mental development in children.

But it is important to note again that NL closed its foundry in 1960. Thus after 1960, no hazard would have existed from the air emissions. Similarly, no current or future air emission health hazard has been detected.

***How could lead have entered the soil?***

As with uranium, lead could have entered the soil from air emissions from the NL plant. In air, lead exists as very small dust-like particles. These particles fall out of the air and onto—among other things—surface water, plant surfaces, and soil. Lead can also end up in the soil from the weathering and chipping of lead-based paint and from past emissions of motor vehicles burning leaded gasoline. Because lead is a heavy metal, it typically stays in the top 2 inches of soil and does not migrate (ATSDR 1999a).

***What are the levels of lead in the soil surrounding the Colonie Site?***

In 1992, the NYSDOH tested four locations for metals in the soil: West Highland Park, the church on Yardboro Avenue, a Kraft Road location near Alsade Supply, and a residence on

Fairfield Avenue. The results showed levels at least three times below what would be of concern in an urban area. But these samples were not all from areas that would likely have had the highest level of deposition, nor were they all from properties that had high levels of DU.

During the 1980s the soil removal from DU-contaminated properties would likely have removed lead-contaminated soil as well, but lead contamination could remain at properties that were not cleaned up. In May 2003 NYSDOH and NYSDEC sampled soil for lead in areas surrounding the former NL plant. This sampling effort included locations that were remediated for uranium contamination as well as locations that did not require remediation. All of the properties sampled are within the area of DU deposition from the former NL plant. Samples taken from remediated areas were collected 3–6 inches below the ground surface. Samples from non-remediated areas were collected at 0–3 inches below the ground surface. The samples showed lead levels that are typical of urban areas.

**Table 3: May 2003 Soil Sampling results for Lead in Residential Areas Near the Colonie Site**

| Area of sampling | Number of sampling locations | Concentration Range (mg/kg) | Average (mg/kg) | Sample Depth (inches) |
|---|---|---|---|---|
| Non-remediated | 3 | 230-510 | 373 | 0-3 |
| Remediated | 5 | 71-250 | 135 | 3-6 |

***Would there be health effects from touching lead-contaminated soil while playing or gardening?***

Lead can not easily get into the body through the skin (ATSDR 1999a). People can, however, incidentally ingest lead by touching lead-contaminated soil and then exhibiting hand-to-mouth behavior (see below).

***Would health effects result from eating lead-contaminated soil found near the Colonie Site?***

When people put their hands in their mouths, smoke cigarettes, or eat food after touching soil and before washing their hands, they can incidentally eat soil. Children are especially prone to this type of hand-to-mouth behavior. Some young children can exhibit soil-pica behavior in which they intentionally eat large amounts of soil and other non-food items.

ATSDR considers widespread soil lead levels above 400 mg/kg to be of potential health concern for children who are likely to be exposed from their activities and who are most sensitive to the health effects of lead. It is important to note, however, that lead-contaminated soil covered by grass and other vegetation is less likely to be accessible for incidental ingestion and is not considered a completed exposure pathway. Also, people— especially children—do not spend all of their time in the same location and would be exposed to an average of the concentrations rather than the highest concentration. Therefore, areas of soil with lead levels above 400 mg/kg will not necessarily cause health effects. Still, because one of the soil samples exceeded this value, ATSDR estimated lead exposure doses from incidentally eating soil. Because there is no ATSDR MRL for lead exposure, ATSDR estimated blood lead levels based on the doses. For more information about these calculations and assumptions, please see Appendix D.

ATSDR calculated the estimated blood lead levels from incidentally ingesting soil with 373 mg/kg of lead, the average of the surface soil samples. Epidemiological studies have identified harmful effects of lead in children at blood lead levels at least as low as 10 µg/dL. Using these studies, the Centers for Disease Control and Prevention (CDC) recommends that action be taken for blood lead levels of 10 µg/dL or higher. The estimated blood lead levels from exposure to soil near the Colonie Site are well below CDC's recommended action level of 10 µg/dL. This estimate is very protective and assumes that the concentrations sampled are accessible to children—i.e., bare soil rather than grass cover. Therefore, ATSDR believes that children will not have health effects from incidentally ingesting lead-contaminated soil.

Although the average of the soil sampling is below the EPA 400-ppm screening level for lead in residential soil and any health effects from incidentally ingesting lead-contaminated soil are not expected, this value may not be protective of children who consume large amounts of soil during episodes of soil-pica behavior. When evaluating exposures, ATSDR considered a wide range of human activities that might increase exposure to contaminants in soil. One activity that may increase concern, particularly in preschool children, is an uncommon behavior called soil-pica, which is the intentional ingestion of large amounts of soil. This behavior occurs in some children as part of their normal exploratory behavior as 1 and 2-year-olds, or as part of intentional behavior in older preschool children (3 to 4 year-olds). The reasons why some children engage in soil-pica behavior is not known. Scientists suspect that soil-pica behavior may have something to do with nutritional deficiencies, psychological needs, or cultural factors (Danford 1982), but none of these links have been proven or shown to be responsible for all soil-pica behavior. Soil-pica behavior is most likely to occur in preschool children, but it can occur in older children and even in adults. The exact number of children who go through a stage of pica behavior is not known. Studies have reported that this behavior occurs in as few as 4% of children or in as many as 21% of children (Barltrop 1966, Robischon 1971, Shellshear 1975, Vermeer and Frate 1979). Using statistics, two scientists have estimated as many as 33% of preschool children will have soil-pica behavior once or twice during their preschool years (Calabrese and Stanek 1998). They admit, however, that their 33 percent may overestimate the percentage of children who engage in 1 to 2 days of soil-pica behavior (Calabrese and Stanek 1993, Danford 1982, EPA 1997). The percentage of children living near the Colonie Site with soil-pica behavior is unknown.

Limited information is also available for how often (i.e., frequency) and how long (i.e., duration) soil-pica children will have this behavior. Some preschool children might eat soil once during their preschool year while others might go through a stage of eating soil several times during a week or over several months. It is reasonable to assume that soil-pica behavior might occur for several days in a row, or a child might skip days between eating soil (Calabrese and Stanek 1998; Calabrese and Stanek 1993; Wong 1989, ATSDR 1992.) In addition, general pica behavior is greatest in 1- and 2-year-old children and decreases as children age during their preschool years (Barltrop 1966).

It is difficult to evaluate the effects of soil-pica in lead-contaminated areas because there is no MRL, and little scientific data about the acute effects of large doses of lead-contaminated soil. ATSDR did not, therefore, evaluate soil-pica using dose or blood lead calculations. However, there are important factors that can affect the amount of lead-contaminated soil ingested in soil-pica children. For instance, most homes in the residential area around the Colonie Site have yards with grass cover, although there may be patches of exposed soil. Bare spots in the yard are the most likely areas that children with soil-pica behavior who live in lead-contaminated

properties could easily have direct access to contaminated soils. Moreover, since winters in Colonie are generally cold, soil-pica behavior is less likely to occur during this time and probably most likely to occur during the warmer summer months, when preschool children are most likely to play outside. In addition, the timing of a soil-pica event must coincide with a child being in a highly lead-contaminated area with bare soil, and the soil-pica child must ingest soil from the same location with high soil concentration rather than being exposed to an average from several locations.

As discussed below, NYSDOH reviewed blood lead results for children in the area surrounding the Colonie Site and found no elevated blood levels in the vicinity of the site. This indicates that soil lead does not appear to be a significant contribution to lead dose, even if soil-pica was prevalent. If a parent believes that a child exhibits soil-pica behavior, there are steps can be taken to limit exposure to soil that may be contaminated. This includes ensuring that a cover, such as grass, clean soil, gravel, or mulch, is maintained on bare soils, especially in areas where children are likely to play. They can also make sure children do not put soiled hands in their mouths.

***Has there been any blood lead testing of children living near the Colonie Site?***

CDC recommends that states develop a plan to find children who could be exposed, and have their blood tested for lead. CDC makes basic recommendations for states to follow, including testing all children at ages 1 and 2. Children who are 3 to 6 years old should be tested if they have never been tested for lead previously and they receive services from public assistance programs such as Medicaid or the Supplemental Food Program for Women, Infants and Children (WIC). Also, children should be tested if they live in a building, or frequently visit a house, built before 1950, if they visit a home (house or apartment) built before 1978 (when lead was removed from paint) that has been recently remodelled, or if they have a brother, sister, or playmate who has had lead poisoning (ATSDR 1999a).

The NYSDOH Childhood Lead Poisoning Prevention Program follows CDC guidelines. New York State requires all health care providers to test all one and two-year old children for lead. In New York, approximately 60–70% of children are tested for lead prior to age 2. While these rates vary across the state, they are generally highest in the neighborhoods which have the greatest risk of exposure. NYSDOH obtained the test results of children who were born between 1994 and 1997 and tested for lead prior to age two in the three ZIP Codes surrounding NL Industries: 12203, 12205, and 12206. The addresses were located on a map, and those children who lived within one mile of NL Industries were selected for further analysis. Four out of 206 children in the area (1.9%) had blood lead levels greater than or equal to 10 micrograms per deciliter (mcg/dL). Given these results, children living in the neighborhood near NL Industries do not appear to be at increased risk of lead exposure. For more information, please see NYSDOH's information paper on this subject in Appendix F.

***Would health effects result from eating fruits and vegetables grown in lead-contaminated soil or contaminated with lead from air emissions?***

When dust containing lead falls onto crops, that lead can end up on plants. If people eat the dirt and dust on the surface of those crops they can be exposed to lead. To reduce this type of exposure, washing and peeling fruits and vegetables is a good precautionary measure (WHO 1999). Again, this would have been of most concern prior to 1960 when the foundry was operational.

Lead also can be taken up by edible plants grown in lead-contaminated soil. The roots typically absorb the lead. The availability of lead to plants in soil is limited because lead strongly adsorbs to the soil's organic matter, but the availability increases as the pH and organic matter in the soil are reduced. ATSDR reviewed the U.S. Food and Drug Administration's (FDA) Total Diet Study results and found that lead in fruits and vegetables of the American food supply typically ranges from non-detect to 12 mg/kg (FDA 2000). Another study reported that lettuce grown in soil with less than 400 mg/kg of lead and radishes grown in soil with less than 800 mg/kg of lead had lead levels equal to or less than those found in the FDA's report (Nwosu et al 1995).

A recent study was conducted in which many different fruits and vegetables were grown in lead-contaminated soil ranging from 27 to 4850 mg/kg. The results showed that all garden vegetable plants grown in contaminated soil accumulate lead to some level, and that the majority of the contamination is in the plant root. Smaller levels of lead were found in the plant shoot, with low to non-detectable levels in the edible fruit (e.g. tomatoes, peppers, beans, and zucchini). Plants with edible leaves (e.g. collard greens, Swiss chard), herbs (e.g. mint, cilantro), and edible roots (e.g. carrot, radish, onion) had the highest levels of lead. ATSDR reviewed the study data of fruits and vegetables grown in soils with lead levels similar to those currently found near the Colonie Site (Finster et al. 2004). The majority of the edible portions of these plants had lead levels either below the detection limit or similar to those found in the FDA Total Diet Study. Based on these studies and the lead levels found in the soil near the Colonie Site, ATSDR believes that edible plants grown in the lead-contaminated soil will not absorb significant amounts of lead. Therefore, eating these plants will not cause health effects.

ATSDR does not have any data for lead in the soil during the period when the NL plant was operational. Therefore, ATSDR cannot make a determination about the levels of lead that could have been found in home-grown fruits and vegetables in the past. However, the highest levels of lead in the soil would have most likely been removed when the areas around the NL plant were remediated for DU-contaminated soil.

Gardeners who still have concerns about contaminants in their gardens can take certain precautions to minimize the uptake of lead. Plants can be grown in raised beds filled with uncontaminated soil. Mulch or a weed tarp can be used in garden beds to reduce the potential for soil dust blowing onto plants. Also, locate gardens away from buildings, especially if peeling paint is evident.

**3. Currently and in the future, could people potentially breathe indoor air with volatile organic compounds (VOCs) from contaminated groundwater?**

*Because groundwater contamination had migrated off site, ACE took two rounds of indoor air samples from five homes near the Colonie Site. The results showed no current public health impact from exposure to VOCs in the indoor air. In addition, a model used to predict indoor air concentrations from the highest values found in groundwater suggests that VOCs in indoor air would not be expected to reach levels that would cause health effects.*

***How did the groundwater become contaminated and where is the contamination now?***

Spills and releases of VOCs at the former NL plant saturated the soils and seeped into underground water (groundwater). The contamination is in the groundwater under the southern portion of the site and has migrated off site, under Yardboro Avenue.

***Can I be exposed to VOCs if I live in an area near the groundwater plumes?***

Under some conditions, VOCs can travel upward from the groundwater, through the soil, and into the air of subsurface spaces. For example, vapors can seep into basements through cracks in the foundation or around the sump pump. If VOCs had reached indoor spaces of houses, residents living in the housing units could come into contact with them by breathing air containing these compounds.

In July and August of 2002, ACE sampled the indoor air of five residences adjacent to the Colonie Site to determine if VOCs from the contaminated groundwater had affected the indoor air quality of those homes (Table 4). Eight-hour samples were taken from the basements, where the highest levels would be expected. All windows in the basements were closed. Contaminants sampled were tetrachloroethene (PCE), trichloroethene (TCE), vinyl chloride (VC), cis-1,2-dichloroethene (cis-1,2-DCE), benzene, toluene, ethylbenzene, and xylene.

**What are VOCs?**

Volatile organic compounds, or VOCs, are a group of chemicals having similar physical properties. VOCs readily evaporate or volatilize into gases when exposed to air. Chemicals in this group include trichloroethene (TCE), dichloroethene (DCE), tetrachloroethene (PCE), benzene, methylene chloride, and vinyl chloride and in general may be used as dry-cleaning solution, additives in fuels, or as solvents to dissolve grease or other compounds.

Exposure to VOCs at high levels can affect the central nervous system, resulting in fatigue, dizziness, headache, and nausea. Liver and kidney damage has been seen in animals exposed to very high levels of VOCs. Although VOCs such as TCE and PCE have not been shown to cause cancer in people, some animals have developed cancer from exposed to these chemicals.

Because contaminant concentrations in indoor air can potentially be higher during the winter months, in January 2003 ACE again sampled the five homes (Table 4). Eight-hour samples were collected from the basements, where the highest levels would be expected. Again, all windows in the basements were closed. The heating systems remained operational during the sampling period.

ATSDR compared the values from the two sampling rounds to ATSDR's comparison values. ATSDR's comparison values do not represent thresholds of toxicity. They are strictly screening values used to facilitate the initial selection of site-specific chemical substances for further evaluation of potential health effects. After the chemicals exceeding the screening values have been identified, they must be individually scrutinized in more detail to determine whether, under site-specific conditions, they represent a realistic threat to human health. Although concentrations at or below ATSDR's comparison values could reasonably be considered safe, it does not automatically follow that any concentration above a comparison value will necessarily produce toxic effects. Comparison values are intentionally designed to be orders of magnitude lower than the corresponding no-effect levels determined in laboratory experiments.

| Table 4: Residential VOC indoor air sampling conducted by ACE* | | | | | | |
|---|---|---|---|---|---|---|
| **July/August 2002 Sampling Round** | | | | | | |
| **Compound** | **Location 1 (µg/m$^3$)** | **Location 2 (µg/m$^3$)** | **Location 3 (µg/m$^3$)** | **Location 4 (µg/m$^3$)** | **Location 5 (µg/m$^3$)** | **ATSDR's comparison values for air† (µg/m$^3$)** |
| PCE | 0.45 | 0.31 | 1.0 | 0.23 | 0.29 | 300 |
| TCE | ND (0.19) | ND (0.19) | ND (0.18) | ND (0.24) | ND (0.19) | 500 |
| cis-1,2-DCE | ND (0.14) | ND (0.14) | ND (0.14) | ND (0.14) | ND (0.14) | 37 |
| VC | ND (0.044) | ND (0.044) | ND (0.044) | ND (0.045) | ND (0.044) | 0.1 |
| Benzene | 3.4 | 1.6 | **48** | 2.3 | 1.7 | 30 |
| Toluene | 25 | 9.4 | 210 | 18 | 16 | 300 |
| Ethylbenzene | 6.3 | 1.8 | 31 | 1.5 | 2.2 | 1000 |
| Xylene (total) | 32.9 | 8.3 | 156 | 3.75 | 9.3 | 400 |
| **January 2003 Sampling Round** | | | | | | |
| **Compound** | **Location 1 (µg/m$^3$)** | **Location 2 (µg/m$^3$)** | **Location 3 (µg/m$^3$)** | **Location 4 (µg/m$^3$)** | **Location 5 (µg/m$^3$)** | **ATSDR's comparison values for air (µg/m$^3$)†** |
| PCE | 12 | 0.52 | 0.44 | 0.29 | 0.2 | 300 |
| TCE | 0.22 | ND (0.17) | ND (0.15) | ND (0.17) | 0.58 | 500 |
| cis-1,2-DCE | 0.21 | ND (0.12) | ND (0.11) | ND (0.13) | 0.48 | 37 |
| VC | ND (0.04) | ND (0.04) | ND (0.036) | ND (0.041) | 0.057 | 0.1 |
| Benzene | 5.3 | 3 | 5 | 2.9 | 3.4 | 30 |
| Toluene | 8.5 | 7.4 | 16 | 23 | 71 | 300 |
| Ethylbenzene | 2.3 | 1.4 | 3.5 | 1 | 2.5 | 1000 |
| Xylene (total) | 10.9 | 5.9 | 17.1 | 7.1 | 11.3 | 400 |

* ACE 2003. All results are in µg/m$^3$. Values in parentheses are the detection limits.
† PCE – chronic environmental media evaluation guide (EMEG); TCE – intermediate EMEG; cis-1,2-DCE – EPA Region 9 Preliminary Remediation Goal (PRG), EPA 2002c; VC – cancer risk evaluation guide (CREG); Benzene – chronic reference media evaluation guide (RMEG); Toluene – CREG/MRL; Ethylbenzene – chronic RMEG; Xylene (total) – chronic RMEG.

The Location 3 sample from the July/August 2002 sampling round exceeded ATSDR's comparison for benzene. All the other levels were below ATSDR's comparison value. Because the benzene sample exceeded the comparison value, ATSDR calculated exposure doses for adults and children in this location and compared them to EPA's Region 3 reference doses. Location 3 is a church and, according to church officials, the basement of the building is occupied less than two hours per week (ACE 2003). To be health protective, ATSDR assumed an occupation of 6 hours per week (e.g. three 2-hour meetings per week, or one 6-hour meeting). The results of the calculations indicate that there is no risk from exposure to benzene at Location 3. Please see Appendix D for more information about the exposure dose calculations.

ATSDR does not believe that there is currently any public health impact from VOCs in indoor air from groundwater contamination. Health effects are not likely in the future, either; ACE is currently evaluating the groundwater and a feasibility study/proposed plan will be issued in 2006. Actions taken as a result of the plan will reduce the chance that higher VOC levels will migrate toward the Yardboro Avenue homes. In addition, the public will haven an opportunity to comment on this plan.

***My home was not sampled. How do I know I won't get sick from VOCs in the indoor air?***

ATSDR applied a simple vapor intrusion model—the Johnson and Ettinger model—to 1) predict indoor air concentrations based on the maximum groundwater concentrations (located on site), 2) predict indoor air concentrations based on the groundwater concentrations near the Yardboro Avenue homes, and 3) predict indoor air concentrations based on the sub-foundation soil gas samples taken during the July/August 2002 sampling round. The groundwater levels used in the model were at least a factor of 10 greater than levels found in groundwater monitoring wells near Yardboro Avenue. Using the results of this model, VOCs in indoor air would not be expected to reach levels that would cause health effects. For more information about this model and the results, please see Appendix E.

***What is being done about the groundwater contamination?***

As discussed in the Background section of this health evaluation, ACE has developed a Remedial Investigation Report for the groundwater. Sampling in off-site monitoring wells indicates groundwater contaminated at low levels had migrated off site. ACE will develop a feasibility study to evaluate alternatives to clean up this contaminated groundwater. A variety of techniques are available to remove or destroy groundwater contaminants to ensure that human health and the environment are protected. Alternatives include using naturally occurring bacteria to degrade the contaminants, injecting other chemicals into the ground to destroy the VOCs, and extracting and treating the groundwater.

In addition, ACE prepared a baseline Human Health Risk Assessment and a Screening-Level Ecological Risk Assessment to evaluate actual and potential effects on human health and the environment posed by the Colonie Site. The risk assessment evaluates the potential risk to human health from exposure to chemicals by residents currently living near the site. The human health risk assessment considered on-site and off-site land use scenarios. The on-site scenario assumes potential future residential development of the site, with a variety of exposure pathways evaluated. The off-site scenario evaluated vapor intrusion from volatile organic chemicals from shallow groundwater exposure since off-site residences use public water for drinking and showering purposes.

The draft final Risk Assessment for the Colonie Site was released to NYSDEC and the NYSDOH for review in early April 2004. The final Risk Assessment was released to the public in September 2004.

## Community Health Concerns

During site visits and telephone conversations with community members, ATSDR identified five community concerns related to the Colonie Site. These are discussed below.

1. **Community members are concerned that past emissions from the site have caused adverse health effects such as various types of cancer, birth defects, Down syndrome, rashes, and endometriosis.**

ATSDR reviewed the available scientific information about the health effects associated with both uranium and lead. Given this information and the data available for the Colonie Site, ATSDR concludes that breathing the DU air emissions from the NL plant could have increased the risk of certain health effects in the community surrounding the plant. Although, as discussed previously, the extent to which these risks were increased is unknown. But the uranium used at

the plant was not water-soluble and would not have been easily absorbed by the body. In addition, many studies of uranium miners, millers, and processors showed no damage to skin after touching uranium. No currently available studies show a link between uranium and birth defects, Down syndrome, or endometriosis.

In both adults and in children the main targets for lead are the central nervous system and the kidney. No currently available studies show a link between lead and birth defects, Down syndrome, or endometriosis. However, fetuses exposed to lead in the womb, because their mothers had a lot of lead in their bodies, may be born prematurely and have lower weights at birth. Exposure in the womb, in infancy, or in early childhood may also slow mental development and lower intelligence later in childhood.

Community members have also expressed concern that because they were exposed to contaminants from the NL plant, they could have passed on health effects to their children and grandchildren. Unborn children can be exposed to lead through their mothers. But DU and lead are not known to cause any kinds of genetic effects and there is no evidence that health effects would be passed on to children and grandchildren in this way. There is also no evidence from animal studies that lead or DU cause malformation of a developing embryo or fetus.

**2. Residents are concerned that possible lead contamination in their yard could harm children and grandchildren.**

In May 2003 NYSDOH and NYSDEC sampled soil in the Yardboro Avenue area for lead and other metals. ATSDR reviewed the data and found that the levels of lead found in these areas are not at levels that would cause adverse health effects. In addition, NYSDOH obtained the test results of children who were born between 1994 and 1997 and tested for lead prior to age two in the three ZIP Codes surrounding NL Industries: 12203, 12205, and 12206. The addresses were located on a map, and those children who lived within one mile of NL Industries were selected for further analysis. Four out of 206 children in the area (1.9%) had blood lead levels greater than or equal to 10 micrograms per deciliter (mcg/dL). Given these results, children living in the neighborhood near NL Industries do not appear to be at increased risk of lead exposure. For more information about lead contamination in soil, please see the previous discussion section on lead in this document.

Lead paint is a major contributor to lead poisoning in children. Through hand-to-mouth behavior children can eat the sweet-tasting lead paint chips, or eat they can lead paint dust. Many of the homes in the residential areas surrounding NL were built before 1950 and could contain both interior and exterior lead paint.

Even though the data do not indicate excessive levels of lead or other chemicals in soil around the NL facility, following safety measures to prevent exposure is always a good idea. These measures should include: (1) using ground cover/grass in your yard, particularly in children's play areas; (2) using sandboxes that contain solid bottoms, top covers, and clean sand; (3) using doormats for wiping feet before entering the house; (4) reducing household dust by wet mopping and dusting; (5) having children wash hands thoroughly after playing outside and before eating; and (6) washing and peeling all home grown vegetables before eating.

CDC recommends that states develop a plan to find children who could be exposed to lead and have their blood tested for lead. They make basic recommendations for states to follow, including testing all children at ages 1 and 2. Children who are 3 to 6 years old should be tested

if they have never previously been tested for lead. Children should also be tested if they receive services from public assistance programs such as Medicaid or the Supplemental Food Program for WIC, if they live in a building or frequently visit a building built before 1950, if they visit a home (house or apartment) built before 1978 that has been recently remodelled, or if they have a brother, sister, or playmate who has had lead poisoning (CDC 1991).

The NYSDOH Childhood Lead Poisoning Prevention Program follows CDC guidelines. Similarly, ATSDR recommends that parents concerned about their children's exposure to lead follow these guidelines and have their children's blood lead levels tested by their health care provider.

**3. Several community members are concerned that children playing on the NL property could have been exposed to contaminants in the past. A citizen's group is also concerned that children played with pellets of DU and abandoned drums on the property.**

Unfortunately, no information is available concerning the contents of any drums on the property while NL was in operation. However, we do know that the contact would have likely been short-term. Typically, illness as a result of exposure to chemicals comes from long-term daily exposure over many years. This would have been unlikely considering that most children would have played in the area for brief periods during the week (i.e., on weekends and after school in non-winter months) during their childhood years. Short-term, or acute, exposures will generally result in immediate illnesses only if the dose is very high.

ATSDR reviewed information from DOE's 1991 soil remediation investigation for the Colonie Site. The levels of both lead and depleted uranium in the on-site soil are high (see Table 5 below). ATSDR calculated exposure doses from incidental ingestion based on the average value for a child playing on the NL property one day per week, 32 weeks per year (see Appendix D). The doses were well below levels that would be of health concern. ATSDR did not include an evaluation for soil-pica because children who exhibit this behaviour tend to be very young and would most likely not be playing unsupervised on the NL property.

**Table 5: Lead and DU levels found in soil on the Colonie Site**

| Contaminant | Maximum | Minimum | Average | Number of samples |
|---|---|---|---|---|
| Lead (mg/kg) | 34,800 | 24.5 | 3600 | 58 |
| DU (pCi/g) | 530 | 1 | 71 | 131 |

As discussed in previous sections, the DU used at the NL plant was water-insoluble. We know from scientific studies that touching or incidentally eating it would not have made people sick. Even if an adult or child were to swallow a small pellet of DU, we would not expect to see health effects. Several studies at the University of Maryland followed 1991 Gulf War veterans who had pieces of DU embedded in their bodies from combat injuries. The veterans with embedded uranium shrapnel had no differences in renal function as compared with veterans with no retained shrapnel (Hooper et al 1999; McDiarmid et al 2001a; McDiarmid et al 2001b; McDiarmid et al 2004). In addition, there were no differences in blood chemistry and hematology tests, hormone tests, and semen analyses (McDiarmid et al 2001a). Neurocognitive tests in earlier studies showed a relationship between performance and urine uranium. However, neurocognitive tests in a later round of the studies showed no significant differences between

those with embedded uranium shrapnel and those without (McDiarmid et al 2001a; McDiarmid et al 2001b; McDiarmid et al 2004).

4. **A community group is concerned about exposure to DU, lead, and other possible contaminants in the surface water and sediment while swimming and wading in areas of the Patroon Creek watershed, including in and around the Patroon Reservoir and Tivoli Preserve.**

The Patroon Creek watershed is located in an industrial area and is subject to contamination from several point and non-point sources of pollution. Although not classified by New York State for primary contact recreation, it is reported that some parts of the Patroon Creek and Patroon Reservoir have been used for many years for swimming and wading by people living nearby. ATSDR has not heard reports of people fishing in Patroon Creek for food.

A local university researcher collected one continuous 3-meter sediment core from the Patroon Reservoir, which is a little more than ½ mile downstream from the Colonie Site and the MerCo state superfund site. A second sediment core was collected adjacent to the first in order to overlap any breaks in the first core. Uranium, lead, cadmium, and mercury were found in the core sample taken from below the sediment surface (Arnason and Fletcher 2003). The maximum levels of these contaminants are shown in Table 6, below.

**Table 6: Maximum concentrations in sediments from the Patroon Creek Reservoir***

| Compound | Maximum concentration (mg/kg) | Depth of maximum concentration† (m) | EPA Region 9 PRGs for residential soil‡ (mg/kg) |
|---|---|---|---|
| Uranium | 320 | 1.7 | 16 |
| Lead | 3600 | 1.9 | 400 |
| Cadmium | 25 | 1.5 | 37 |
| Mercury | 13 | 0.8 | 23 |

* Arnason and Fletcher 2003
† Depths are approximate
‡ EPA 2002c; concentration for uranium is for soluble uranium compounds; value for lead is from the EPA Region 9 Preliminary Remediation Goals (PRGs), EPA 2002c

Although the maximum concentrations for uranium and lead exceed the EPA Region 9 Preliminary Remediation Goals (PRGs), it is important to note that the PRGs are health-protective concentrations for residential soil; they are not applicable to sediments under approximately 2.5 meters (or 8.2 feet) of water. The maximum concentrations were found in samples approximately 0.8 to 1.9 meters (or 2.6 to 6.2 feet) below the sediment/water interface. This means that although the levels of contaminants are high, people cannot presently encounter these contaminants in the sediment. The contaminant levels at the sediment/water interface are approximately 2 mg/kg of uranium, 90 mg/kg of lead, 1 mg/kg of cadmium, and 0.6 mg/kg of mercury. In addition, researchers have found no evidence of sediments resuspended from the bottom of the Patroon Reservoir (Arnason and Fletcher 2003). This means that the contaminants will not be resuspended in the water and do not currently pose a health risk. It is important to remember, however, that the Patroon Creek watershed is located in an industrial area and is subject to contamination from several point and non-point pollution sources.

Past contamination levels in the water and in the sediment are unknown. The Patroon Creek watershed was in an industrialized area with few environmental safeguards. The ACE sampled

sediments in the unnamed tributary leaving the Colonie Site and parts of Patroon Creek and found all samples to be below the 35 picocuries per gram (pCi/g) cleanup level.

5. **Several community members requested that ATSDR conduct a community health survey to assess the impacts of exposure from NL on their health.**

ATSDR does not believe that conducting a community health survey will answer the community's questions about whether or not the NL plant impacted their health. Different diseases have different causes and based on scientific studies, we know that exposure to uranium can increase the risk of kidney disease. In addition, the combination of inhaling DU dust and cigarette smoke could have increased risk of lung cancer. This is because of the irritant effect of the dust particles combined with the cigarette smoke. It has not been shown to cause other types of cancers. A door to door health survey could help to describe the health status of a particular community but would not explain why the health effects occurred.

Designing a health study to determine the risk factors that contributed to the occurrence of disease in the community near the former NL would be difficult. A health study designed to evaluate the relationship between chemical releases from NL and health effects would not likely answer the question for several reasons. First, reliable information on past exposure is not known. Second, because the community directly surrounding the former NL facility is small, an epidemiologic, or statistical, study of area residents would not be likely to show any health effects that could be directly linked to emissions from the plant. Even if cases of kidney disease and lung cancer were found, it would be difficult to determine whether they were related to a specific environmental cause or to the natural incidence of disease within the general population.

Finally, kidney disease, a health effect shown to be related to uranium exposure in the scientific literature, would likely not be seen in the community currently since releases into the air stopped in 1984. The New York State Department of Health has conducted three reviews of cancer incidence in the area around the former NL. These analyses have shown elevations in lung cancer. A health study in a small population would make it very difficult to evaluate lung cancer further since smoking is a strong causal factor and past analyses by New York State Department of Health indicated that a large proportion of people with lung cancer were also smokers.

## Child Health Considerations

In communities faced with air, water, or food contamination, the many physical differences between children and adults demand special emphasis. Children could be at greater risk than are adults from certain kinds of exposure to hazardous substances. Children play outdoors and sometimes engage in hand-to-mouth behavior that increases their exposure potential. Children are shorter than are adults; this means they breathe dust, soil, and vapor close to the ground. A child's lower body weight and higher intake rate results in a greater dose of hazardous substance per unit of body weight. If toxic exposure levels are high enough during critical growth stages, the developing body systems of children can sustain permanent damage. Finally, children are dependent on adults for access to housing, for access to medical care, and for risk identification. Thus adults need as much information as possible to make informed decisions regarding their children's health. ATSDR is committed to evaluating children's sensitivities at areas such as the Colonie Site.

ATSDR has attempted to identify populations of children in the vicinity of the Colonie Site and any public health hazards threatening these children. Some 710 children aged 6 and younger live

within a 1-mile radius of the Colonie Site. All calculations, health guidelines, and comparison values consider the sensitivities of children.

The calculations for exposure to DU in the soil discussed in the text were also performed for children. ATSDR concluded that no adverse health effects are expected to occur in children who contact DU-contaminated soil when playing or gardening, or when eating fruits and vegetables grown in DU-contaminated soil.

The calculations for exposure to lead in the soil discussed in the text were also performed for children. ATSDR concluded that no adverse health effects are expected to occur in children who contact lead-contaminated soil when playing or gardening, or when eating fruits and vegetables grown in lead-contaminated soil.

The biggest source of lead exposure for children is paint in older homes. Before 1978, paints contained high amounts of lead. Interior and exterior lead-based paint can flake off as chips or dust. Children can be exposed to lead from paint by eating the sweet-tasting lead paint chips or, by eating lead paint dust through hand-to-mouth behavior. Children's exposure can be prevented by keeping the paint in older homes in good repair and using dust- control measures during remodelling of older homes.

ATSDR recommends that parents concerned about their children's exposure to lead follow established guidelines and have their children's blood lead levels tested by their health care provider.

## Conclusions

Please see Appendix A (ATSDR glossary of terms) for definitions of ATSDR's conclusion categories.

1. Although EPA did not have air regulations for DU while the plant was operating, the highest stack releases of uranium for the 1979–1984 period exceeded EPA's current NESHAP guidelines for radionuclides by a large margin. Based on the levels of DU found in soil off-site, and the fact that the NL plant scaled down operations during the late 1970s and early 1980s (DOE 1989b), the earlier air emissions were probably higher than those documented between 1979 and 1984. ATSDR believes that breathing the DU emissions at these high levels could have increased the risk of health effects—especially kidney disease—for people living near the plant. In addition, the combination of inhaling DU dust and cigarette smoke could have increased risk of lung cancer. This is because of the irritant effect of the dust particles combined with the cigarette smoke. Although how much the risk was increased is unknown, ATSDR concludes that the uncharacterized emissions from the NL plant were a **past public health hazard** to the community surrounding the plant. On the other hand, contacting DU-contaminated soil when playing or gardening, or when eating fruits and vegetables grown in DU-contaminated soil, probably would not have caused people to become sick. ATSDR's conclusion category for this exposure is **no apparent public health hazard**.
2. NL operated a foundry until 1960. During this time no air emissions were measured at the plant. Because of the lack of data on lead-air emissions from the plant, ATSDR's conclusion category for breathing lead from air emissions at NL is an **indeterminate public health hazard**. That said, however, it is important to note that when the foundry stopped operations the lead emissions also stopped. In addition, when the vicinity

properties were remediated for DU-contaminated soil, lead contamination would have also been removed.

In May 2003 NYSDOH and NYSDEC sampled soil in the Yardboro Avenue area for lead and other metals. ATSDR reviewed the data and found that the lead in these areas is not at levels that would cause adverse health effects. Using this data, contacting lead-contaminated soil, ingesting lead-contaminated soil, and eating fruits and vegetables grown in lead-contaminated soil is currently **no apparent public health hazard**.

3. Spills and releases of VOCs at the former NL plant saturated the soils and seeped into underground water (groundwater). The contamination is in the groundwater under the southern portion of the site and has migrated off site, under Yardboro Avenue. Under some conditions, VOCs can travel upward from the groundwater, through the soil, and into the air of subsurface spaces. For example, vapors can seep into basements through cracks in the foundation or around the sump pump. If VOCs had reached indoor spaces of houses, residents living in the housing units could come into contact with them by breathing air containing these compounds.

   Because groundwater contamination had migrated off site, ACE took two rounds of VOC-indoor samples from five homes near the Colonie Site. ATSDR compared these results to reference values and used a screening level model to predict indoor air concentrations from the highest values found in the groundwater plume for homes not sampled. The results of these samples and the results from the model showed VOCs in indoor air would not be expected to reach levels that would cause health effects. ATSDR's conclusion category for this exposure is **no apparent public health hazard**.

   ACE has continued to test the indoor air of homes on Yardboro Avenue. In addition, ACE, under the regulation of NYSDEC, will be following a plan of action for groundwater remediation. This will ensure that, in the future, indoor air contamination from VOCs in groundwater will not pose a public health concern to the community.

## Recommendations

1. Because the biggest source of lead exposure for children is paint in older homes built before 1960, ATSDR recommends that children's exposure to lead paint be prevented by keeping the paint in older homes in good repair and using dust- control measures during remodelling of older homes.
2. ATSDR also recommends that parents concerned about their children's exposure to lead have their children's blood-lead levels tested by their health care provider. This includes following CDC's recommendations for testing children who live in houses built before 1950.

## Public Health Action Plan

### Completed Actions

1. Between 1984 and 1988 DOE cleaned up 53 of the 56 DU-contaminated vicinity properties.
2. ACE has conducted three sampling rounds for VOCs in the indoor air in five homes adjacent to the Colonie Site.

3. ATSDR participated in the November 21, 2002 NYSDOH/NYSDEC public meeting discussing the lead-soil sampling plan for properties surrounding the former NL plant.
4. On May 1, 2003 NYSDOH and NYSDEC conducted soil sampling for lead in areas around the Colonie Site.
5. NYSDOH reviewed data for the four most frequently diagnosed cancers in NY from the NYSDOH Cancer Surveillance Improvement Initiative.
6. In the fall of 2003, ACE sampled sediments in the unnamed tributary leaving the Colonie Site and parts of Patroon Creek.
7. In September 2004 ACE released a health risk assessment to evaluate both the human health and the ecological impacts of groundwater contaminants from the Colonie Site.

**Ongoing Actions**

1. ACE is continuing to remediate the soil at the Colonie Site. The estimated completion date for the overall soil cleanup is 2006.

**Planned Actions**

1. ATSDR will work with local physicians and provide information on taking patients' environmental exposure histories. ATSDR will also make available resources related to environmental exposure, including contaminant-specific case studies and fact sheets.
2. ATSDR is evaluating the feasibility of conducting a study that would compare the mortality rates of former NL workers to the mortality rates of the general public. Former workers likely received the highest exposures to depleted uranium from 1958 to 1984 during operation of the facility. Currently, ATSDR is determining whether relevant past worker records exist.
3. NYSDOH and NYSDEC will sample areas near the Colonie Site for lead contamination in the soil.
4. NYSDOH will complete an evaluation of blood lead levels in children living near the former NL Site.
5. ACE will conduct a fourth sampling round for VOCs in the indoor air in five homes adjacent to the Colonie Site in the winter of 2004/2005.
6. ACE will develop a feasibility study evaluating the remediation alternatives for VOCs in groundwater.
7. Upon completion of the groundwater feasibility study, ACE will prepare a proposed plan that will clearly identify to the public what the preferred groundwater cleanup alternative is for the site.

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## References

[ATSDR] Agency for Toxic Substances and Disease Registry. 1999a. Toxicological profile for lead. Atlanta: US Department of Health and Human Services.

[ATSDR] Agency for Toxic Substances and Disease Registry. 1999b. Toxicological profile for uranium (update). Atlanta: US Department of Health and Human Services.

[ATSDR] Agency for Toxic Substances and Disease Registry. 2002. Public health assessment guidance manual (update) public comment draft. Atlanta: US Department of Health and Human Services.

Arnason JG, Fletcher BA. 2003. A 40+ year record of CD, Hg, Pb, and U deposition in sediments of Patroon Reservoir, Albany County, NY, USA. Environ Pollut 123(3):383–91.

Bleise A, Danesi PR, Burkart W. 2003. Properties, use and health effects of depleted uranium (DU): a general overview. J Environ Radioact 64(2–3):93–112.

Butterworth A. 1955. The significance and value of uranium in urine analysis. Trans Assoc Ind Med Offrs 5:30–43.

Calabrese EJ, Stanek EJ. 1993. Soil-pica: not a rare event. J. Environmental Science and Health A28(2):373–284.

Calabrese EJ, Stanek EJ, James RC, Roberts SM. 1997. Soil ingestion: a concern for acute toxicity in children. Environ Health Perspect 105(12):1354–58.

Calabrese EJ, Stanek EJ. 1998. Soil ingestion estimation in children and adults: a dominant influence in site-specific risk assessment. ELR News&Analysis 28:10660–71.

[CDC] Centers for Disease Control and Prevention. 1991. Preventing Lead Poisoning in Young Children. Atlanta: US Department of Health and Human Services. Available at: http://www.cdc.gov/nceh/lead/publications/books/plpyc/contents.htm. Accessed August 2003.

[BEIR IV] Committee on the Biological Effects of Ionizing Radiations, National Research Council. 1988. Health risks of radon and other internally deposited alpha-emitters. National Academy Press. Washington, DC.

Cragle DL, McLain RW, Qualters JR, Hickey JLS, Wilkinson GS, Tankersley WG et al. 1988. Mortality among workers at a nuclear fuels production facility. Am J Ind Med 14:379–401.

Danford DE. 1982. Pica and nutrition. Annual Reviews in Nutrition 2:303–22.

Finster ME, Gray KE, Binns HJ. 2004. Lead levels of edibles grown in contaminated residential soils: a field survey. Sci Total Environ 320 (2–3):245–57.

Fischer ML, Bentley AJ, Dunkin KA, Hodgson AT, Nazaroff WW, Sextro RC et al. 1996. Factors affecting indoor air concentrations of volatile organic compounds at a site of subsurface gasoline contamination. Environ Sci Technol 30:2948–57.

Fitzpatrick NA, Fitzgerald JJ. 1996. An evaluation of vapor intrusion into buildings through a study of field data. Presented at the 11th Annual Conference on Contaminated Soils, University of Massachusetts at Amherst.

Hadjumichael OC, Ostfeld AM, D'Atri DA, Brubaker RE. 1983. Mortality and cancer incidence experience of employees in a nuclear fuels fabrication plant. J Occ Med 25(1):48–61.

[HPS] Health Physics Society. 1996. Performance criteria for radiobioassay: an American national standard. HPS N13.30-1996. New York: American National Standards Institute.

Hooper FJ et al. 1999. Elevated urine uranium excretion by soldiers with retained uranium shrapnel. Health Phys 77(5):512–19.

[IEM] Institute of Environmental Medicine. 1979. Estimation of non-occupational exposures to compounds of depleted uranium report no. 1. New York University Medical Center. Tuxedo, NY. December.

[ICRP] International Commission on Radiological Protection. 1979. Limits for Intakes of Radionuclides by Workers: Part 1. ICRP Publication 30. Oxford:Pergamon Press.

[ICRP] International Commission on Radiological Protection. 1995. Age-dependent doses to members of the public from intake of radionuclides: Part 3, Ingestion dose coefficients. ICRP Publication 69. Oxford: Pergamon Press.

Kressin IK. 1984. Spectrophotometric method for the determination of uranium in urine. Anal Chem 56:2269–2227.

Macfarlane GJ, Biggs AM, Maconochie N, Hotopf M, Doyle P, Lunt M. 2003. Incidence of cancer among UK Gulf War veterans: cohort study. BMJ 327(7428):1373–1377.

McClain DE, Benson KA, Dalton TK, Ejnik J, Emond CA, Hodge SJ, et al. 2001. Biological effects of embedded depleted uranium (DU): summary of Armed Forces Radiobiology Research Institute research. Sci Tot Environ 274:115–118.

McDiarmid MA et al. 2000. Health effects of depleted uranium on exposed Gulf War veterans. Environ Res 82(2):168–80.

McDiarmid MA et al. 2001a. Surveillance of depleted uranium exposed Gulf War veterans: health effects observed in an enlarged "friendly fire" cohort. J Occup Environ Med 43(12):991–1000.

McDiarmid MA, Engelhardt SM, Oliver M. 2001b. Urinary uranium concentrations in an enlarged Gulf War veteran cohort. Health Phys 80(3):270–73.

McDiarmid MA et al. 2004. Health effects of depleted uranium on exposed Gulf War veterans: a 10-year follow-up. J Toxicol Environ Health A 67(4):277-96.

Miller AC, Xu J, Stewart M, Brooks S, Hodge S, Shi L, et al. 2002. Observation of radiation-specific damage in human cells exposed to depleted uranium: dicentric frequency and neoplastic transformation as endpoints. Rad Prot Dos 99(1–4):275–278.

New York State Department of Economic Development. 2000. Population of New York State by County – 1790 to 1990. Albany, NY. July. Available at: http://www.nylovesbiz.com/nysdc/State CountyPopests/CountyPopHistory.PDF. Accessed May 2003.

[NYSDOH] New York State Department of Health. 1979a. November 29 memorandum to Sherwood Davies from Karim Rimawi concerning lung scans for residents living near NLI. Albany, NY.

[NYSDOH] New York State Department of Health. 1979b. Draft status report: environmental and public health evaluation of discharges, National Lead Industries. Bureau of Radiological Health. Division of Environmental Health. Albany, NY.

[NYSDOH] New York State Department of Health. 1981. Roessleville study: investigation of health effects in a community downwind of uranium oxide effluents. Albany, NY.

[NYSDOH] New York State Department of Health. 1993. Cancer incidence in ZIP Code areas 12205, 12211, 12110, 12128 (Colonie Town), Albany County, New York. Albany, NY.

[NYSDOH] New York State Department of Health. 2003. Letter to Robert Prentiss from Ronald Tramantano concerning the National Lead Industries Facility in Colonie NY. Troy, NY. November 20.

Nwosu JU, Harding AK, Linder G. 1995. Cadmium and lead uptake by edible crops grown in a silt loam soil. Bull Environ Contam Toxicol 54:570–78.

Pavlakis N, Pollock CA, McLean G, Bartrop R. 1996. Deliberate overdose of uranium: Toxicity and treatment. Nephron 72(2):313–7.

Polednak AP, Frome EL. 1981. Mortality among men employed between 1943 and 1947 at a uranium-processing plant. J Occ Med 23(3):169–78.

Robischon P. 1971. Pica practice and other hand-mouth behavior and children's developmental level. Nursing Research 20:4–16.

Schlein B, editor. 1992. The health physics and radiological health handbook. Silver Spring, MD: Scinta, Inc.

Scott LM, Bahler KW, De La Garza A, Lincoln TA. 1972. Mortality experience of uranium and nonuranium workers. Health Phys 23:555–57.

Shellshear ID. 1975. Environmental lead exposure in Christchurch children: soil lead a potential hazard. New Zealand Medical Journal 81:382–386.

Sheppard MI, Vandergraaf TT, Thibault DH et al. 1983. Technetium and uranium: sorption by and plant uptake from peat and sand. Health Phys 44:635–44.

Teledyne Isotopes. 1980. A survey of uranium in soils surrounding the NL bearings plant. Westwood, NJ.

[ACE] US Army Corps of Engineers. 2001a. Proposed action memorandum for soil removal at the Colonie Site, Colonie, NY.

[ACE] US Army Corps of Engineers. 2001b. July 25 letter to Arthur Block from Stuart Piken concerning the Colonie Site. New York, New York.

[ACE] US Army Corps of Engineers. 2002a. Second half 2002 semi-annual groundwater sampling report, Colonie FUSRAP Site. New York, New York.

[ACE] US Army Corps of Engineers. 2002b. Colonie Site Background. Available at: http://web.ead.anl.gov/corps/colonie/back/. Accessed: July 2003.

[ACE] US Army Corps of Engineers. 2003. Revised draft document: Indoor air data assessment Colonie FUSRAP Site. New York, New York. June.

US Bureau of the Census. 2000. Census 2000 Summary File 1 New York – County. Washington: US Department of Commerce. Available at: URL: http://factfinder.census.gov/ servlet/GCTTable?ds_ name=DEC_2000_SF1_U&geo_id=04000US36&_box_head_nbr=GCT-PH1&format=ST-2. Accessed May 2003.

[DOE] US Department of Energy. 1985. Results of the radiological survey at 5 Yardboro Avenue, Albany, New York (AL031). Oak Ridge, TN.

[DOE] US Department of Energy. 1989a. Post-remedial action report for the Colonie Interim Storage Site vicinity properties – 1988 Colonie, New York. Oak Ridge, TN.

[DOE] US Department of Energy. 1989b. Certification docket for the remedial action performed at the Colonie Interim Storage Site vicinity properties in Colonie and Albany, New York, in 1984 and 1985. Oak Ridge, TN.

[DOE] US Department of Energy. 1992. Baseline risk assessment for exposure to contaminants at the Colonie Site, Colonie, New York. Oak Ridge, TN.

[DOE] US Department of Energy. 1995. Engineering evaluation and cost analysis (EE/CA) for the Colonie Site. Oak Ridge, TN.

[EPA] US Environmental Protection Agency. 1996. Soil Screening Guidance: Technical Background Document. EPA/540/R-95/128. Washington, DC. July. Available at: http://www.epa.gov/superfund/ resources/soil/toc.htm#p5. Accessed July 2004.

[EPA] US Environmental Protection Agency. 1997. Exposure Factors Handbook, Volume 1 - General Factors. Washington, D. August.

[EPA] US Environmental Protection Agency. 2002a. About CAP88 PC. Washington, DC. December. Available at: http://www.epa.gov/radiation/assessment/CAP88/aboutcap88.htm. Accessed January 2004.

[EPA] US Environmental Protection Agency. 2002b. Radiation Risk Assessment Software: CAP88 PC. Washington, DC. December. Available at: http://www.epa.gov/radiation/ assessment/CAP88/index.html. Accessed January 2004.

[EPA] US Environmental Protection Agency. 2002c. Region 9 preliminary remediation goals. San Francisco. March. Available at: http://www.epa.gov/Region9/waste/sfund/prg/files/02 table.pdf. Accessed April 2004.

[EPA] US Environmental Protection Agency. 2004. Region 3 risk based concentration table. Philadelphia. April. Available at: http://www.epa.gov/reg3hwmd/risk/human/rbc/rbc0404.pdf. Accessed April 2004.

[FDA] US Food and Drug Administration. 2000. Total diet study statistics and element results: 1991–1998. Washington, DC. April 25. Available at: http://www.cfsan.fda.gov/~acrobat /TDS1byel.pdf. Accessed May 2003.

Van Netten C, Morley DR. 1983. Uptake of uranium molybdenum copper and selenium by the radish from uranium rich soils. Arch Env Health 38:172–75.

Vermeer DE, Frate DA. 1979. Geophagia in rural Mississippi: environmental and cultural contexts and nutritional implications. American Journal of Clinical Nutrition 32:2129–2135.

Whittemore AS, McMillan A. 1983. Lung cancer mortality among U.S. uranium miners: a reappraisal. J Natl Cancer Inst 71(3):489–99.

Wong MS. 1988. The role of environmental and host behavioural factors in determining exposure to infection with Ascaris lumbriocoides and Trichuris trichlura. Ph.D. Dissertation, Faculty of Natural Sciences, University of the West Indies.

[WHO] World Health Organization. 1999. Contaminated soil in gardens—how to avoid the harmful effects. Copenhagen, Denmark.

[WHO] World Health Organization. 2001. Depleted uranium—sources, exposure and health effects. Geneva. April.

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# Figures

# Colonie Interim Storage Site

## FIGURE 2: DEMOGRAPHICS

## Albany, New York

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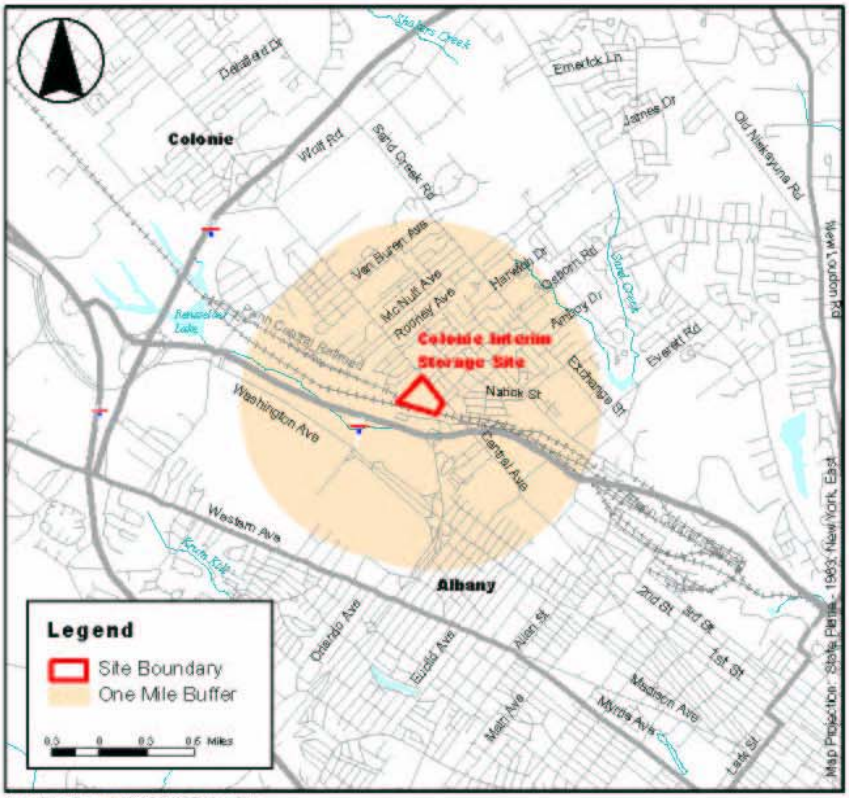
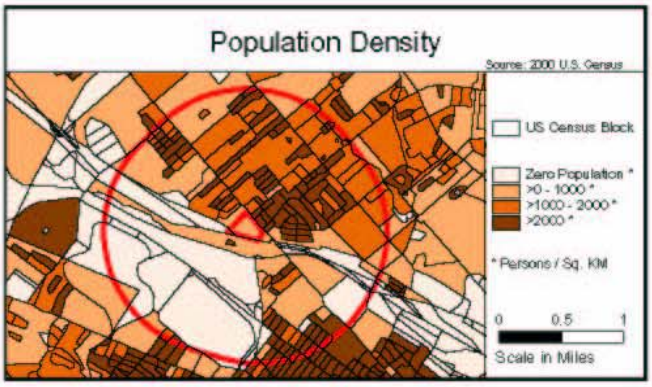


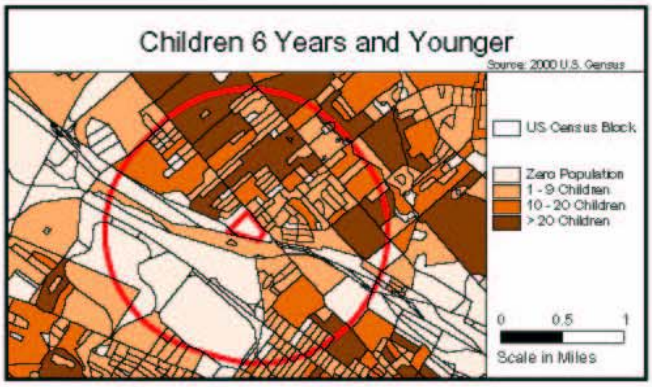


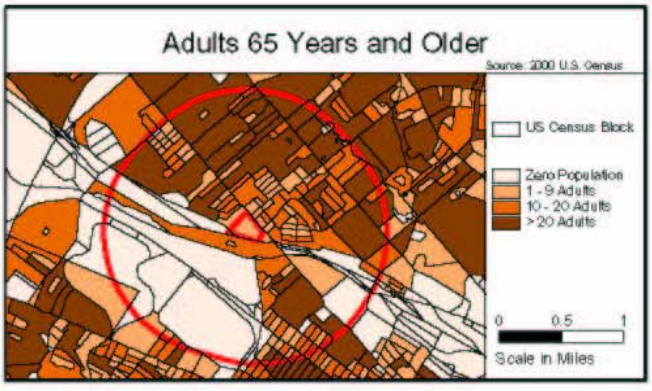
Albany County, New York

| Demographic Statistics Within Area of Concern* | |
|---|---|
| Total Population | 10045 |
| White alone | 9296 |
| Black alone | 376 |
| Am. Indian and Alaska Native alone | 16 |
| Asian alone | 192 |
| Native Hawaiian and Other Pacific Islander alone | 3 |
| Some other race alone | 44 |
| Two or More races | 122 |
| Hispanic or Latino | 150 |
| Children Aged 6 and Younger | 710 |
| Adults Aged 65 and Older | 2050 |
| Females Aged 15 - 44 | 2012 |
| Total Housing Units | 4548 |

Demographics Statistics Source: 2000 US Census
*Calculated using an area-proportion spatial analysis technique



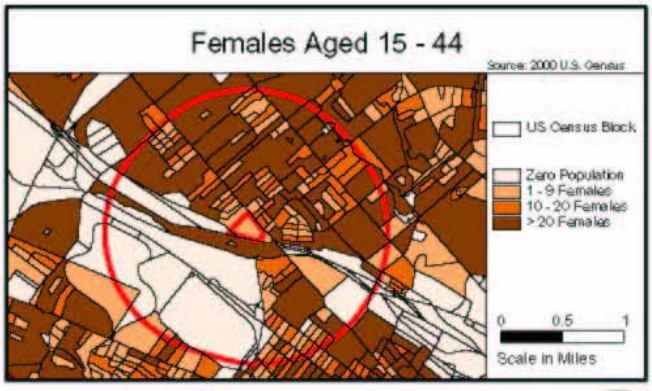




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*Figure 2: Colonie Site Demographics*

# Appendices

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## A. 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, 1-888-42-ATSDR (1-888-422-8737).

**Absorption**

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

**Acute**

Occurring over a short time [compare with chronic].

**Acute exposure**

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

**Additive effect**

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

**Adverse health effect**

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

**Aerobic**

Requiring oxygen [compare with anaerobic].

**Ambient**

Surrounding (for example, ambient air).

**Anaerobic**

Requiring the absence of oxygen [compare with aerobic].

**Analyte**

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

**Analytic epidemiologic study**

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

**Antagonistic effect**

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

**Background level**

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

**Biodegradation**

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

**Biologic indicators of exposure study**

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

**Biologic monitoring**

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

**Biologic uptake**

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

**Biomedical testing**

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

**Biota**

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

**Body burden**

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

**CAP [see Community Assistance Panel.]**

**Cancer**

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

**Cancer risk**

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

**Carcinogen**

A substance that causes cancer.

**Case study**

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

**Case-control study**

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

**CAS registry number**

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

**Central nervous system**

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

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

**Chronic**

Occurring over a long time [compare with acute].

**Chronic exposure**

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

**Cluster investigation**

A review of an unusual number, real or perceived, of health events (for example, reports of cancer) grouped together in time and location. Cluster investigations are designed to confirm case reports; determine whether they represent an unusual disease occurrence; and, if possible, explore possible causes and contributing environmental factors.

**Community Assistance Panel (CAP)**

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

**Comparison value (CV)**

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

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

**Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA)**

CERCLA, also known as Superfund, is the federal law that concerns the removal or cleanup of hazardous substances in the environment and at hazardous waste sites. ATSDR, which was created by CERCLA, is responsible for assessing health issues and supporting public health activities related to hazardous waste sites or other environmental releases of hazardous substances. This law was later amended by the Superfund Amendments and Reauthorization Act (SARA).

**Concentration**

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

**Contaminant**

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

**Delayed health effect**

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

**Dermal**

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

**Dermal contact**

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

**Descriptive epidemiology**

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

**Detection limit**

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

**Disease prevention**

Measures used to prevent a disease or reduce its severity.

**Disease registry**

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

**DOD**

United States Department of Defense.

**DOE**

United States Department of Energy.

**Dose (for chemicals that are not radioactive)**

The amount of a substance to which a person is exposed over some time period. Dose is a measurement of exposure. Dose is often expressed as milligram (amount) per kilogram (a measure of body weight) per day (a measure of time) when people eat or drink contaminated water, food, or soil. In general, the greater the dose, the greater the likelihood of an effect. An "exposure dose" is how much of a substance is encountered in the environment. An "absorbed dose" is the amount of a substance that actually got into the body through the eyes, skin, stomach, intestines, or lungs.

**Dose (for radioactive chemicals)**

The radiation dose is the amount of energy from radiation that is actually absorbed by the body. This is not the same as measurements of the amount of radiation in the environment.

**Dose-response relationship**

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

**Environmental media**

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

**Environmental media and transport mechanism**

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

**EPA**

United States Environmental Protection Agency.

**Epidemiologic surveillance [see Public health surveillance].**

**Epidemiology**

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

**Exposure**

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

**Exposure assessment**

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

**Exposure-dose reconstruction**

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

**Exposure investigation**

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

**Exposure pathway**

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

**Exposure registry**

A system of ongoing followup of people who have had documented environmental exposures.

**Feasibility study**

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

**Geographic information system (GIS)**

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

**Grand rounds**

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

**Groundwater**

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

**Half-life (t½)**

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

**Hazard**

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

**Hazardous Substance Release and Health Effects Database (HazDat)**

The scientific and administrative database system developed by ATSDR to manage data collection, retrieval, and analysis of site-specific information on hazardous substances, community health concerns, and public health activities.

**Hazardous waste**

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

**Health consultation**

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

**Health education**

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

**Health investigation**

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

**Health promotion**

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

**Health statistics review**

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

**Indeterminate public health hazard**

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

**Incidence**

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

**Ingestion**

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

**Inhalation**

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

**Intermediate duration exposure**

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

**In vitro**

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

**In vivo**

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

**Lowest-observed-adverse-effect level (LOAEL)**

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

**Medical monitoring**

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

**Metabolism**

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

**Metabolite**

Any product of metabolism.

**mg/kg**

Milligram per kilogram.

**mg/cm2**

Milligram per square centimeter (of a surface).

**mg/m3**

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

**Migration**

Moving from one location to another.

**Minimal risk level (MRL)**

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

**Morbidity**

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

**Mortality**

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

**Mutagen**

A substance that causes mutations (genetic damage).

**Mutation**

A change (damage) to the DNA, genes, or chromosomes of living organisms.

**National Priorities List for Uncontrolled Hazardous Waste Sites (National Priorities List or NPL)**

EPA's list of the most serious uncontrolled or abandoned hazardous waste sites in the United States. The NPL is updated on a regular basis.

**National Toxicology Program (NTP)**

Part of the Department of Health and Human Services. NTP develops and carries out tests to predict whether a chemical will cause harm to humans.

**No apparent public health hazard**

A category used in ATSDR's public health assessments for sites where human exposure to contaminated media might be occurring, might have occurred in the past, or might occur in the future, but where the exposure is not expected to cause any harmful health effects.

**No-observed-adverse-effect level (NOAEL)**

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

**No public health hazard**

A category used in ATSDR's public health assessment documents for sites where people have never and will never come into contact with harmful amounts of site-related substances.

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

Physiologically based pharmacokinetic model (PBPK model)

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

**Pica**

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

**Plume**

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

**Point of exposure**

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

**Population**

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

**Potentially responsible party (PRP)**

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

**ppb**

Parts per billion.

**ppm**

Parts per million.

**Prevalence**

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

**Prevalence survey**

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

**Prevention**

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

**Public availability session**

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

**Public comment period**

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

**Public health action**

A list of steps to protect public health.

**Public health advisory**

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

**Public health assessment (PHA)**

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

**Public health hazard**

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

**Public health hazard categories**

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

**Public health statement**

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

**Public health surveillance**

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

**Public meeting**

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

**Radioisotope**

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

**Radionuclide**

Any radioactive isotope (form) of any element.

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

**Receptor population**

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

**Reference dose (RfD)**

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

**Registry**

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

**Remedial investigation**

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

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

This Act regulates management and disposal of hazardous wastes currently generated, treated, stored, disposed of, or distributed.

**RFA**

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

**RfD [see reference dose]**

**Risk**

The probability that something will cause injury or harm.

**Risk reduction**

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

**Risk communication**

The exchange of information to increase understanding of health risks.

**Route of exposure**

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

**Safety factor [see uncertainty factor]**

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

**Sample**

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

**Sample size**

The number of units chosen from a population or an environment.

**Solvent**

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

**Source of contamination**

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

**Special populations**

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

**Stakeholder**

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

**Statistics**

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

**Substance**

A chemical.

**Substance-specific applied research**

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

**Superfund [see Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA) and Superfund Amendments and Reauthorization Act (SARA)**

**Superfund Amendments and Reauthorization Act (SARA)**

In 1986, SARA amended the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA) and expanded the health-related responsibilities of ATSDR. CERCLA and SARA direct ATSDR to look into the health effects from substance exposures at hazardous waste sites and to perform activities including health education, health studies, surveillance, health consultations, and toxicological profiles.

**Surface water**

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

**Surveillance [see public health surveillance]**

**Survey**

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

**Synergistic effect**

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

**Teratogen**

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

**Toxic agent**

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

**Toxicological profile**

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

**Toxicology**

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

**Tumor**

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

**Uncertainty factor**

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

**Urgent public health hazard**

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

**Volatile organic compounds (VOCs)**

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

**Other glossaries and dictionaries:**

Environmental Protection Agency (http://www.epa.gov/OCEPAterms/)

National 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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## B. Glossary of Radiation Terms

### *What is radioactivity?*

Radioactivity is the spontaneous emission of radiation from the nucleus of an unstable atom. Atoms are the smallest units of an element that have the same properties as the element. All matter is made up of atoms. Atoms are made up of protons and neutrons (found in the nucleus of the atom) and electrons. The number of protons in an atom of a particular element is always the same, but the number of neutrons can vary. Whether an atom is unstable, or radioactive, is determined by the ratio of neutrons to protons. Isotopes are forms of the same element with different numbers of neutrons. To name the isotope, the number of protons and neutrons in the atom are added. For example, an atom of cobalt that has 27 protons and 33 neutrons is called cobalt-60. Cobalt-60 is radioactive and is therefore called a radioisotope, or a radionuclide.

### *Where does radioactivity come from?*

All elements heavier than bismuth (which contains 83 protons) are naturally radioactive. Lighter elements, such as carbon-14, tritium, and potassium-40, are radioactive because of natural processes in the environment. Everyone is exposed to naturally occurring radiation from space and from radioactive materials in the ground. Scientists can also create radionuclides of most elements. For example, scientists create radionuclides to use as tracers to help measure the flow of materials in sick people or in the environment. Radioactive or not, the way a substance moves in people or through the environment depends on its chemical properties. Some radioactive materials can travel through the air as particles or gases; some can enter soil, water, plants, and animals. Most of the radiation that people are exposed to in the air is radon, an alpha emitter that results from decaying uranium-238, which is found to varying degrees in all soil and rocks.

### *What is radiation?*

Radiation, a form of energy, can be ionizing or non-ionizing. Ionizing radiation occurs as alpha particles, beta particles, gamma rays, x-rays, neutrons, high-speed electrons, high-speed protons, and other particles able to produce ions, or charges. Non-ionizing radiation includes radio waves, microwaves, visible light, infrared light, and ultraviolet light.

### *What are alpha particles, beta particles, and gamma radiation?*

Alpha particles are positively charged particles made up of two protons and two neutrons. They can travel only a few inches (centimeters) in air. The particles lose their energy quickly and do not penetrate the skin surface if exposure is external. Alpha particles can enter the body through a cut in the skin, by ingestion, or inhalation. Once inside the body, alpha-emitting radioactive substances can be harmful. Uranium-238 and plutonium-239 are sources of alpha radiation.

Beta particles, or beta radiation, are made of fast-moving particles that can be either positively or negatively charged. A negatively charged beta particle is an electron, and a positively charged one is a positron. Beta particles are easily stopped by a thin sheet of metal or plastic. Beta radiation can penetrate a few millimeters in human tissue before losing all of its energy. Large amounts of beta radiation can cause skin burns, and beta emitters can be harmful if they enter the body from ingestion or inhalation. Iodine-131, phosphorus-32, and strontium-90 are sources of beta radiation.

Gamma rays, or gamma radiation, occur as high-energy, short-wavelength electromagnetic radiation, or packets of energy emitted from the nucleus, or core, of an atom. Gamma radiation

often accompanies alpha and beta emissions, and always accompanies fission, or splitting of atoms. Unlike alpha and beta particles, gamma rays are very penetrating and are best stopped, or shielded against, by dense materials such as lead. Gamma rays are like x-rays, but more energetic. Gamma rays emitted from a nearby source can enter the body without ingestion or inhalation. That said, the energy (and the dose that can be deposited) drops rapidly with distance from the source of radiation. The dose received by a person 1 meter (just over a yard) from a source is 0.01% of the dose that would be received 1 centimeter (just under ½ inch) from the source. If enough gamma rays pass through the body, they can damage cells. Cesium-137 is a source of gamma radiation.

***What is worldwide fallout?***

Fallout is the term given to radioactive particles that fall from the atmosphere and settle on the Earth's surface. Radionuclides enter the atmosphere worldwide from atmospheric testing of nuclear weapons and accidents at weapons production facilities. Accidents involving weapons transport, satellite re-entry, and nuclear reactors have also released some radionuclides, though in much smaller amounts. Scientists track radionuclide levels in our environment that have resulted from fallout. The information collected to date suggests that the levels are very low and that exposure to these low levels is not likely to increase an individual's chances of developing health effects such as cancer.

Source: Schlein B, editor. 1992. The health physics and radiological health handbook. Silver Spring, MD: Scinta, Inc.

## C. EPA's CAP88 Model

### *Background*

The CAP-88 (which stands for Clean Air Act Assessment Package-1988) computer model is a set of computer programs, databases and associated utility programs for estimation of dose and risk from radionuclide emissions to air. CAP-88 is composed of modified versions of AIRDOS-EPA (Mo79) and DARTAB (ORNL5692).

The original CAP-88 program is written in FORTRAN77 and was compiled to run on an IBM 3090 under OS/VS2, using the IBM FORTRAN compiler, at the EPA National Computer Center in Research Triangle Park, NC. The CAP88-PC software, released in 1992, allows the user to complete CAP-88 dose and risk assessment calculations in a personal computer environment.

### *Regulatory Context*

On October 31, 1989 the Environmental Protection Agency issued final rules for radionuclide emissions to air under 40 CFR Part 61, National Emission Standards for Hazardous Air pollutants (NESHAPS). CAP-88 was used to generate risk estimates for the risk assessment supporting this rule. The CAP88-PC software has been approved for demonstrating compliance with the requirements in 40 CFR 61.93a for Department of Energy facilities.

### *Application Niche*

CAP88-PC uses a modified Gaussian plume model to estimate the average dispersion of radionuclides released from up to six sources. The sources may be either elevated stacks, such as a smokestack, or uniform area sources, such as a pile of uranium mill tailings. While up to six stacks or area sources can be modeled, all the sources are modeled as if located at the same point; that is, stacks cannot be located in different areas of a facility. Uniform contamination is assumed for area sources. This is an appropriate assumption for the Colonie Site because ATSDR used the highest value from a single stack in the model analysis (see pages 17-18).

Plume rise can be calculated assuming either a momentum or buoyancy-driven plume. The same plume rise mechanism (buoyant or momentum) is used for each source. Assessments are done for a circular grid of distances and directions with a radius of 80 kilometers (50 miles) around the facility. Errors arising from these assumptions will have a negligible effect for assessments where the distance to exposed individuals is large compared to the stack height, area or facility size.

The program computes radionuclide concentrations in air, rates of deposition on ground surfaces, concentrations in food and intake rates to people from ingestion of food produced in the assessment area. Estimates of the radionuclide concentrations in produce, leafy vegetables, milk and meat consumed by humans are made by coupling the output of the atmospheric transport models with the U.S. Nuclear Regulatory Commission Regulatory Guide 1.109 terrestrial food chain models. The greatest risk, however, from the Colonie Site was from inhalation of the DU emissions.

Dose and risk estimates from CAP88-PC are applicable only to low-level chronic exposures, since the health effects and dosimetric data are based on low-level chronic intakes. CAP88-PC cannot be used for either short-term or high-level radionuclide intakes.

### *Strengths and Limitations*

CAP88-PC provides the CAP-88 methodology for assessments of both collective populations and maximally-exposed individuals, and allows users to edit some environmental transport variables. The complete set of dose and risk factors, census data, and stability array data used is provided in the CAP-88 user's guide.

Variation in radionuclide concentrations due to complex terrain cannot be modeled; all assessments assume a flat plain. This is an appropriate assumption for the Colonie Site because the terrain within the modeling area is flat.

### *Validation*

EPA has made comparisons between the predictions of annual-average ground-level concentration to actual environmental measurements, and found very good agreement. Environmental monitoring data at five Department of Energy (DOE) sites was compared to AIRDOS-EPA predictions in 1987. A report titled, Comparison of AIRDOS-EPA Prediction of Ground-Level Airborne Radionuclide Concentrations to Measured Values (Be86) summarizes the results. EPA concluded that as often as not, AIRDOS-EPA predictions were within a factor of 2 of actual concentrations.

Source: EPA 2002a, EPA 2002b

## D. Exposure Evaluation Methodology and Assumptions for DU and Lead in Soil and Benzene in Indoor Air

This appendix details the assumptions and calculations that ATSDR used to estimate potential exposure levels from the consumption of soil contaminated with DU and lead and breathing benzene in indoor air. To be protective and account for the uncertainty surrounding how representative the exposure factors are for the residents near the Colonie Site, ATSDR used health-protective assumptions to estimate the reasonable maximum exposure level. These estimates are a daily exposure dose in milligrams of contaminant per kilogram body weight (mg/kg/day). And because lead is typically compared based on a concentration in blood, the estimates for lead doses were further converted to correspond to micrograms of lead per deciliter of blood. All of these calculations are intentionally protective and likely overestimate the amount of chemical exposure.

### *Estimating DU exposure doses from ingesting off-site soil*

The highest average of DU in soil from a vicinity property, 320 pCi/g, was used to calculate the exposure doses for children, children who exhibit soil-pica behavior, and adults—including pregnant women and the elderly. This value was converted to 810 mg/kg based on the activity of DU, where 150 pCi equals 0.38 mg.

The amount of soil each group would ingest was intentionally overestimated. Table D-1 lists additional assumptions used in the calculations**.** Pica children were evaluated for acute rather than long-term exposures because pica behavior generally involves ingestion of a large amount of soil during single day rather than smaller amounts over a longer period of time (Calabrese 1997).

The following equation was used in calculating the exposure doses:

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

**Table D-1: DU Exposure Dose Assumptions for Off-site Soil**

| Parameter | | Child with pica behavior | Child | Adult |
|---|---|---|---|---|
| **Chemical Concentration** | C | 810 mg/kg | 810 mg/kg | 810 mg/kg |
| **Ingestion Rate** | IR | varies | 100 mg/day | 50 mg/day |
| **Exposure Frequency** | EF | varies | 224* days/year | 224* days/year |
| **Exposure Duration** | ED | varies | 6 years | 30 years |
| **Absorption fraction**† | AF | 0.02 | 0.02 | 0.02 |
| **Body Weight** | BW | 16 kg | 16 kg | 70 kg |
| **Averaging Time** | AT | varies | 365 days/year | 365 days/year |
| **Averaging Duration** | AD | ED | ED | ED |

* Excludes winter months
†ICRP 1995

Table D-2 lists the calculated non-cancer effects doses for DU exposure from incidentally ingesting soil for children and adults.

**Table D-2: Estimated DU Exposure Dose Levels from Incidentally Ingesting Off-site Soil**

| Dose (mg/kg/day) | | Intermediate Oral MRL* (mg/kg/day) |
|---|---|---|
| Child | Adult | |
| $6.2 \times 10^{-5}$ | $7.1 \times 10^{-6}$ | $2 \times 10^{-3}$ |

*This MRL is based on highly soluble uranium salts. The uranium from the NL plant was most likely insoluble compounds.

ATSDR compared these estimated exposure doses with ATSDR's MRL for oral exposure to uranium. This MRL is based on the chemical non-cancerous health effects of uranium rather than the radiological effects. MRLs for radiological exposure were not calculated because:

- no data are available for use in calculating radiological MRLs for any duration because no radiological effects were identified in any of the available studies that used natural uranium as a test material;
- the MRLs for chemical effects would adequately protect against the possible radiotoxicity of natural and depleted uranium because radiological effects are not expected to occur, based on the low specific activities of these isotopic mixtures and the current toxicity data in humans and animals;
- the studies that reported potential radiological effects (severe pulmonary fibrosis, friable blood vessels) used highly enriched uranium in a single inhalation exposure
- the United Nations Scientific Committee on the Effects of Atomic Radiation has considered that limits for natural (and depleted) uranium in food and drinking water (the most important sources of human exposure) should be based on the chemical toxicity rather than on a hypothetical radiological toxicity, which has not been observed in either humans or animals (ATSDR 1999b).

In addition, no acute- or chronic-duration oral MRLs were developed for uranium because of a lack of suitable data. ATSDR used the intermediate duration MRL (15-364 days) to compare the estimated exposure doses. The exposure to DU-contaminated soil near the Colonie Site was most likely for longer than 364 days. ATSDR believes, however, that because the assumptions used in the calculations are very protective and the estimated exposure doses are all below the intermediate-duration MRL, people, including children, are not at risk of adverse health effects from ingesting DU-contaminated soil.

There is minimal data on acute exposure to uranium in humans by ingestion. Two separate reports looked at one-time oral exposure to uranium. In one study, a volunteer given a single dose of 1 g uranyl nitrate (14.3 mg/kg) and observed for clinical signs and symptoms within 24 hours after intake suffered acute nausea, vomiting, and diarrhea within a few hours of administration. All clinical signs returned to normal within 24 hours after administration of the oral uranyl nitrate dose (Butterworth 1955). In another study a male (no age or weight given), was admitted to hospital following the deliberate ingestion of 15 g of uranyl acetate (approximately 131 mg/kg for a 70 kg reference man), along with an unknown quantity of

benzodiazepine, in a failed suicide attempt. Symptoms of this ingestion included inflammation of the heart muscle, bowel obstruction, liver dysfunction, and kidney dysfunction which had not cleared up 6 months after intake (Pavlakis 1996).

Table D-3 shows the results of the soil-pica analysis. Because of the uncertainty associated with soil-pica behavior, ATSDR evaluated this issue by using a range of soil intakes for three exposure scenarios to calculate exposure doses. ATSDR then compared these doses to the lowest observed adverse effect level (LOAEL) from one of the studies described above that looked at acute (or short-term) exposure to DU. The dose estimates were all below the LOAEL at each soil intake for each exposure scenario. Based on this evaluation, ATSDR believes that children were not at risk of adverse health effects from soil-pica behavior in areas with around the Colonie Site with DU-contaminated soil.

**Table D-3: Estimated DU Exposure Dose Levels from Ingesting Off-site Soil for Soil-pica Children**

| Amount of soil ingested (mg) | Dose (mg/kg/day) | | | Acute LOAEL* (mg/kg/day) |
|---|---|---|---|---|
| | Three days per week | Four days per week | Five days per week | |
| 1000 | 0.01 | 0.01 | 0.01 | 14.3 |
| 3000 | 0.02 | 0.03 | 0.03 | 14.3 |
| 5000 | 0.03 | 0.04 | 0.05 | 14.3 |

*Butterworth 1955

***Estimating lead exposure doses and blood lead levels from ingesting off-site soil***

There is no established MRL for lead exposure for adults or children. ATSDR compared the potential lead exposure for children with the potential for an increase in blood lead levels predicted by EPA's Integrated Exposure Uptake Biokinetic Model for Lead in Children (IEUBK). This model predicts the probable blood lead concentrations for children between 6 months and 7 years due to exposure to lead in environmental media. The IEUBK model standardizes exposure by assuming age-weighted parameters for intake of food, water, soil, and dust. The model simulates continual growth under constant exposure levels (on a year-to-year basis). The model also simulates lead uptake, distribution within the body, and elimination from the body.

ATSDR recognizes that the IEUBK model can be a useful tool in modeling potential lead uptake in children. Using the IEUBK model, the average concentration for lead in the soil, 373 ppm, was entered to estimate the contribution of exposure to the amount of lead in children's blood. Using the IEUBK model, we applied the estimated amount of lead children take into their bodies daily, the estimated amount obtained from their mother before birth, and the contribution of soil exposure to determine the geometric average of blood lead for children ages 6 months to 7 years. The results are shown in Table D-4.

**Table D-4: Estimated PbB Level for Children from Ingestion of Off-site Soil using IEUBK Model**

| Soil lead level (ppm) | Geometric mean blood lead level (µg Pb/dL blood) | CDC's recommended action level (µg Pb/dL blood) |
|---|---|---|
| 373 | 4.9 | 10 |

MRLs for lead have not been developed because a clear threshold for some of the more sensitive effects in humans has not been identified. In addition, there is a wide body of literature about lead in the blood (PbB) and deriving an MRL would overlook this significant information. Epidemiological studies have identified harmful effects of lead in children at blood lead levels at least as low as 10 µg/dL. Because 10 µg/dL is the lower level of the range at which effects are now identified, CDC recommends that primary prevention activities, community wide environmental interventions, and nutritional and educational campaigns should be directed at reducing children's blood lead levels at least to below 10 µg/dL (CDC 1991). ATSDR believes that because the assumptions used in the calculations are protective and the estimated blood lead level is below CDC's action level for blood lead levels, children are not at risk of adverse health effects from ingesting lead contaminated soil.

The IEUBK model, however, does not include children who may exhibit soil-pica behavior. It is difficult to evaluate the effects of soil-pica in lead-contaminated areas because there is no MRL and little scientific data about the acute effects of large doses of lead-contaminated soil. ATSDR did not, therefore, evaluate soil-pica using dose or blood lead calculations. Please see page 25 for a discussion of this issue.

***Estimating DU and lead exposure doses from ingesting on-site soil***

Community members report that children used to play on the NL facility property. The average levels of lead and DU found on the Colonie Site were used to calculate past exposure doses from incidental ingestion for a child playing on the NL property one day per week, 32 weeks per year. The assumptions for these calculations are listed in Table D-5. ATSDR did not include an evaluation for soil-pica because children who exhibit this behaviour tend to be very young and would most likely not be playing unsupervised on the NL property.

**Table D-5: Lead Exposure Dose Assumptions for On-site Soil for Children**

| Parameter | | DU | Lead |
|---|---|---|---|
| **Chemical Concentration** | C | 181mg/kg | 3600 mg/kg |
| **Ingestion Rate** | IR | 100 mg/day | 100 mg/day |
| **Exposure Frequency** | EF | 32 days/year | 32 days/year |
| **Exposure Duration** | ED | 9 years | 9 years |
| **Absorption fraction*** | AF | 0.02 | 0.3 |
| **Body Weight** | BW | 16 kg | 16 kg |
| **Averaging Time** | AT | 365 days/year | 365 days/year |
| **Averaging Duration** | AD | ED | ED |

* ICRP 1995

The following equation was used in calculating the exposure doses:

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

As shown in Table D-6, the doses were well below levels that would be of health concern.

| Table D-6: Estimated DU and Lead Exposure Doses and Estimated PbB Levels for Children from Ingestion of On-site Soil | | | |
|---|---|---|---|
| **Contaminant** | **Estimated Exposure dose for children (mg/kg/day)** | **Geometric mean blood lead level in children (µg Pb/dL blood)** | **Comparison Value** |
| DU | $6 \times 10^{-4}$ | N/A | $2 \times 10^{-3}$ mg/kg/day* |
| Lead | $2 \times 10^{-6}$ | 4.5 | 10 µg Pb/dL blood† |

* ATSDR's Intermediate Oral MRL
† CDC's recommended action level

***Estimating benzene exposure doses from indoor air***

The value from Location 3 which exceeded ATSDR's comparison value of benzene in indoor air, 48 $\mu g/m^3$, was used to calculate non-cancer exposure doses and cancer risk for men, women, and children. Because this location is a church, ATSDR estimated an average usage of 6 hours per week. Table D-7 lists additional assumptions used in the calculations**.**

| Table D-7: Benzene Exposure Dose Assumptions for Indoor Air | | | | |
|---|---|---|---|---|
| **Parameter** | | **Man** | **Woman** | **Child** |
| **Chemical Concentration** | C | 0.048 $mg/m^3$ | 0.048 $mg/m^3$ | 0.048 $mg/m^3$ |
| **Inhalation Rate*** | IR | 15.2 $m^3$/day | 11.3 $m^3$/day | 10 $m^3$/day |
| **Exposure Frequency†** | EF | 13 days/year | 13 days/year | 13 days/year |
| **Exposure Duration** | ED | 30 years | 30 years | 6 years |
| **Absorption fraction** | AF | 1 | 1 | 1 |
| **Body Weight** | BW | 70 kg | 65 kg | 16 kg |
| **Averaging Time** | AT | 365 days/year | 365 days/year | 365 days/year |
| **Averaging Duration: non-cancer** | AD | ED | ED | ED |
| **Averaging Duration: cancer** | AD | 70 years | 70 years | 70 years |
| **EPA Cancer Slope Factor‡** | CSF | 0.027 $mg/kg/day^{-1}$ | 0.027 $mg/kg/day^{-1}$ | 0.027 $mg/kg/day^{-1}$ |

* ATSDR 2002
† Based on being at the location 6 hours per week
‡ EPA 2004

For non-cancer calculations, the following formula was used. The estimated exposure doses were compared to EPA Region 3's reference dose for benzene.

$$\textit{Non-Cancer Dose (mg/kg/day)} = \frac{C \times IR \times EF \times ED \times AF}{BW \times AT \times AD}$$

As shown in Table D-8, all of the estimated doses were below the reference dose.

| Table D-8: Estimated Non-cancer Benzene Exposure Doses for Indoor Air | | | |
|---|---|---|---|
| **Dose (mg/kg/day)** | | | **USPEA Reference Dose (mg/kg/day)** |
| **Man** | **Woman** | **Child** | |
| 0.0004 | 0.0003 | 0.001 | 0.0086 |

For cancer risk calculations, the following formula was used. These risk calculations are used primarily to screen the data. If the resulting cancer risks are high, then ATSDR reviews available scientific information, including medical, epidemiological, and toxicological literature, to determine if a health hazard exists. The cancer risks were calculated using EPA's cancer slope factor for benzene and compared to a risk level. The risk level of 1 x $10^{-5}$ (1/10,000) was used because it reflects realistic human exposures. Still, risk levels are theoretical and actual risks could be as low as zero. The slope factor and risk level method are protective by design and none of the risk estimates exceeded the comparison value.

$$\textit{Cancer Risk (unitless)} = \frac{C \times IR \times EF \times ED \times AF}{BW \times AT \times AD} \times CSF$$

As shown in Table D-9, all of the estimated risk levels are below the risk level of 1 x $10^{-5}$.

**Table D-9: Estimated Cancer Risk Levels from Exposure to Benzene in Indoor Air**

| Cancer Risk | | | |
|---|---|---|---|
| **Man** | **Woman** | **Child** | **Risk Level** |
| 4 x $10^{-6}$ | 3 x $10^{-6}$ | 2 x $10^{-6}$ | 1 x $10^{-5}$ |

Using the calculations for both non-cancer exposure doses and cancer risk, ATSDR believes that there is no health hazard from breathing the indoor air at levels found in Location 3.

## E. Johnson and Ettinger Indoor Air Model (1991)

### *VOC air modeling*

The contaminated groundwater under the southern portion of the site has migrated off site, under Yardboro Avenue. The majority of the contaminants in the groundwater plumes are volatile organic compounds having the ability to volatilize into vapor. This vapor can, in turn, move from the groundwater, through soil, and eventually seep into basements and affect indoor air. Indoor air sampling was performed in a few houses near the groundwater plume from the Colonie Site. ATSDR applied the Johnson and Ettinger model to estimate indoor air concentrations for homes that were not sampled.

### *Modeling approach*

Rather than simulating the many complex factors that affect how toxic chemicals disperse in air, ATSDR evaluated a simple and overestimated exposure situation, formulating the modeling scenario as *What would be the predicted indoor air concentration of a VOC contaminant for a house located directly above a groundwater plume with a VOC concentration equal to the highest level measured at the Colonie Site?* This scenario provides an extreme, upper-bound estimate of what the actual ambient air concentrations might be. Groundwater sampling data from the Colonie Site was used in the Johnson and Ettinger indoor air model to estimate indoor air concentrations in residences near the groundwater plume. The maximum value for each VOC is much higher than the groundwater contamination near any of the homes.

In addition, ATSDR entered the sub-foundation soil gas concentrations measured in the July/August 2002 sampling round into the model.

### *Limitations of the Johnson and Ettinger Model*

The Johnson and Ettinger model is a first-tier screening tool that is based on several assumptions. As a result, it has limitations:

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

All but the most sensitive parameters have been set to either an upper bound value or the median value. As a result, the model is very protective when predicting indoor air concentrations.

### *Validation of model*

Some researchers have compared their measured results to those predicted by the Johnson and Ettinger model. These comparisons found that the model can effectively predict indoor air

concentrations. But they also stressed the importance of collecting the proper site-specific information to identify appropriate values of the input parameters (Fischer et al 1996, Fitzpatrick and Fitzgerald 1996).

***Air model results***

ATSDR used the model with three different input parameters:

- Maximum groundwater concentrations from the Colonie Site
- Groundwater concentrations in off-site wells on Yardboro Avenue
- Sub-foundation soil gas sampling from ACE's 2002 sampling round

*Using maximum groundwater concentrations from the Colonie Site as model inputs*

For predicting indoor air concentrations in homes near the plume from the Colonie Site, ATSDR entered the groundwater concentrations from the on-site well with the highest levels for each VOC into the Johnson and Ettinger model. Benzene, toluene, ethylbenzene, and toluene were not used in the model because these compounds were not detected in the groundwater well. Predicted concentrations were then compared to ATSDR's comparison value for that compound. Based on this method, ATSDR found that none of the contaminants exceeded ATSDR's comparison values (Table E-1).

**Table E-1: Predicted indoor air concentrations from maximum groundwater concentrations**

| Compound | Groundwater concentration* (µg/L) | Predicted indoor air concentration† (µg/m$^3$) | ATSDR's comparison values for air (µg/m$^3$) |
|---|---|---|---|
| PCE | 490 | 1.52 | 300 |
| TCE | 190 | 0.37 | 500 |
| cis-1,2-DCE | 440 | 0.36 | 37‡ |
| VC | 11 | 0.087 | 0.1 |

* ACE 2002a
† The indoor air concentration that would be expected from the maximum groundwater concentration.
‡ EPA Region 9 PRG for ambient air, EPA 2002c

*Using off-site groundwater concentrations on Yardboro Avenue*

ATSDR then entered the groundwater concentrations near Yardboro Avenue for each VOC into the Johnson and Ettinger model. Benzene, toluene, ethylbenzene, and toluene were not used in the model because these compounds were not detected in the groundwater well closest to Yardboro Avenue. Predicted concentrations were then compared to ATSDR's comparison value for that compound. Based on this analysis, ATSDR found that none of the air concentrations exceeded the references (Table E-2).

| Table E-2: Predicted indoor air concentrations from groundwater concentrations near Yardboro Avenue | | | |
|---|---|---|---|
| **Compound** | **Groundwater concentration* (µg/L)** | **Predicted indoor air concentration† (µg/m$^3$)** | **ATSDR's comparison values for air (µg/m$^3$)** |
| PCE | 41 | 0.13 | 300 |
| TCE | 3 | 0.0058 | 500 |
| cis-1,2-DCE | ND (0.5) | 0.00043 | 37‡ |
| VC | ND (0.5) | 0.0037 | 0.1 |

* ACE 2002a; Note: the detection limits (in parentheses) were used for the cis-1,2-DCE and VC calculations.
† The indoor air concentration that would be expected from the groundwater concentration near Yardboro Avenue.
‡ EPA Region 9 PRG for ambient air, EPA 2002c

*Using sub-foundation soil gas concentrations*

Sub-foundation soil gas concentrations were collected during the ACE's July/August 2002 sampling round. ATSDR entered the maximum soil gas concentration measured for each VOC into the Johnson and Ettinger model and a predicted indoor air concentration was calculated. The predicted concentrations were then compared to ATSDR's comparison value for that compound. Based on this strategy, ATSDR found that none of the air concentrations exceeded reference values and thus were not at levels that could cause adverse health effects (Table E-3).

| Table E-3: Predicted indoor air concentrations from soil gas concentrations | | | |
|---|---|---|---|
| **Compound** | **Soil gas concentration* (µg/L)** | **Predicted indoor air concentration† (µg/m$^3$)** | **ATSDR's comparison values for air (µg/m$^3$)** |
| PCE | 120 | 0.0012 | 300 |
| TCE | 63 | 0.00064 | 500 |
| cis-1,2-DCE | 32 | 0.00032 | 37‡ |
| VC | ND (0.27) | 0.0000028 | 0.1 |
| Benzene | 66 | 0.00067 | 30 |
| Toluene | 610 | 0.0062 | 300 |
| Ethylbenzene | 200 | 0.0020 | 1000 |
| Xylene (total) | 1330 | 0.013 | 400 |

* ACE 2003. Note: the detection limit (in parentheses) was used for the VC calculation.
† The indoor air concentration that would be expected from the highest sub foundation soil gas concentration sampled.
‡ EPA Region 9 PRG for ambient air, EPA 2002c.

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## F. Public Comment Responses

### General Comments

1. Comment: The Dept. of Health and Human Services must work for the citizens of this area and not cover up for big business.

ATSDR Response: ATSDR is an independent federal advisory public health agency. Our 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 disease related to toxic substances. One of our core values is trust. The agency is committed to being honest and ethical in all communications and actions.

2. Comment: We note that the precautionary recommendations for people concerned about not exposing themselves or their children to lead and DU contaminated soil is buried in the report. On pages 18, 19, and 27, ATSDR states that children should be tested for lead exposure and people can prevent exposure by ensuring children wash their hands after playing in the dirt and peeling vegetables. Approximately 710 children 6 years and younger live within 1 mile of the NL site. ATSDR should provide clear, understandable recommendations for parents in Fact Sheets and in the beginning of the report.

ATSDR Response: Given the levels of lead in the soil surrounding the NL site, ATSDR believes that children will not have health effects from incidentally ingesting lead- or DU-contaminated soil. Children at the greatest risk for elevated blood lead levels are those who live in or frequently visit a home with exterior or interior lead paint that is in poor condition, such as chipping, peeling, or flaking. ATSDR's recommendation to wash hands after playing in the dirt, peel home-grown vegetables, and having children's blood lead tested according to the NYSDOH lead poisoning prevention plan are prudent measures that parents can take.

3. Comment: …[W]e request that ATSDR redo the Health Consultation to expand and improve on the report so it provides an accurate assessment of the community's health risks. The agency needs to fully address the radioactive hazards posed by DU. The agency needs to substantially improve the emissions estimates and exposure scenarios. We also support the comments of [names omitted], and urge ATSDR to incorporate their recommendations in a new report as well.

ATSDR response: Public comments on original releases are one way ATSDR gathers information. We review and respond to all the comments and revise the document as needed.

Please see response to comment 78 regarding the radioactive hazards of DU.

4. Comment: The report didn't consider lag time between exposure and onset of disease, the contamination during early childhood and fetal growth, and exposure to other communities downwind.

ATSDR response: Typically in cases involving cancer and exposure to chemicals there is a latency period of decades between exposure and the onset of disease ATSDR considers this latency period in evaluating the possibility of cancer as a normal part of its process. Additionally, ATSDR considers sensitive populations such as young children and the unborn in evaluating public health implications of environmental contamination.

Please see the Child Health Considerations Section on page 31 for more information about early childhood and fetal exposure.

ATSDR considered "downwind" communities in its assessment. Using the information about air emissions and the deposition of DU in the soil around the NL plant, the highest levels of DU contamination occurred within a few blocks of the plant. Although others outside this area may have been exposed to DU air emissions from NL, they were not exposed at levels that would have caused them to be sick.

**Information Sources**

5. Comment: Aren't there possibly other sources of information that could be accessed to predict the levels of emissions that may have been released from the plant and the types of processes that were used at the plant? For instance, has anyone contacted former employees of NL who may have known the processes and chemicals used at the plant as well as the levels of production? Has anyone checked the past financial reports of NL to find out if the reports contain any information about NL's Colonie plant?

ATSDR Comment: As discussed in the document, ATSDR searched all available records at federal, state, and local agencies for information about National Lead. ATSDR also contacted the NYS Attorney General's office and the Albany County Court of the NYS Supreme Courts to determine if any records were available. In addition, ATSDR received information from community groups and local community members, some of whom worked at the NL plant. Scientists at ATSDR work on DOE sites all over the country and have an understanding of the processes involved and the sources of information.

ATSDR has not checked past financial reports of NL because information contained in those types of reports are not generally beneficial for scientific analysis. The best type of information for determining past health impacts is data related to emissions and ATSDR has some air emissions data. The emissions data were sufficient to determine that there was a past public health hazard from breathing emissions from the plant. Information from NL's past financial reports will not provide any greater certainty in relation to adverse health effects.

6. Comment: What other agencies or organizations could assist ATSDR in collecting the information it needs to develop conclusions about other medical conditions for which people who have lived or are living near the plant may have an increased risk?

ATSDR Response: ATSDR received letters, emails, and phone calls from many community members concerned that their health effects were caused by exposure to contaminants from NL. Many of these included different kinds of cancers. Different diseases have different causes and, based on scientific studies, we know that exposure to DU can increase the chance of developing kidney disease. In addition, the combination of inhaling DU dust and cigarette smoke could have increased risk of lung cancer. This is because of the irritant effect of the dust particles combined with the cigarette smoke. Studies do not show that DU will cause other diseases. The information collected from the community members indicates that the residents near NL suffer from many different illnesses; however there is no indication that the contamination from NL caused these illnesses. People who are concerned about their health should, of course, discuss those concerns with their healthcare provider.

7. Comment: Did ATSDR consult with the US Department of Energy, the US Army Corps of Engineers, Albany County Health Department or former NL Industries employees to determine if uranium air emission data for the years 1958-1979 exists? What happened to it? Where is it now located? Did ATSDR contact NL Industries to determine if the company has retained any

stack emissions records, employment records, or other information that might help quantify the uranium emissions?

ATSDR Response: As discussed in the document, ATSDR met with and collected information from several federal, state, and local agencies, including NYSDEC Headquarters and Region 4 offices, NYSDOH, ACHD, and NYSDOL. ATSDR also contacted the New York State Office of the Attorney General and the Albany County Courthouse. ATSDR also received information from community groups and local community members, some of whom worked at the NL plant.

It is unlikely that there are emissions records for the periods prior to 1979, when NYSDEC began requiring NL to submit emissions samples. Because ATSDR followed many different avenues in which to locate data, we believe that what we found is most likely all that exists.

Additionally, ATSDR sent a letter to NL industries requesting information. ATSDR discussed with NL the need for additional information about releases and company processes to help define past exposures. The company reviewed the public comment draft of the document and concluded that further information from them would not allow any more precise assessment.

8. Comment: Has ATSDR attempted to speak with the hundreds of people who lived near the NL site from 1958 (when the uranium emissions began) through the 1980s (when the emissions ended and the DOE removed some of the uranium from some of the neighborhood properties)? These residents and former residents can provide vast amounts of information about their activities, which ATSDR could use to determine uranium exposures. Some of these people also worked at NL Industries. As part of the health consultation ATSDR might benefit from conducting a public hearing or a series of hearings where people could provide oral and written testimony about their exposures, their knowledge of NL's operations, and their health concerns.

ATSDR Response: ATDSR has attended three meetings with the community since September 2002. During these meetings, ATSDR asked community members to contact ATSDR staff regarding any health related concerns. In addition, during the public comment period for the health consultation ATSDR has received many phone calls, emails, and letters from local community members concerned about their health.

9. Comment: Because of the importance of this study from every point of view, the fullest effort must be made to collect base data from all available sources, including any existing files of the NL corporation itself, of regulatory agencies. Although we know that ATSDR "reviewed and copied many documents related to the site" it is not clear whether all means have been utilized to locate all available information which could lead to better estimates of the amount and nature of the emissions. Again, on p.5, has it been assured with certainty that "there are no disposal records."? What investigation was made on this point? What records exist of the 1980 Teledyne investigation?

ATSDR Response: It is always difficult to find past data for two main reasons. First, much of NL's operation occurred before environmental regulations were in place, therefore they were not required to maintain disposal and emissions records. And second, because the plant ceased operation in 1984, information from both the plant and the regulatory agencies could have been purged or lost. ATSDR has searched the records of many agencies looking for information related to the practices, processes, and emissions at NL. ATSDR has spoken with several community members about their potential exposures from the NL site. ATSDR staff has reviewed several reports, including the 1980 Teledyne report. In addition, scientists at ATSDR

work on DOE sites all over the country and have an understanding of the processes involved and the sources of information. We believe that our search has been thorough.

**Former NL worker issues**

10. Comment: The health study does not include former workers at the NL plant. While they were at work, may of them were exposed constantly to DU dust and other toxic chemicals. Why are they not included in the health study?

ATSDR Response: ATSDR evaluates exposure to the general community surrounding hazardous waste sites and its mandate does not include workers. Agencies such as the National Institute for Occupational Safety and Health (NIOSH) and the Occupational Safety and Health Administration (OSHA) typically evaluate worker exposure issues.

The U.S. Department of Energy's Office of Worker Advocacy operates a program established under the Energy Employees Occupational Illness Compensation Act. This program provides compensation to individuals who developed illnesses as a result of their employment in nuclear weapons production-related activities and at certain federally-owned facilities in which radioactive materials were used. The Colonie Site is listed as one of the covered facilities.

More information about this program can be found at:
http://tis.eh.doe.gov/advocacy/laws/20010611list.pdf and
http://www.cdc.gov/niosh/ocas/default.html

Or by contacting:

Office of Worker Advocacy (EH–8)
U.S. Department of Energy
1000 Independence Avenue, SW
Washington, DC 20585
email: worker_advocacy@eh.doe.gov
toll-free: 1–877–447–9756

11. Comment: Did ATSDR make any effort to contact former NL Industries employees to obtain information about the day-to-day practices and manufacturing processes at the NL facility? The ATSDR report provides only skimpy and superficial information about what actually was taking place at the NL facility. Given what ATSDR knows about NL operations, does the agency think production workers were heavily exposed to uranium? We believe there is substantial evidence that this occurred. We also believe a health study of the surviving workers is warranted. We request that ATSDR contact NIOSH and recommend that NIOSH undertake such a study. NIOSH did investigate the NL Industries plant in the 1980s and was concerned about health risks to workers.

ATSDR Response: Please see response to comment 10 for information related to former workers.

In the 1980s, at the request of a local organization, NIOSH visited the NL plant to investigate the possibility of doing a study of the health impacts on the NL's worker population. NIOSH, however, decided to study the workers at TNS, a plant in Jonesboro, Tennessee that used depleted uranium as well. NIOSH had enough resources for only one study and focused on TNS because the industrial hygiene and exposure data were more complete than that at NL. The

NIOSH staff also commented that exposures at NL and TNS were probably very similar. However, the study at TNS was never completed at because of a worker's strike at the facility.

**General DU information**

12. Comment: You have also omitted information about the half-life of DU in your report. In a telephone conversation with [name omitted] I am told that the half-life for U-235 DU is 246,000 years; and that the half-life for U-238 DU approximates the life of the earth (4.7 billion years).

ATSDR Response: Natural uranium is mixture of 0.01% U-234, 0.72% U-235, and 99.27% U-238, by weight. Depleted uranium is uranium with decreased fractions of U-234 and U-235. The half-lives of U-234, U-235, and U-238 are 244,000, 710 million, and 4 billion years, respectively. Radioactivity is the spontaneous emission of radiation from the nucleus of an unstable atom. DU is considered weakly radioactive because U-234, U-235 and U-238 have such long half-lives. For example, if you have one gram of U-238, the major component of DU, it will take 4 billion years for half of that amount to decay by emitting radiation from its nucleus. Therefore, the radiation from DU is released so slowly that the chemical health effects would show up much sooner than any radiation health effects. This is why DU is considered as a heavy metal chemical toxin and not a radioactive hazard.

13. Comment: The report claims that "…when the plant stopped operating in the 1980's, the DU emissions stopped as well." This is of course true, but it does not follow that the hazard ceased when the emissions did. Once the radioactive DU dust has entered a region, it remains radioactive at a constant or increasing level, and as dust it continues to scatter and become windborne through future time.

It is also true that radioactive particles, once lodged in the lung, continue to radiate surrounding tissue continuously, so that health effects from the initial exposure may be exhibited at any future point in the lifetime of the person.

For both of these reasons, therefore, the health hazard from the NL site by no means ended at the time the stack emissions themselves ceased.

ATSDR Response: DU is only weakly radioactive and the major concern for exposure is from chemical toxicity. One way in which radiation causes cancer is that an energetic particle is released, passes through tissue and hits DNA in a cell that is dividing. The more rapidly cells in tissue divide, the more likely that the cell in the tissue is a target for an effect by the radiation. The rate at which particles are released from DU is extremely low. The rate at which cells in the lung tissue divide and, therefore are susceptible, is also very low. The combination of these biological factors may be reasonably assumed to be the reason that uranium or DU has not been considered as a human carcinogen.

As discussed in the document, between 1984 and 1988, DOE cleaned up DU-contaminated soil from 53 vicinity properties. Under its current program, ACE is cleaning up two additional properties: the town of Colonie property and the Consolidated Railroad Corporation property. Another adjacent area—the Niagara Mohawk property—requires no further remedial action for DU contamination. Therefore, there is no hazard from contaminated dust.

14. Comment: The report unfortunately at one point repeats a remark which often confuses the discussion of the health effects of DU. It states: "This is because natural and depleted uranium are only weakly radioactive."

This statement is completely misleading. It would be true if our concern were with radiation entering the body through the skin, which alpha radiation from DU will not penetrate. However, the pathways by which DU particles can cause cancer in the human body are well known, and the fact that the radiation is "weak" is irrelevant when that radiation is coming from particles lodged within the lung and inducing cancer in immediately adjacent body cells. This radiation, and the threat of cancer which it poses, continues throughout the lifetime of the person affected.

ATSDR Response: DU is only weakly radioactive and the major concern for exposure is from chemical toxicity. One way in which radiation causes cancer is that an energetic particle is released, passes through tissue and hits DNA in a cell that is dividing. The more rapidly cells in tissue divide, the more likely that the cell in the tissue is a target for an effect by the radiation. The rate at which particles are released from DU is extremely low. The rate at which cells in the lung tissue divide and, therefore are susceptible, is also very low. The combination of these biological factors may be reasonably assumed to be the reason that uranium or DU has not been considered as a human carcinogen because of radiation.

In addition, current studies on humans with known amounts of uranium or DU have never identified uranium as a known human carcinogen. This has been verified by the UN's International Agency for Cancer Research. The greater hazard is from DU particles in the lung being absorbed in to the blood and targeting the kidney as a heavy metal toxin.

15. Comment: …[T]he Health Consultation omits the biokinetic model developed by the International Commission on Radiation Protection that explains how uranium microparticles can enter the body and spread to vital organs; but instead reaches the conclusion that the consequences of the exposure to the citizens of the surrounding area are minimal.

ATSDR Response: The biokinetic model is used to set limits for exposure, not to calculate dose. Based on the DU air emissions from the NL plant, the greatest concern from exposure is chemical toxicity. ATSDR concluded that breathing the airborne DU emissions could have increased the risk of kidney disease. In addition, the combination of inhaling DU dust and cigarette smoke could have increased risk of lung cancer. This is because of the irritant effect of the dust particles combined with the cigarette smoke.

**DU health effects**

16. Comment: The team responsible for the ATSDR health study has failed to present convincing evidence why they conclude there are few or no adverse health consequences to people who have lived in the neighborhood of the NL plant and were exposed to fallout of DU particles years ago when the plant was operating.

ATSDR Response: This comment is erroneous. ATSDR did conclude that the health of the community could have been impacted by the DU emissions. The community was exposed to DU air emissions from the NL plant operations. The scientific literature shows the health consequences of this type of exposure. DU is a heavy metal and through this property may result in kidney disease similar to disease caused by other heavy metals. In addition, the combination of inhaling DU dust and cigarette smoke could have increased risk of lung cancer. This is because of the irritant effect of the dust particles combined with the cigarette smoke.

17. Comment: With respect to a potential health hazard from airborne DU, the report states "…no human cancer has been directly linked to natural or depleted uranium."

It is not clear what a “direct” link would consist in, but the links which would establish this health hazard would in the first instance take statistical or epidemiological form. It is therefore not a question of “direct links.” Although data necessary for such studies are often limited or unavailable, there is a convincing and growing body of evidence of this kind that airborne DU does constitute a serious health risk. Remarkably, the report itself includes references to valuable epidemiological evidence of the health hazard from airborne emissions, based on data from the NL site itself.

ATSDR Response: The statement that no human cancer is directly linked to natural or depleted uranium comes from epidemiological studies. Studies of uranium miners, millers, and processors have shown that the main risk of developing lung cancer is associated with breathing other cancer-causing substances such as radon and cigarette smoke and not with breathing uranium (Whittemore and McMillan 1983; Polednak and Frome 1981; Scott et al 1972; Hadjumichael et al 1983; Cragle et al 1988). Therefore, ATSDR cannot determine a direct link between illness and DU exposure. We can, however, determine breathing DU at levels from NL could have increased the risk of developing kidney disease. In addition, the combination of inhaling DU dust and cigarette smoke could have increased risk of lung cancer. This is because of the irritant effect of the dust particles combined with the cigarette smoke.

18. Comment: The report emphasizes here the increased risk when DU inhalation is combined with cigarette use, as it would be for many in the exposed region, but this of course does not imply that the hazard is any way confined to cigarette users. It may be exacerbated by cigarette smoking, and this is a very interesting and important fact, but this does not mean that the risk from airborne DU is contingent on cigarette smoking, or that is does not exist in the absence of cigarette smoking.

ATSDR Response: Current studies on humans with known amounts of uranium or DU have never identified uranium as a known human carcinogen. This has been verified by the UN’s International Agency for Cancer Research. There are, however, several scientific studies that indicate that smoking is a significant risk factor for lung cancer in people exposed to respirable dust. ATSDR believes that there could have been significant amounts of respirable particles in NL’s airborne emissions. Therefore, ATSDR concluded that there could have been and increased risk of lung cancer among smokers.

19. Comment: The statement on page 1 and elsewhere in the document (p. 9, p. 12 Did people breath harmful levels of DU in the past, and p. 26 conclusion 1) supporting the conclusion that "the combination of inhaling DU and cigarette smoke could have increased risk of lung cancer" needs to be clarified. If, as stated by ATSDR during our recent conference call, the conclusion was arrived at by considering the "dust-like" nature of the uranium particles in air (and not possible radiological effects), interacting in some way with cigarette smoke to increase the risk of lung cancer, then the Mabuchi et al. 1991 reference does not support the conclusion. The Mabuchi et al. 1991 reference speaks to the issue of radiation, cigarette smoking and lung cancer, and concludes that a submultiplicative model, perhaps even additive, may be sufficient to account for interaction between radiation and cigarette smoking in the causation of lung cancer. The more recent article of Pierce, Sharp and Mabuchi (Radiat. Res 2002 Apr; 159 (4): 511–20) describes these effects as additive rather than "greater than additive". **Given this information, ATSDR needs to clarify and better support their conclusion in the Health Consultation concerning exposures to DU and cigarette smoke and an increased risk of lung cancer.**

ATSDR Response: ATSDR has provided further scientific support in the document related to inhalation of particles and cigarette smoke increasing the risk of lung cancer.

20. Comment: How many particles of ceramic uranium oxide or other types of uranium might that person have inhaled and retained in his or her lungs? How many particles must be inhaled to cause injury? Could the inhalation of as few as one particle cause cancer or other illnesses?

ATSDR Response: There are many different factors which affect people's exposure to an airborne contaminant. First, one must know the chemical forms, release rates, and length of time the contaminants were released. Secondly, it is important to have monitoring data for the surrounding area and the meteorological data during the release times. Also important are the population specific data, including information about the duration of exposure, breathing rate, level and frequency of physical activity, body weight, overall health status, smoking status, and pulmonary disease status.

We know that because the DU was burned, the resulting emissions were probably an insoluble oxide and would therefore stay in the lung for a long time. We also have some information about the monitoring data and the deposition pattern of the DU. However, because of the variability between different people as a result of the population specific factors, it is impossible to know how much uranium that residents who lived near the NL plant inhaled and retained in their lungs.

In addition, we do not know the size and shape of the particles that were emitted. We do know, however, that because the DU was burned, there were most likely particles that were in the respirable size range of less than 10 μm. Particles of this size can be trapped in the deepest part of the lung and act as an irritant in conjunction with cigarette smoke (Knutsson *et al* 2000; Wild *et al* 2000; Szadkowska-Stanczyk and Szymczak 2001). We cannot prove nor disprove the case of one particle of DU causing cancer. Cancer, among other issues, is a failure of the immune system. But at the very low radiological doses we believe occurred at NL, the immune system was probably not affected.

21. Comments: Depleted uranium is radioactive. It is well known that any increased exposure to radiation causes an increased risk of cancer. Radiation exposure can also cause birth defects and weaken the immune system. ATSDR has not included many medical journal references on the hazards of radiation in its health assessment literature. ATSDR has substantially downplayed the health risks of cancer and birth defects from exposure to DU uranium. We request that ATSDR correct its report to fully include the hazards of DU radiation in its health assessment. Environmentally induced cancers can take 5 to 40 years to show up.

ATSDR Response: It is true that certain types of radiation can cause cancer, but the well known cases of cancer involve other types of radioactive material, not DU. For example, exposure to radiation from the sun is known to cause specific types of skin cancer, and exposure to radon gas is known to cause lung cancer. Depleted uranium does not have the same characteristics as the sources of the above mentioned radiation exposures.

While it is true that depleted uranium is radioactive, compared to naturally occurring uranium, DU is about 40% LESS radioactive. Depleted uranium has a half-life almost as long as the solar system is old, and is therefore practically non-radioactive. One millicurie of DU, which is a unit used to describe the intensity of radioactivity in a material, would weigh about 1000 pounds, while a millicurie of Radium-226, a highly radioactive material, would weigh 2 millionths of

a pound. Because DU is so weakly radioactive, the radiation dose is very, very low. No human studies have found any cancer increase from exposure to DU, however there is evidence of kidney toxicity. This is why DU is considered as a heavy metal chemical toxin and not a radioactive hazard.

As a result of manufacturing practices in the United States and around the world, DU has been present in the environment for about 60 years. Natural uranium has been in the environment from the beginning of the planet and people have been exposed continuously to uranium in the air, food, and water. ATSDR's toxicological profile for uranium (ATSDR 1999b) has not identified any adverse health effects associated with environmental exposures to uranium, nor has the National Academy of Science (BEIR IV 1988). Studies of DOE workers with known amounts of uranium in their bodies have never identified any cancers associated with their exposures.

**DU soil clean-up guidelines**

22. Comment: The clean-up guideline for the Colonie Site for unrestricted public use of the NL site has been stated as 35pCi of U-238 per gram of soil. The guideline must refer to alpha particle emission from U-238, since this is the major emission from U-238. But alpha particle emission from U-234 in DU is not included in the guideline. If total alpha emission is considered, 5 pCi per gram must be added to the 35 pCi per gram guideline…Omission of the U-234 alpha activity cannot be justified on scientific grounds. What is the reason why U-234 alpha emission is ignored?

ATSDR Response: The commenter is asking why the cleanup guideline was based on the activity of U-238 and did not include the uranium isotope 234. In 1983, NRC issued its Guidelines for Decontamination of Facilities and Equipment Prior to Release for Unrestricted Use or Termination of Licenses for Byproduct, Source, or Special Nuclear Material, Policy and Guidance Directive FC 83-23 (Directive FC 83-23). Under Directive FC 83-23, the NRC established guidelines for acceptable average and maximum contamination levels for a wide variety of radionuclides. The cleanup level for DU in soil is 35 Ci/gm. U-234 is a short-lived decay product of U-238. Because the contamination was depleted uranium, there is essentially no U-234. In fact, it would take nearly a half-million years before the U-234 reached half the activity of U-238 in DU, and 2.5 million years for the activity of U-234 to equal the activity of U-238. This is why the cleanup guideline is described as 35pCi of U-238 per gram of soil.

23. Comment: On page 24 the EPA Region 9 PRG for residential soil is 16 mg/kg. For comparison, the cleanup guideline for unrestricted use at the NL site is 35 pCi per gram of U-238, which is a U-238 soil concentration of 104 mg/kg. Albany area soil is only 1-2 mg/kg. The PRG does not agree with the cleanup guideline. If the EPA PRG takes precedence, does this mean that no residential dwellings can ever be constructed on the former NL site? If so, how will this be enforced?

ATSDR Response: Preliminary Remediation Goals (PRGs) are tools for evaluating and cleaning up contaminated sites. They are risk-based concentrations that are intended to assist risk assessors and others in initial screening-level evaluations of environmental measurements. They are calculated without site specific information. PRGs are EPA guidelines, not legally enforceable standards. They are used for site "screening" and as initial cleanup goals if applicable; they are not *de facto* cleanup standards (EPA 2003).

Thirty-five pCi/g is a NRC guidance limit and it is roughly equivalent to 50 mg/kg of DU. Since this was an NRC licensed facility, the NRC limit is applicable. In addition, this level is protective of public health. The site-specific guidelines (35 pCi/g in the top 2 inches of soil and 1076 square foot area, and 100 pCi/g in the top 2 inches of soil and 10 square foot area) were developed by DOE and New York State officials and were reviewed by EPA (DOE 1989b). Once the remediation at the Colonie Site is completed, the property will be turned over to the Town of Colonie. At this point, there have been no decisions about what the land use will be. ATSDR believes that the soil remediated to 35 pCi/g will be safe for residential use.

24. Comment: ATSDR noted on page 12 of its report that the Department of Energy (DOE) regulatory soil cleanup limits "were decided for the purposes of remediation and not based on health risk or dose." DOE obviously did not remove all of the uranium NL emitted. Does the uranium that remains in the soil off-site pose a health risk to humans? This is an important question. There are many people who never walked or played on or near the NL property but who live or used to live a half-mile or a mile or two miles away from the NL site. Some of these people desire to know if there is a health risk to them from either the uranium particles they might have breathed in during the years NL operated or from any uranium that remains in the ground now. [A local scientist] has demonstrated that uranium particles emitted from the NL factory were transported via air currents to a distance of at least 25 miles from the NL factory.

ATSDR Response: The depleted uranium that remains in the soil off-site does not pose a health risk to humans. The cleanup guidelines are *much lower* than those that would cause health effects and are very protective of public health.

25. Comment: On page 6, the report notes that between 1984 and 1988, Oak Ridge National Laboratories performed radiological surveys of over 200 individual properties surrounding the former NL site. Fifty-six of these were found to have concentrations of radioactive material that would require clean-up. ATSDR notes that the limits used were for remediation and not based on health risk or dose. On page 12, the report notes that ATSDR reviewed surveys for 48 out of 56 of the properties found to require remediation. Since the limits used for remediation are not based on health risk or dose, was the ATSDR provided the results of all the surveys so that it might determine if any of the remaining properties posed any health risk.

ATSDR Response: The levels used for the cleanup of the vicinity properties were *much lower* than those based on health risks. ATSDR found that even the vicinity properties that were remediated did not pose a public health hazard. The cleanup of the properties was protective of public health.

26. Comment***:*** DU rods used to make projectiles might have been heat treated by lead dipping before coating with a metallic aluminum jacket. This metallic combination could increase the toxicity of the dust emissions leaving the stacks at the former NL site. ATSDR should evaluate the possible health effects of these combined metals in the dust fallout in the surrounding community.

ATSDR Response: If DU rods were dipped in lead during the projectile manufacturing process, the emissions from the stacks at the former NL site would contain oxides of the metals as a result of the burning rather than the metallic forms of DU and lead. As with the issue of air emissions when the facility was a foundry, ATSDR cannot evaluate the potential additional health impacts of lead oxide releases from projectile manufacturing because there are no air emissions data for lead during this period, only DU.

**DU-contaminated soil**

27. Comment: On page 24 is the following statement: "As discussed in previous sections, the DU used at the NL plant was water-insoluble. Touching or incidentally eating it would not have made people sick." This statement is insensitive and highly misleading…[U]nder no circumstances was a radiological worker allowed to touch with bare hands, inhale or ingest any amount, no matter how small, of any alpha-emitting radionuclide. The ATSDR statement shows a surprising distain for strict radiological controls on large quantities of DU used in manufacturing operations.

ATSDR Response: ATSDR has clarified the statement to apply to incidental touching of DU for community members. ATSDR believes that workers in a manufacturing setting should follow applicable radiological controls when working with large quantities of DU. ATSDR also believes, however, that the amount of DU to which the local community was exposed by incidental soil contact is far less than the amounts that workers are exposed to in a manufacturing setting. Therefore, incidentally touching DU by community members would not have caused people to become sick.

28. Comment: The ATSDR report does not comment on the exposures children might have because of the inhalation or ingestion of DU particles that landed on the ground and were resuspended in the air. This is a very important omission that should be corrected. There were scores of children and teenagers who lived in close proximity to the NL facility for much or all of their early years. For example, a child born in 1958 who lived within a block of the NL Industries facility until 1980 would or might have been exposed to 21 or 22 years of air emissions.

ATSDR Response: On page 16, ATSDR discusses exposure to DU from incidental ingestion and concludes that adverse health effects would not be expected, even for children. In addition, the resuspension and subsequent inhalation of DU-contaminated soil would be minimal compared to inhalation of DU air emissions from the NL plant. DU is a heavy metal and the particles in the soil are likely large particles that are hard to suspend. Lighter and smaller particles would likely have been dispersed and essentially diluted in the air from the initial emissions. In addition, the types of health effects expected from DU would have required large amounts of material to be inhaled and it is unlikely that there would have been a large enough volume of resuspended particles to cause health effects. The greatest risk would have come from inhaling the emissions from the plant.

29. Comment: Another key concern is that many children—who are the most sensitive and vulnerable to toxic chemicals—ingest soil while playing in the dirt. ATSDR stated that contacting DU contaminated soil is not expected to cause illness. However, ATSDR grossly underestimated children's exposures to soil contaminated with DU and lead by ignoring important soil ingestion studies by Dr. Edward Calabrese of the University of Massachusetts. His study found that 62% of the children at a day care center ingested 1 gram of soil a day; with 33% of the children ingesting over 10 grams of soil a day. ATSDR based its assessment on the assumption that children ingest a much smaller amount of soil—500 or 100 milligrams per day. We request a reassessment of the health risk based on 1 and 10 grams of soil ingestion per day assuming 373 milligram per kilogram for lead and 320 picocuries for DU contaminated soil.

ATSDR Response: Drs. Calabrese and Stanek looked at 64 children at a day care center for a period of 2 weeks. The 1995 study indicated that 33 percent of the children studied over the 2-

week period would have **1 to 2 days** a year where they would ingest more than 10 grams of soil while 16 percent would ingest more than a 1 gram of soil 35 to 40 days a year. According to Calabrese and Stanek, these values are modeled estimates and are likely to overestimate soil ingestion. Indeed, Calabrese and Stanek indicate that their data and others suggest that the "average" child ingests about 35-60 mg/day (Calabrese and Stanek 1998).

Even if a child ingested DU or lead at up to 10 g/day on rare occasions, the bioavailability (ability of a material in a form to be readily absorbed by the body) of uranium is very small, about 2%, and the bioavailability of lead is about 25-40%.

30. Comment: On page 13, the report notes that skin does not *easily* absorb water-insoluble forms of uranium like the type used at NL. Does this mean that skin can absorb some water-insoluble uranium, and if so, could concentrations be high enough to cause a health risk? Also, are there any situations which in the skin may be more prone or at risk to absorb water-insoluble forms of uranium, such as cuts in the skin or skin conditions?

ATSDR Response: Scientists know that the skin does not easily absorb water-insoluble forms of uranium; the DU used at the NL plant was water-insoluble. Some animal studies have found health effects such as skin irritation and dermal ulcers after exposure to different uranium compounds, although a study on rats found that a 1-year exposure to uranium tetrachloride (a water-insoluble compound) did not affect the skin (Stokinger et al 1953). In addition, dermal effects were not seen in studies of uranium miners, millers, and processors. The observed skin damage reported in animals dermally exposed to excessive quantities of uranium compounds is not expected to occur in human exposures at hazardous waste sites. Such exposures, if they do occur, are expected to be at or less than the levels at which uranium miners, millers, and processors are exposed, [i.e., levels at which no attributable dermal health effects were reported (ATSDR 1999b)].

Cuts or abrasions in the skin or other skin conditions might increase the likelihood that contaminants on the skin could be absorbed by the body. However, the amount of DU that could be absorbed will be limited by the surface area of the abrasion or skin condition and is not likely to significantly increase the amount of DU in the body. ATSDR concludes that it would be very unlikely for people playing or gardening to absorb uranium into their bodies through the skin, even if they have cuts or other skin conditions. Consequently, no health effects would results from touching the soil.

31. Comment: Likewise, on page 14, the report states that water-insoluble compounds of uranium such as those used at NL are not easily absorbed by the body's gastrointestinal tract. Are there any situations in which DU may be more easily absorbable in the gastrointestinal tract? Also, does this mean that the intestinal tract can absorb some water-insoluble uranium, and if so, could concentrations be high enough to cause a health risk?

ATSDR Response: Typically, the digestive system will only absorb about 0.2% of ingested insoluble uranium compounds, and the hydrochloric acid in the stomach renders most forms of uranium insoluble. ATSDR reviewed the soil data from the properties surrounding the Colonie Site and calculated doses for the incidental ingestion of DU. The dose calculations were based on health protective assumptions and assumed that 2% of the DU would be absorbed. The estimates were compared to ATSDR's minimal risk levels (MRLs) and ATSDR found that adverse health effects would not be expected. Appendix D has information about ATSDR's calculations and assumptions for eating DU-contaminated soil.

Conditions in the gastrointestinal tract such as gastritis (inflammation of the stomach lining), gastroenteritis (irritation and inflammation of the digestive tract), and ulcers (sores on the lining of the digestive tract) may increase the likelihood that ingested contaminants could be absorbed by the body. However, we know from the levels of DU in the soil and health protective assumptions used in the calculated exposure dose from ingesting DU-contaminated soil is orders of magnitude below levels that would cause a risk of health effects. Therefore, conditions of the gastrointestinal tract are not likely to increase the risk of health effects.

32. Comment: [ATSDR's report states,] "Concerns have been raised that children could have been playing in the soil with bare feet, arms, and legs during the summer months, thus increasing the area on their bodies that could contact contaminated soil. Because, however, the water-insoluble form of uranium is not very easily absorbed by the skin, ATSDR believes these children would not be at any higher risk of health effects."

Your report does not address the effects of when the plant processed enriched uranium. Potential effects related to the processing of the fuel of the enriched uranium at NL should be examined with respect to the human population who lived around NL when they were processing fuel from enriched uranium.

ATSDR Response: DU is pyrophoric, meaning that it can spontaneously ignite. The vicinity properties surrounding the NL plant were contaminated with DU because large amounts of DU were burned regularly in the chip burner to prevent the ignition of left over DU. The manufacturing processes at NL that used DU and enriched uranium did not contribute significantly to the offsite contamination. In addition, the results of the offsite soil sampling show that the uranium contamination was depleted and not enriched. Therefore the chemical form of the uranium that people would come into contact with was the insoluble form of DU that is not readily absorbed by the skin.

33. Comment: The ATSDR report stated, "Little scientific information is available regarding how touching DU or DU-contaminated soil can affect health" but then downplayed concerns this phenomenon. (Page 12.) If little information is available, how can ATSDR be so confident that there is little risk? Children played in the dirt, played football on the NL property, sat on the ground, splashed in puddles, waded in stream, swam in the pond, dug holes in the ground and touched interesting looking and unusual objects. Having spoken to many people who lived in the NL neighborhood for part or all of their childhood and teenage years, we are aware that many children and teenagers played with pieces of radioactive debris that NL buried or discarded in the neighborhood. (We informed ATSDR of this concern in our meeting with agency officials.) If children had open wounds, cuts, or scrapes in the skin, or if the DU came in contact with their eyes, nose, ears, or mouth, they could have absorbed or inhaled DU. We believe both children and adults had substantial exposure to DU through inhalation, ingestion, and skin exposure for many, many years. Many children spent parts of many days playing on or near the NL property. These people had repeated exposures to the soil contamination in addition to the 1958-1984 air emission exposures.

ATSDR Response: It is true that little scientific information is available regarding how touching *DU or DU-contaminated soil* can affect health. There is, however, information about dermal exposure to other uranium compounds. Scientists do know that the skin does not easily absorb water-insoluble forms of uranium; the DU used at the NL plant was water-insoluble. Although some animal studies have found health effects such as skin irritation and dermal ulcers after

exposure to different uranium compounds, a study on rats found that a 1-year exposure to uranium tetrachloride (a water-insoluble compound) did not affect the skin (Stokinger et al 1953). Thus the concern for dermal effects from skin contact with uranium is minimal. Dermal effects were not seen in studies of uranium miners, millers, and processors. The observed skin damage reported in animals dermally exposed to excessive quantities of uranium compounds is not expected to occur in human exposures at hazardous waste sites. Such exposures, if they do occur, are expected to be at or less than the levels at which uranium miners, millers, and processors are exposed, [i.e., levels at which no attributable dermal health effects were reported (ATSDR 1999b)]. Even in the case where someone had broken skin from a cut or scrape, the amount of DU that would be absorbed through that opening would be much less than what uranium miners, millers, and processors were exposed to. ATSDR concludes that it would be very unlikely for children playing on or near the NL facility to absorb uranium into their bodies through the skin.

**DU air emissions**

34. Comment: New York State made measurements of the DU emissions from NL for a period of time before NL was forced to cease production. Why are they not discussed and included in the health report? The measurements for January 1980 must have far exceeded the 150 μCi maximum radioactive emission amount allowed by NY state for January...The public cannot make informed judgments without access to numerical data.

ATSDR Response: ATSDR does not have any DU emissions data collected by NYSDOH. We do, however, have approximately 1000 measurements of DU emissions for limited periods between 1979 and 1984 submitted by NL to the New York State Department of Environmental Conservation. These data are from several of the stacks that were in operation during this time, with the highest levels coming from the chip burner. This data was used by ATSDR in its evaluation of exposure to DU emissions. As discussed in the health consultation, ATSDR searched the records of several state and local agencies looking for data and was only able to locate these data sets. Table 2 in the main body of the health consultation provides a summary of the DU air emissions data.

35. Comment: In 1979, a researcher at the Knolls Atomic Power Laboratory in Schenectady, NY discovered particles of depleted uranium in air filters as far as 26 miles away from the former NL site. The NL plant was identified as the source of the depleted uranium. The particles were of aspirable size, meaning that the particles would have become lodged in the lungs. According to [name omitted], these particles could have traveled even further than 26 miles. A copy of the internal memorandum is enclosed with these questions. How does this report change the analysis contained in the Health Consultation and to what extent does it affect the definition of the exposed population?

ATSDR Response: Although particles of DU were found at distances from the NL plant, the amount of DU at those distances would not have caused adverse health effects. Based on the levels of DU emissions and the fact that the majority of DU-contaminated soil was in close proximity to the NL plant (we evaluated soil contamination data), only residents within a few blocks of the Colonie Site would have been exposed to levels of DU that could have harmed their health. ATSDR does not believe that people who lived further from the plant would have been adversely impacted.

36. Comment: On page 12 of the report, ATSDR stated: "Based on the levels of DU found in the soil, and the fact that the NL plant scaled down operations during the late 1970s and early 1980s (DOE 1989b), the earlier (pre-1979) air emissions were probably higher." It is our understanding based upon news reports from 1979-1982 and interviews with former NL workers, that NL operations were at their peak in late 1979 and early 1980.

ATSDR Response: A draft report states that the production level at NL was increased in 1977 and that NL added an electrostatic precipitator and a filter system to the chip burner. Prior to that date, NL's chip burner did not operate with any emissions control equipment. In 1979, NYSDEC was alerted that the filter system in the chip burner had been bypassed (NYSDOH 1979b). Following that, the plant operated at a reduced level of activity beginning in 1980 (DOE 1985). Using this information and the levels of DU found in soil of vicinity properties, ATSDR believes that the emissions from NL were probably higher before the period for which we have air sampling data.

If, however, NL's operations were highest during the period that air emissions data are available, then it is possible that the DU emissions were not as high in earlier years. Still, in a situation with conflicting information we would rather be health protective and assume that levels were higher in the past.

37. Comment: An article in the *Schenectady Gazette* on February 6, 1980, reported that NL's uranium emissions for January 2-23 1980 exceeded 417 microcuries. On page 11 of ATSDR's report, in bold print, there is a section heading, "How much DU was released in air emissions from the NL plant?" the answer to that question is extremely important but not provided nor is any estimate made. Can ATSDR provide any quantitative answer as to how much uranium NL might have emitted over the years? Would it be a gram and ounce, a pound, one hundred pounds? Also, what is the range and size of the uranium particles NL emitted? What is the shape(s) of these particles? How does the size and shape of the particle inhaled impact health?

ATSDR Response: Because of the limitations of available data ATSDR cannot provide a definitive or quantitative answer for how much DU was released by the NL plant from 1958 to 1984. This is one of the difficulties in dealing with past emissions and past exposures. We have some air emissions data, which is important information for assessing public health impact. The best scientific practice for a site like that at Colonie is to use the available information—environmental data and toxicological studies—to determine whether there is a possibility of an increased risk of health effects. Even if we could find the exact amount of DU that was released, we still would not be able to give an exact number for an increased risk. This is because there are still many factors that are variable or unknown. For instance, environmental contamination can affect individuals differently because of such factors as age, immune system, body weight, and respiratory rate.

We do not know the size and shape of the particles that were emitted. We do know, however, that because the DU was burned, there were most likely particles that were in the respirable size range of less than 10 μm. Particles of this size can be trapped in the deepest part of the lung and act as an irritant in conjunction with cigarette smoke. This is why ATSDR concluded that there is an increased risk of lung cancer from DU emissions, particularly for smokers.

38. Comment: While we know that DU was transmitted over a wide area centered at the Colonie site, we have at this point no information concerning the pattern of this deposition, or the seriousness of the associated threat to health of area residents. It would, however, be possible to

make at least a preliminary estimate of the pattern of deposition, and then to investigate whether there have in fact been consequences to area health in this area. Since the implications for public health are potentially very serious, preparation of such an estimate becomes a matter of high priority.

To estimate the probable region of exposure from the NL stack, two factors would be involved, as follows:

**(1) Determination of prevailing wind patterns**

Data should be researched from current and historic records concerning typical local prevailing wind patterns in the vicinity of Colonie, including direction, velocity, times and duration. This information would then be fed into a model of distribution and deposition of airborne particles.

**(2) Modeling of distribution and deposition of airborne DU particles**

Theory exists by which the transmission of airborne particles from stack plumes, and the pattern of their deposition, can be determined, and general models are available into which the Colonie DU data could be inserted.

By the combination of (1) and (2), a map would be produced showing an estimate of the density of exposure to airborne DU particles in a certain most-affected region within the Capital District. This map would embody what we may refer to as the **Regional Exposure Estimate**.

In the absence of proper records from the NL operators concerning the amounts and times of emissions, such an estimate would necessarily be only approximate. Such an approximation, however, would be far better than the present state of ignorance, in which it is known only that a major emission of DU occurred of some 26 years, though no estimate is available of either the area affected, or the distribution of the exposure.

This Regional Exposure Estimate would serve as the basis for a valid, systematic epidemiological study of the effects of radiation from the Colonie site.

ATSDR Response: We do have information about the pattern of deposition. As discussed in the health consultation, in 1980 TI surveyed the neighborhood surrounding the NL plant for radioactivity. TI determined that the uranium released into the air through stack emissions had deposited on residential and commercial properties and structures. The survey showed that the majority of the contamination was north/northwest and southeast of the plant, in the direction of prevailing summer and winter winds (Teledyne Isotopes 1980).

In addition, between 1984 and 1988, Oak Ridge National Laboratory (ORNL) performed radiological surveys of over 200 individual properties surrounding the former NL property. Of these, ORNL found that 56 vicinity properties were contaminated with concentrations of uranium exceeding the regulatory guidelines. Between 1984 and 1988, DOE cleaned up 53 vicinity properties. Under its current program, ACE is cleaning up two additional properties: the town of Colonie property and the Consolidated Railroad Corporation property. Another adjacent area—the Niagara Mohawk property—requires no further remedial action for radiological contamination. Because we know the prevailing winds and the pattern of deposition, there is no need for further analysis with a computer model.

39. Comment: Can ATSDR quantify the amount of total stack emissions based on the amounts of uranium found in the soil on-site and in the surrounding community? We request that ATSDR expand its exposure evaluation by doing a computer model to estimate air emissions based on the

levels of DU found in the soil. This has been done at other sites, such as the Kelly site. It is critical that additional research be done to much more accurately estimate the exposure to the community. ATSDR should contact NL Industries, DOE, the Albany County Health Department, the Army Corps of Engineers and any consultants to legally request all their NL emissions information. It should also conduct an exposure evaluation on the likely air emissions based on the levels of DU found in the soil.

ATSDR Response: Although this type of modeling has been used by ATSDR at other sites, it is generally used when there are *no* air emissions data available. Although the data that ATSDR used is for a limited period of time and not complete over the time period, it is still more accurate than modeling soil data as a proxy for air data.

Because there are so many factors and assumptions involved in using a model to predict what the air emissions were from levels in the soil, we would not be able to more accurately estimate exposure to the community. We believe that the data we have gives us a much better measure of exposure. It is also important to note that models and calculations will never provide an exact number for emissions or increased health risk. The best scientific practice in this situation is to use the available information—data and toxicology—to determine whether there is a *possibility* of increased risk of health effects. ATSDR believes that the DU emissions data were sufficient to determine that there was a past public health hazard because breathing DU emissions from the plant could have increased the risk of kidney disease, and that the combination of inhaling DU dust particles and cigarette smoke could have increased risk of lung cancer. In addition, based on the levels of DU found in soil off-site, and the fact that the NL plant scaled down operations during the late 1970s and early 1980s, we believe that the levels of stack emissions before 1979 were probably higher than those found in the 1979–1984 data.

As discussed in the document, ATSDR met with and collected information from several federal, state, and local agencies. ATSDR also received information from community groups and local community members, some of whom worked at the NL plant.

40. Comment: Throughout the report, the assumption is made that health effects from the stack are confined to an area near the plant. There is good reason, however, to believe that this is not the case, but that the health hazard due to depleted uranium from the National Lead plant extends a much greater distance from the Colonie site. It would appear that the authors of the report may have been unaware at the time of writing of a report by [name omitted], formerly of the Knolls Atomic Power Laboratory, which demonstrates, it would seem beyond possibility of doubt, that particles of depleted uranium from the Colonie site were detected in filters at the Knolls laboratory ten miles from the Colonie site, and were even detected in a filter 26 miles from the NL site. It appears that [name omitted] has here shown conclusively, both experimentally and by careful theoretical analysis based on particle size and aerial transport, that it is not true that the health hazard is limited to an area near the site. Unfortunately, the false assumption pervades the report.

ATSDR Response: ATSDR has reviewed the report about DU particles found at Knolls Atomic Power Laboratory. Although the researcher found a few particles of DU at a facility 10 miles from the Colonie Site, this does not indicate widespread contamination, nor does it indicate a widespread health hazard. Although particles of DU were found at distances from the NL plant, the amount of DU at those distances would not have caused adverse health effects. Several factors can determine whether someone will become ill from coming into contact with, or being

exposed to, uranium. One of these factors is the dose, or how much of the chemical gets into the body. Only residents within a few blocks of the Colonie Site would have been exposed to levels of DU that could have harmed their health. ATSDR does not believe that people 26 miles away, 10 miles away, or even 1 mile away would have been adversely impacted.

41. Comment: The ATSDR, by the application of a mathematical model, determined that "…the highest 1979-1984 stack releases exceeded the current NESHAP guidelines by a factor of 54,000." ATSDR estimates as well that "…the earlier (pre-1979) emissions were probably higher."

These astonishing numbers reveal the magnitude of the threat which has been introduced into the Capital District. Despite the fact that there emissions occurred in the past, the DU which has been spread over a very wide area goes on emitting its radioactivity unabated at this present time.

ATSDR Response: The value from the COMPLY modeling program was based on the highest air sample from data collected during 1979–1984. The highest sample was used because, based on available information, it is probable that the levels of stack emissions before 1979 were higher than those found in the 1979–1984 data. The fact that the NESHAP guidelines were exceeded by 54,000 was used as a comparative value indicating that the levels were very high and could have been a public health hazard. For this final version of the Colonie Site public health consultation, ATSDR has used another EPA-approved model, CAP-88, which is a more detailed model than COMPLY. This model also indicates that the highest 1979–1984 stack releases exceeded the current NESHAP guidelines. Please see page 16 and Appendix C for more information about the CAP-88 model.

In 1983, ORNL performed detailed radiological surveys of the individual vicinity properties surrounding the NL plant, including private residences. These surveys were designed to locate all properties on which uranium contamination exceeded the guidelines developed by New York State and DOE. The agencies surveyed 219 locations. The results indicated that 56 properties required remediation (DOE 1995). Between 1984 and 1988, DOE cleaned up 53 vicinity properties. Under its current program, ACE is cleaning up two additional properties: the town of Colonie property and the Consolidated Railroad Corporation property. Another adjacent area—the Niagara Mohawk property—requires no further remedial action for DU contamination.

The radioactivity of DU is extremely low and its toxicity is evaluated based on its chemical nature (please see response to comment 78 for more discussion). The levels of DU in the soil are not at levels that would cause health effects. Therefore, there is currently no hazard from DU in the soil.

42. Comment: The report states, "Therefore, DU emissions at these high levels could have increased the risk of health effects – especially kidney disease – for people living near the plant." In view of what has already been shown, this must be amended to extend to people living within a radius of a number of miles of the NL plant. It therefore becomes urgent to make the best possible estimate of the area and population actually exposed to this hazardous emission.

ATSDR Response: Although particles of DU were found at distances from the NL plant, the amount of DU at those distances would not have caused adverse health effects. Only residents within a few blocks of the Colonie Site would have been exposed to levels of DU that could have harmed their health. Due to the low concentrations detected in soil and minimal opportunity for

exposure, ATSDR does not believe that people living farther from the site would have been adversely impacted.

43. Comment: …[A]ttention should now focus on making a thorough and scientifically controlled study of the airborne emissions from the NL plant, and their effect over a large surrounding region over the entire period of time from the earliest emissions to the present.

The best estimate of the region on which the study would be that described earlier as the Regional Exposure Estimate. Note that this includes not only and overall area of exposure, but an estimate of the levels of exposure within the area. Though only an estimate, it becomes the best available guide to the epidemiological study.

Without attempting to anticipate the design of a study which is a problem for epidemiological specialists, we can envision that a sample of the impacted population would be surveyed for health problems, especially lung cancer. The impacted population would consist of those who had lived in the area during the period 1958-1984, grouped by age and perhaps other categories. Various categories of duration of residence in the area during or after the 1958-1984 period would be considered in analysis of the data. The reference population unaffected by the NL emissions should be taken far from the Colonie site, or perhaps from comparable populations in other parts of the state.

Such a study should be framed with scientific care and carried out with the help of members of the local medical community. The results should be made known to the affected public and local physicians, but should as well be published in a peer-reviewed journal as a contribution to the medial literature on a subject which is of great importance, and still inadequately studied.

ATSDR Response: Using the information we have about the soil deposition pattern, the levels of DU found in the soil, and the prevailing wind patterns, we know that the people exposed to the highest levels of DU air emissions were located within a few blocks of the NL plant. We also know that the exposed population is small and an epidemiologic, or statistical, study of area residents would not be likely to show any health effects that could be directly linked to emissions from the plant. Even if cases of kidney disease and lung cancer were found, it would be difficult to determine whether they were related to a specific environmental cause or to the natural incidence of disease within the general population.

44. Comment: …We stated that the COMPLY code is a very conservative screening tool, that it overestimates the potential radiation doses, and that the United States Environmental Protection Agency states that the results from COMPLY are not intended to represent actual doses to real people. We recommended that ATSDR use a more realistic model to assess potential radiation doses... Although there is no question that depleted uranium was released to the atmosphere while National Lead operated at the site, the values produced by COMPLY do not provide a realistic estimate of the potential radiation doses to the public. We recommend that ATSDR use another method to estimate those doses.

ATSDR Response: The value from the COMPLY modeling program was based on the highest air sample from data collected during 1979–1984. The highest sample was used because, based on available information, it is probable that the levels of stack emissions before 1979 were higher than those found in the 1979–1984 data. The fact that the NESHAP guidelines were exceeded by 54,000 was used as a comparative value indicating that the levels were very high and could have been a public health hazard. ATSDR revaluated the data using EPA's CAP88-PC modeling

program, which is a more detailed model than COMPLY. ATSDR again ran the program using the maximum value from the air emissions data because we believe that using the maximum air emissions value is the most health protective method. The results from the model indicate that the levels would have been a public health hazard. Please see page 16 and Appendix C for more information about the CAP-88 model.

45. Comment: …[T]he report fails to include a record of New York State's measurements of the emissions from the time that they forced NL Industries to shut down.

ATSDR Response: Please see Table 2 for a summary of the air emissions data.

46. Comment: …[I]n support of the trivialization of the health concerns in the Health Consultation, studies involving uranium miners are cited. How can the exposure of uranium miners – who work a set number of hours per day, 5 days per week, wearing masks, be compared to the exposure of children growing up near the NL Industries plant, breathing depleted uranium and enriched uranium particles 24 hours a day, seven days a week? This trivialization doesn't even attempt to account for the exposure to the other harmful chemicals noted in the Consultation. In addition, the report's attempt to directly correlate the body mass of an adult uranium miner to that of a child is unsound at best. Also, the report fails to incorporate the most recent research regarding the effects that exposure to uranium and depleted uranium has on the human body.

ATSDR Response: Although there are differences in exposure between workers and the community, the worker population is usually exposed to higher levels of contaminants over a greater period of time. Typically the levels of contamination that the worker population comes in contact with are higher than those to which the community is exposed. There is no indication that the NL facility was operating and emitting DU 24 hours per day, 7 days per week.

Children are not small adults. They differ from adults in their exposures and may differ in their susceptibility to hazardous chemicals. Childrens' unique physiology and behavior can influence the extent of their exposure. Specific information is not available on whether children are more susceptible than adults to the effects of uranium. There is, however, a great deal of information in the scientific literature about the health effects of workers and animals that have been exposed. In the absence of scientific studies specific to children, we rely on other data and use very conservative assumptions in our analyses to be protective of children.

Please see page 13 and the response to comment 90 for more information about recent studies of 1991 Gulf War veterans.

47. Comment: The Health Consultation should provide more evidence supporting the conclusion - "*In the past uncharacterized emissions from the NL plant were a public hazard to the community surrounding the plant".* The document states in the summary that "the highest stack releases of uranium exceeded EPA's current National Emissions Standards Hazardous Air Pollutants (NESHAP) guidelines by a factor of 54,000." This value was derived using the COMPLY code. The COMPLY computer code used was developed to determine compliance with the Clean Air Act (CAA) standards for radionuclides by users of small quantities of radionuclides. The values estimated using this screening model are strictly for comparison with environmental standards and **are not intended to represent actual doses to people**. In order to estimate doses to people, information such as respirable particle size and solubility class should be considered. In instances such as this, where there are very few site-specific input data, the

code relies on default values that result in "worst case" scenarios. Also, as written, the summary gives the impression that the above statement is based on actual data rather than modeled estimates. This distinction should clearly be stated in the summary, if this model and results are included in the final report.

ATSDR Response: The value from the COMPLY modeling program was based on the highest air sample from data collected during 1979–1984. The highest sample was used because, based on available information, it is probable that the levels of stack emissions before 1979 were higher than those found in the 1979–1984 data. The fact that the NESHAP guidelines were exceeded by 54,000 was used as a comparative value indicating that the levels were very high and could have been a public health hazard. ATSDR re-evaluated the data using EPA's CAP88-PC modeling program, which is a more detailed model than COMPLY. ATSDR again ran the program using the maximum value from the air emissions data because we believe that using the maximum air emissions value is the most health protective method. The results from the model indicate that the levels would have been a public health hazard. Please see page 16 and Appendix C for more information about the CAP-88 model.

48. Comment: In an attempt to duplicate the results of the ATSDR consultation, the COMPLY code (Level 1) was run using the discharge value of 0.000000018 µCi/ml for U-238 as indicated in the report. The results from the run indicated an error an order of magnitude different from that described in the ATSDR Health Consultation. The result of 542,000 times allowable amount (as opposed to that of 54,000) was obtained from the level 1 run. It should be emphasized that this is no indication of the actual intake and the model assumes "No Dispersion". As requested by the COMPLY code (after the level 1 results failed), the code was run in level 2 using conservative assumptions on discharge and stack height, location to the nearest receptor, etc. The level 2 run was on the order of 2,200 mrem/yr for the 0.000000018 µCi/ml U-238 discharge per second. While this still exceeds the NESHAP limit, it only exceeds it by a factor of 220. This identifies a significant difference between level 1 and level 2 of the code. Upon failure of the level 2 COMPLY code, the code requests a level 3 run which requires more input. Please review this information and re-evaluate the dose modeling performed.

ATSDR Comment: ATSDR reevaluated the data using EPA's CAP88-PC modeling program, which is a more detailed model than COMPLY. ATSDR ran the program using the maximum value from the air emissions data because we believe that using the maximum air emissions value is the most health protective method. The results from the model indicate that the levels would have been a public health hazard. Please see page 18, Appendix C, and the responses to comments 41, 44, and 47 for more information about the CAP-88 model.

**DU urinalysis results**

49. Comment: On page 10 is the statement: "the results of all the urine sampling showed no traces of uranium."…The unspecified analytical method used must have been too insensitive to measure trace quantities of DU and natural uranium in urine samples.

ATSDR Response: The urinalysis done at the NYSDOH Radiologic Laboratory in the Divisions of Laboratories and Research measured total uranium fluorometric. All of the individuals tested had urine levels of total U fluorometric at less than 8 µg/L, the detection limit of the analytical method. According to *USNRC Regulatory Guide 8.22*, the acceptable methods for the quantification of uranium in urine must have a detection limit of 5000 µg/L (Kressin 1984), and

an acceptable minimum detection activity of 20 µg/L of urine has also been established for natural uranium based on mass determination (HPS 1996). The analytical method used by NYSDOH in this analysis is well within an acceptable detection limit. In addition, a 1955 study showed that urinary concentration greater than 100 µg/L is indicative of recent absorption (Butterworth 1955).

50. Comment: Additionally, as mentioned in the report, while NL was still operating, the NYSDOH and the Albany County Health Department evaluated 49 individuals in 22 homes to determine contamination as well as possible exposures to DU. The evaluation included soil and wipe samples, vacuum cleaner samples, as well as urine analyses. Six of those individuals were selected for further study, which included lung/bone scans for DU. These individuals were selected because they represented those with the greatest exposure potential and included different age groups and gender. No measurable levels of DU were found in any of these individuals as compared to unexposed individuals. These data should weigh more than the derived values from the COMPLY code. There is perhaps less uncertainty about these measures compared to the modeled results.

ATSDR Response: The results of these medical evaluations are reassuring. However, they may not be indicative of urine levels in people prior to 1979 when air emissions may have been higher. ATSDR believes that the best approach is to evaluate the exposure with all available information, including the medical results, the epidemiological studies, and the air emissions data. Based on this information, ATSDR still concludes that there could have been an increased risk for kidney disease and that the combination of inhaling DU dust particles and cigarette smoke could have increased risk of lung cancer.

**On-site contamination**

51. Comment: On page 5, the report stares that nickel sulfamate, sodium cyanide, ferric chloride, nitric acid, silicate phosphate, iridite (a chromium brightener), cadmium metal, nickel metal, boric acid, and perchloroethylene (PCE), acids, bases, degreasing agents, carbon tetrachloride, benzene, polychlorinated biphenyls (PCBs), cyanide, heavy metals, and asbestos were all used at the NL plant. There are no disposal records for any of this material, but letters from NL to AEC indicate that in 1961 about 55 cubic yards of graphite, slag, refractory material, uranium oxide, insoluble oil, metal scrap, and combustible trash were buried in the Patroon Lake, as per NL's license.

a. What evidence, if any, is there that some of these materials might still be at the site?

b. What will be done to determine if any of these materials may have been disposed of in the Patroon Lake, or otherwise migrated offsite?

c. What potential health risks do these chemicals pose?

ATSDR Response: Patroon Lake (a.k.a Ford's Pond or Ford's Lake) was drained in the early 1970s. The former lake contained materials disposed in the southeast end of the old lake bed by NL Industries and municipal waste materials disposed of in the northwest end of the lake by the Town of Colonie (EE/CA). ACE has excavated the former Patroon Lake and backfilled with clean soil.

Any packaged chemicals, chemical wastes, and other materials remaining on-site in the main building after closure of the plant were removed and disposed of by DOE prior to the dismantling of the building.

ACE soil cleanup activities include soil excavation and waste treatment; containerization, shipment, and disposal; final closure and backfilling; dust control and perimeter air monitoring; and dewatering, water treatment plant operation, and groundwater monitoring. The soil cleanup goals include uranium-238, thorium-232, lead, copper, and arsenic. Upon completion of any removal action, an average of two feet of clean soil is placed over affected areas, with most areas requiring a greater backfill depth. All contaminated soil is removed from the site for off-site disposal.

The Patroon Lake was fed and discharged by an unnamed tributary of the Patroon Creek. Sediment sampling in the unnamed tributary downstream of the Patroon Lake has not shown significant levels of uranium or other heavy metals.

Because the former Patroon Lake has been excavated and remediated, the on-site soil is currently undergoing remediation, and the contaminated sediment in the downstream areas of the unnamed Patroon Creek tributary are not accessible to people, these chemicals do not pose a health risk to the community.

52. Comment: Is there any way we can find out what was stored in the drums on the NL site and whether the contents of these drums may have caused health effects to children who may have played with abandoned drums on the property? Who took these drums away and what records exist from the removal?

ATSDR Response: As discussed in the document, ATSDR searched all available records for information about National Lead. There was no information detailing the contents of those drums. Patroon Lake (a.k.a. Ford's Pond or Ford's Lake), however, was used by NL Industries for waste disposal. ACE has excavated the former Patroon Lake and backfilled with clean soil.

Any packaged chemicals, chemical wastes, and other materials remaining on-site in the main building after closure of the plant were removed and disposed of by DOE prior to the dismantling of the building.

53. Comment: Report raises more concerns than it answers. Did not address affects of PCB, PCE, TCE, cadmium, benzene, cyanide, asbestos and vinyl chloride.

ATSDR Response: ATSDR used all available information and data when evaluating the exposures and health consequences of people who lived near the Colonie Site while the NL plant was operating.

These chemicals do not pose a health risk to the community. Due to corrective action, the potential for exposure and the possibility of subsequent health impact is gone. The former Patroon Lake has been excavated and remediated and on-site soil is currently undergoing remediation. Sediment sampling in the unnamed tributary downstream of the Patroon Lake has not shown significant levels of uranium or other heavy metals.

NL Industries disposed of waste materials in the former Patroon Lake (a.k.a. Ford's Pond or Ford's Lake). ACE has excavated the former Patroon Lake and backfilled with clean soil. In addition, any packaged chemicals, chemical wastes, and other materials remaining on-site in the main building after closure of the plant were removed and disposed of by DOE prior to the dismantling of the building.

ACE soil cleanup activities include soil excavation and waste treatment; containerization, shipment, and disposal; final closure and backfilling; dust control and perimeter air monitoring;

and dewatering, water treatment plant operation, and groundwater monitoring. The soil cleanup goals include uranium-238, thorium-232, lead, copper, and arsenic. Upon completion of any removal action, an average of two feet of clean soil is placed over affected areas, with most areas requiring a greater backfill depth. All contaminated soil is removed from the site for off-site disposal.

54. Comment: [ATSDR's report states,] "A citizen's group is concerned that people, especially children, could have been exposed to DU in the past by playing with pellets and abandoned drums on the property. As discussed in previous sections, the DU used at the NL plant was water-insoluble. Touching or incidentally eating it would not have made people sick. No information is available concerning the contents of any drums on the property while NL was in operation."

This does not include the processing fuel from enriched uranium and its health risks. The contents of the drums on the property are well documented and known to be carcinogenic substances (as provided in report 10 to Congress on Hazardous Substances and their health risks). PCB's are known to cause cancer, including breast cancer. I know that various members of my family and myself were exposed to those drums and that we suffer from health related problems from NL Industries dumping of drums off of their property. Appendix E has no mention of PCB exposure and its health risks.

ATSDR Response: DU is pyrophoric, meaning that it can spontaneously ignite. The vicinity properties surrounding the NL plant were contaminated with DU because large amounts of DU were burned regularly in the chip burner to prevent the ignition of left over DU. The manufacturing processes at NL that used DU and enriched uranium did not contribute significantly to the offsite contamination. In addition, the results of the offsite soil sampling show that the uranium contamination was depleted and not enriched.

ATSDR does not have information about what was in the contents of the on-site drums. However, we reviewed on-site soil sampling results from DOE's 1991 remedial investigation and these data indicate that there is no on- or off-site PCB contamination from NL operations. There did not appear to be a complete pathway of exposure between the community and PCB contamination at NL.

55. Comment: …[T]he Consultation indicates that chemicals, including nickel sulfamate, sodium cyanide, ferric chloride, nitric acid, silicate phosphate, iridite, cadmium metal, nickel metal, boric acid, perchloroethylene, acids, bases, degreasing agents, carbon tetrachloride, benzene, polychlorinated biphenyls (PCBs), cyanide, heavy metals, and asbestos were used and disposed of on the NL Industries Colonie Site. The Consultation does not address the question of what health consequences can be anticipated from exposure to emissions of these substances. The emissions of many of these substances are now tightly regulated because they have been proven to cause serious illnesses.

ATSDR Response: The different chemicals listed were used in processes at the NL plant, but not necessarily released as air emissions. DU was the major air emission because DU shavings and grindings resulting from the fabrication components were incinerated in the plant's chip burner. The other manufacturing processes at NL did not contribute significantly to the offsite contamination. Therefore, we do not believe that residents in the areas surrounding the NL plant were exposed to air emissions of these various chemicals.

However, these chemicals were located on-site and may have been buried in the former Patroon Lake or otherwise disposed of on the property. ACE has excavated the former Patroon Lake and backfilled with clean soil. In addition, any packaged chemicals, chemical wastes, and other materials remaining on-site in the main building after closure of the plant were removed and disposed of by DOE prior to the dismantling of the building. People trespassing or playing on the NL property prior to the fencing and remediation could have come into contact with these contaminants. However, the contact would have been short-term and infrequent. Typically, illness as a result of exposure to chemicals comes from long-term frequent exposure to significantly high concentrations over many years. This would have been unlikely considering that most children would have played in the area for brief periods during the week (i.e., on weekends and after school in non-winter months) during their childhood years. Short-term, or acute, exposures will generally result in immediate illnesses only if the dose is very high—many times higher than the doses that might have occurred at the Colonie Site.

**Thorium**

56. Comment: According to page 5 of the report, NL also used thorium. To what extent, if any, has thorium been investigated as a potential health risk to the neighborhood?

ATSDR Response: DU contamination of the vicinity properties resulted primarily from airborne emissions from the plant due to incineration of uranium shavings and grindings resulting from the fabrication components (DOE 1992). In addition, some materials, including uranium, thorium, and other chemicals were buried in the former Patroon Lake area (DOE 1992). Therefore, we would not expect to find thorium from air emissions in the soil surrounding the Colonie site.

Because much of this material may have been buried in the Patroon Lake, ATSDR looked at the surface water and sediment sampling data downstream of this area. Sampling for thorium in surface water and sediment began in 1990 and samples were taken from downstream of the Colonie Site. The results of these samples from 1990 to 2001 have shown no elevated levels thorium. In fact, thorium levels have been within the range of background levels for the area.

57. Comment: …[T]he Health Consultation only notes in passing that between 1960 and 1972, thorium and enriched uranium were also used by NL Industries plant at the Colonie Site, and that from 1966 to 1972 they manufactured fuel from enriched uranium. No original research is cited as to the extent of the even more harmful emission of thorium and enriched uranium, or even of the depleted uranium emissions. Although there were no regulations regarding discharge at that time, it is difficult to believe that NL Industries has no record whatsoever of the extent of any emissions – why weren't they consulted regarding any possible records? How could NL Industries discharge such a massive amount of radioactive particles and chemical pollutants into the atmosphere with a total disregard for the health and well being of the large population of men, women and children living in close proximity of the plant, without any monitoring whatsoever of the discharges? If no such records exist, were there records/invoices kept showing what types and amounts of uranium and thorium were purchased? Or alternatively, do their suppliers have such records? A greater effort needs to be made to calculate the extent of the far more dangerous emission of enriched uranium and thorium, as well as the depleted uranium.

ATSDR Response: We would not expect to find thorium or enriched uranium from air emissions in the soil surrounding the Colonie site. DU contamination of the vicinity properties resulted primarily from airborne emissions from the plant due to incineration of DU shavings and

grindings resulting from the fabrication components. The other manufacturing processes at NL did not contribute significantly to the offsite contamination. In addition, the results of the offsite soil sampling show that the uranium contamination was depleted and not enriched and there were no elevated levels of thorium.

**Lead health effects**

58. Comment: Although pre-remedial soil samples were not analyzed for lead, based on the results of post-cleanup soil samples collected in the neighborhood near the former NL facility, exposure to elevated levels of site-related lead in soil at off-site locations is not currently occurring. However, due to the potential exposures to lead from the NL facility which may have occurred prior to remedial efforts, **a more complete and balanced discussion of the toxicological ramifications of lead exposure is warranted.**

ATSDR Response: ATSDR has added more information to the text of the health consultation about the potential health effects from lead exposure.

59. Comment: The statement on page 16 that "No available evidence indicates that lead causes cancer in humans" perhaps oversimplifies a very complex issue. The EPA lists lead as a probable human carcinogen based on inadequate evidence in humans and sufficient evidence in animals. The documentation on lead in EPA's Integrated Risk Information System notes that at least eleven studies in rodents have shown statistically significant increases in renal tumors on exposure to lead compounds. While there are considerable uncertainties in understanding and quantifying the cancer risks for lead in humans, the limited epidemiological evidence and the number of animal studies showing positive results for the carcinogenic effects of lead suggest that the carcinogenic potential of lead should at least be mentioned. The following summarizes some of the epidemiological studies that evaluate the possible association between lead exposure and an increase for cancer: See Steenland and Boffeta Am J Ind Med. 2000 Sep;38(3):295-9 for review. Rather than say “No available evidence indicates that lead causes cancer in humans”, **a more appropriate characterization would be that the human data are inadequate to refute or demonstrate the potential carcinogenicity of lead exposure.** A brief discussion or characterization of the uncertainties would help the reader put this information in perspective.

ATSDR Response: ATSDR has made changes within the document to reflect these uncertainties. There are, however, site-specific factors at the Colonie Site that indicate that cancer is an unlikely outcome in the community surrounding National Industries resulting from exposure to lead contamination in residential soil.

There is no evidence that exposures to the community near the site would be significant from a cancer standpoint. In the human occupational studies showing some positive association between lead exposure and cancer, the blood levels reported in the workers far exceeded any of the blood lead levels detected in the community. The amount of lead that the community could have been exposed to is much lower than the doses used in the animal studies where a positive association was seen between cancer and lead exposure. If one assumes that a person was exclusively exposed to the maximum lead concentration detected in residential soils (510 mg/kg), the estimated lifetime average daily exposure dose to an adult (assuming default intake rates, residential duration and bodyweight) is approximately 0.0008 mg/kg/day. The lowest cancer effect level reported in an animal study was 27 mg/kg/day for kidney cancer (ATSDR 1999). The dose required to give animals cancer was over 33,000 times higher than the most conservative exposure estimate for residents near National Lead.

There are questions about the relevancy of the animal studies to humans. The extremely high cumulative doses of lead used in these studies are difficult to extrapolate to low-level exposure in humans, and thus do not provide a sufficient basis for quantitative risk assessment. It is possible that the high doses required to induce renal tumors may themselves have produced a carcinogenic effect that was independent of any direct effect of lead as a result of non-specific tissue damage. Furthermore, the relevance of male rat kidney tumors induced by some chemicals to humans has been questioned. There is some indication that the mechanism by which lead induces tumors in the rat kidney involves species-specific proteins that would not be relevant to humans (ATSDR 1999a).

In studies with well-documented high occupational exposures, the evidence is somewhat suggestive of an association with lung, stomach and kidney cancer but remains limited. The lead compounds, exposure routes, and the levels of exposure were not always reported. Furthermore, concurrent exposure to other chemicals (including arsenic, particularly in lead smelters) and confounding variables, such as smoking, were often not evaluated. As a result, currently available studies in exposed workers are of limited usefulness and do not support an assessment of the potential carcinogenic risk of lead in humans (ATSDR 1999a; Steenland and Boffeta 2000).

**Lead emissions**

60. Comment: On page 16, the report indicates that if lead-oxide were used at the NL site, there could have been health effects. These effects could have included kidney disease, central nervous system effects and impaired mental development in children. How can we find out whether lead oxide was emitted from the NL foundry before 1960?

ATSDR Response: ATSDR searched all available records for information about National Lead. Unfortunately, because the plant ceased operations as a foundry in 1960, little information is available about what type of compounds were released. And even assuming that lead oxide was produced, there are no data or emissions records to evaluate the levels of exposure.

61. Comment: [ATSDR's report states,] "Would health effects result from eating fruits and vegetables grown in lead-contaminated soil or contaminated with lead from air emissions?

When dust containing lead falls onto crops, that lead can end up on plants. If people eat the dirt and dust on the surface of those crops they can be exposed to lead. To reduce this type of exposure, washing and peeling fruits and vegetables is a good precautionary measure (WHO 2000). Again, this would have been of most concern prior to 1960 when the lead foundry was operational."

When I was a child, there were many wild berry bushes and fruit trees which I would eat from. I am concerned about the air born lead air emissions that could have covered those fruits. I had a blood test done that showed I have lead in my body.

ATSDR Response: There are many ways that people can be exposed to lead. Leaded gasoline, which was officially banned by EPA in 1996, was a major source of lead contamination in the United States prior to the 1980s. In addition, many homes still have interior and exterior lead based paint. It would be very difficult to tell if the lead in your body came from the berries. In fact, lead in the body could be from a combination of sources. The best thing you can do is to reduce your exposure to any lead contamination. Once exposure is stopped, your blood lead levels will reduce over time.

**Blood lead**

62. Comment: Isn't there currently some dispute in the scientific community over whether the 10µg/dL blood lead threshold should be lowered?

ATSDR Response: This topic is currently being debated within the scientific community. Currently, CDC considers 10 µg/dl to be a health protective screening level for blood lead levels in children. Recently, some studies have shown that children could have a loss of IQ points at blood lead levels between 10 and 20 µg/dL as well as below 10 µg/dl. There are, however, several variables that could confound these results and the association between low blood lead levels and an effect on cognitive development is not conclusive.

Despite the current scientific debate about what blood lead level is "safe," it is important that parents take steps to reduce their children's exposure to lead. Children at the greatest risk are those who live in or frequently visit a home with exterior or interior lead paint that is in poor condition, such as chipping, peeling, or flaking.

63. Comment: The ATSDR recommends that parents concerned about the blood lead levels of their children should have those levels tested by their family physician. Since we do not have any blood tests to indicate whether blood lead levels are actually a problem in children, wouldn't it be better to have an organized campaign of lead level testing? Wouldn't it be better for the findings to be public information so that the public knows if there is a problem rather than having parents visit their physician individually?

ATSDR Response: New York State requires all health care providers to test all one and two-year old children for lead. NYSDOH recently reviewed the blood lead data in the areas surrounding the NL plant. Please see the response to comment 64 for a discussion of the results.

Children at the greatest risk for lead poisoning are those who live in or frequently visit a home with exterior or interior lead paint that is in poor condition, such as chipping, peeling, or flaking.

64. Comment: On page 18, the report concludes that children, even pica children (children that intentionally eat soil) will not have health effects from incidentally ingestion lead-contaminated soil. This conclusion is based upon estimated blood levels which were calculated using a formula provided in Appendix D of the report. Why didn't the study involve the testing of actual blood lead levels of residents at the soil sampling sites? If those residents were offered tests and refused, I'm sure there are others in the neighborhood who would agree to have their blood lead levels tested.

ATSDR Response: As part of the public health evaluation process ATSDR reviews available data to determine if there has been an impact to public health. In May 2003 NYSDOH and NYSDEC sampled soil for lead in areas surrounding the former NL plant. The samples showed lead levels that are typical of urban areas.

In addition, NYSDOH reviewed the blood lead data in the area surrounding the NL plant. New York State requires all health care providers to test all one and two-year old children for lead. In New York, approximately 60-70% of children are tested for lead prior to age two. While these rates vary across the state, they are generally highest in the neighborhoods which have the greatest risk of exposure. NYSDOH obtained the test results of children who were born between 1994 and 1997 and tested for lead prior to age two in the three ZIP Codes surrounding NL Industries: 12203, 12205, and 12206. The addresses were located on a map, and those children who lived within one mile of NL Industries were selected for further analysis. Four out of 206

children in the area (1.9%) had blood lead levels greater than or equal to 10 micrograms per deciliter (mcg/dL), and there was no indication of geographic clustering near the Colonie Site. Based on these results children living in the neighborhood near NL Industries do not appear to be at increased risk of lead exposure. Please see Appendix G for NYSDOH's information sheet on the results of this review.

**Lead in soil**

65. Comment: Also, although there is no current risk from emissions since NL stopped its foundry operations in 1960, to what extent could lead oxide be present in the soil surrounding the NL site? Have any studies been done to detect lead oxide in the sites that have not been cleaned up?

ATSDR Response: If there were lead oxide in the soil, it would be measured as lead in the analysis of soil samples. In May 2003 NYSDOH and NYSDEC sampled soil for lead in areas surrounding the former NL plant. This sampling effort included locations that were remediated for uranium contamination as well as locations that did not require remediation. All of the properties sampled are within the area of DU deposition from the former NL plant. Samples taken from remediated areas were collected 3-6 inches below the ground surface. Samples from non-remediated areas were collected at 0-3 inches below the ground surface. The samples showed lead levels that are typical of urban areas.

As discussed in comment 64, there does not appear to be any elevated blood lead levels in children around the Colonie Site. Based on the soil sampling results collected by NYSDOH and the information about the blood lead levels from the NYSDOH Blood Lead Poisoning Prevention Program, ATSDR believes that there is no public health hazard from lead in the soil.

In addition, NYSDOH and NYSDEC will conduct another round of soil sampling in several areas around the Colonie Site later this year.

66. Comment: On page 18, the report states that ATSDR considers widespread soil levels above 400 mg/kg to be of potential health concern to children who are likely to be exposed from their activities and yet the ATSDR concludes that the soil poses no health threat to children, even pica children. One of the soil samples take by the DEC and DOH exceeded 400 mg/kg, Where was the sample taken from? Was the property a cleaned property or not? Also, because only 8 samples were taken, how do we know that there aren't more sites with over 400 mg/kg of lead?

ATSDR Response: The soil sample exceeding 400 mg/kg of lead was taken from a private residence. ATSDR does not release identifying information related to environmental sampling. The resident was notified by NYSDOH that the soil sample exceeded the concentration that EPA considers a hazard in bare soil used for children's play area—400mg/kg—but was below the concentration that EPA considers a hazard in non-play areas—1200mg/kg. NYSDOH also recommended to the homeowner that simple measures be taken so that a cover, such as grass, clean soil, gravel, or mulch, is maintained on bare soils, especially where children are likely to play.

It is important to note that the 400 mg/kg level is intended to serve as a screening level and is not necessarily a level at which adverse health effects would be expected. It is a guidance that scientists use in conjunction with other site-specific information to determine the potential for health impacts.

The NYSDOH/NYSDEC soil sampling plan was developed as a preliminary screening in the areas most likely to have elevated levels of lead in the soil from past air emissions at NL, based on the deposition pattern of DU from air emissions. And because these areas show soil lead levels typical of an urban environment, ATSDR believes that the soil lead levels in other areas are most likely within the range of those found in the sampling survey.

In addition, NYSDOH reviewed the blood lead data in the area surrounding the NL plant. Using the results of this review, children living in the neighborhood near NL Industries do not appear to be at increased risk of lead exposure. Please see response to comment 64 for a more detailed discussion.

67. Comment: While the cleanup of the 56 sites identified as having high levels of radioactive material may removed the lead in those sites, have sufficient studies/surveys been performed to determine the extent of lead contamination in other sites in the neighborhood? Notably, the Department of Environmental Contamination and the Department of Health sampled soil from 8 locations for the presence of lead, including 3 of the properties which were not cleaned up (page 17). Is this a large enough sample size or were the samples taken from sites which could be expected to have higher concentrations?

ATSDR Response: In May 2003 NYSDOH and NYSDEC sampled soil for lead in areas surrounding the former NL plant. The NYSDOH/NYSDEC soil sampling plan was developed as a preliminary screening in the areas most likely to have elevated levels of lead in the soil from past air emissions at NL, based on the deposition pattern of DU from air emissions. This sampling effort included locations that were remediated for uranium contamination as well as locations that did not require remediation. Samples taken from remediated areas were collected 3–6 inches below the ground surface. Samples from non-remediated areas were collected at 0–3 inches below the ground surface. The samples showed lead levels that are typical of urban areas.

In 1992, NYSDOH tested four locations for metals in the soil: West Highland Park, the church on Yardboro Avenue, a Kraft Road location near Alsade Supply, and a residence on Fairfield Avenue. ATSDR and EPA consider widespread soil lead levels above 400 mg/kg to be of potential health concern. The results, which ranged from 29.5 to 136 mg/kg, were at least three times below this level.

In addition, NYSDOH reviewed the blood lead data in the area surrounding the NL plant. Based on the results of this review, children living in the neighborhood near NL Industries do not appear to be at increased risk of lead exposure. Please see response to comment 64 for a more detailed discussion.

Therefore, looking at the two sets of soil lead sampling and the blood lead data, ATSDR concluded that soil lead in the vicinity of the Colonie Site is not a hazard to the residents.

68. Comment: Also on page 18, the report states that a pica child at a site with soil containing 373 mg/kg of lead would have an estimated blood level of 15 µg/dL. Although harmful effects can occur at blood levels as low as 10 µg/dL, the report concludes that even pica children will not have health effects from incidentally ingesting lead-contaminated soil. The report notes that the estimate for pica children is "very protective," but how do we know how protective that number is and that there aren't some children in the neighborhood with blood levels between 10 µg/dL and 15 µg/dL?

ATSDR Response: Although the average of the soil sampling is below the EPA 400-ppm screening level for lead in residential soil and there are not expected to be any health effects from incidentally ingesting lead-contaminated soil, this value may not be protective of children who consume large amounts of soil during episodes of soil-pica behavior. When evaluating exposures, ATSDR considered a wide range of human activities that might increase exposure to contaminants in soil. One activity that may increase concern, particularly in preschool children, is an uncommon behavior called soil-pica, which is the intentional ingestion of large amounts of soil. This behavior occurs in some children as part of their normal exploratory behavior as 1 and 2-year-olds, or as part of intentional behavior in older preschool children (3 to 4-year-olds). The reasons why some children engage in soil-pica behavior is not known. Scientists suspect that soil-pica behavior may have something to do with nutritional deficiencies, psychological needs, or cultural factors (Danford 1982), but none of these links have been proven or shown to be responsible for all soil-pica behavior. Soil-pica behavior is most likely to occur in preschool children, but it can occur in older children and even in adults. The exact number of children who go through a stage of pica behavior is not known. Studies have reported that this behavior occurs in as few as 4% of children or in as many as 21% of children (Barltrop 1966, Robischon 1971, Shellshear 1975, Vermeer and Frate 1979). Using statistics, two scientists have estimated as many as 33% of preschool children will have soil-pica behavior once or twice during their preschool years (Calabrese and Stanek 1998). They admit, however, that their 33 percent may overestimate the percentage of children who engage in 1 to 2 days of soil-pica behavior (Calabrese and Stanek 1993, Danford 1982, EPA 1997). The percentage of children in near the Colonie Site with soil-pica behavior is unknown.

Limited information is also available for how often (i.e., frequency) and how long (i.e., duration) soil-pica children will have this behavior. Some preschool children might eat soil once during their preschool year while others might go through a stage of eating soil several times during a week or over several months. It is reasonable to assume that soil-pica behavior might occur for several days in a row, or a child might skip days between eating soil (Calabrese and Stanek 1998; Calabrese and Stanek 1993; Wong 1988; ATSDR 1992.) In addition, general pica behavior is greatest in 1- and 2-year-old children and decreases as children age during their preschool years (Barltrop 1966).

It is difficult to evaluate the effects of soil-pica in lead-contaminated areas because there is no MRL and little scientific data about the acute effects of large doses of lead-contaminated soil. ATSDR did not, therefore, evaluate soil-pica using dose or blood lead calculations. However, there are important factors that can affect the amount of lead-contaminated soil ingested in soil-pica children. For instance, most homes in the residential area around the Colonie Site have yards with grass cover, although there may be patches of exposed soil. Bare spots in the yard are the most likely areas that children with soil-pica behavior who live in lead-contaminated properties could easily have direct access to contaminated soils. Moreover, since winters in Colonie are generally cold, soil-pica behavior is less likely to occur during this time and probably most likely to occur during the warmer summer months, when preschool children are most likely to play outside. In addition, the timing of a soil-pica event must coincide with a child being in a highly lead-contaminated area with bare soil, and the soil-pica child must ingest soil from the same location with high soil concentration rather than being exposed to an average from several locations.

NYSDOH reviewed blood lead results for children in the area surrounding the Colonie Site and found no elevated blood levels in the vicinity of the site. Please see the response to comment 64 for a discussion of the results. This indicates that soil lead does not appear to be a significant contribution to lead dose, even if soil-pica was prevalent. If a parent believes that a child exhibits soil-pica behavior, there are steps can be taken to limit exposure to soil that may be contaminated. This includes ensuring that a cover, such as grass, clean soil, gravel, or mulch is maintained on bare soils, especially in areas where children are likely to play. They can also make sure children do not put soiled hands in their mouths.

**Patroon Creek Watershed**

69. Comment: On page 25, the report concludes that although the levels of contaminant in the Patroon Creek are high, people can not presently encounter these contaminants in the sediment. This is based on the maximum concentration of pollutants being found, in the study by a local university researcher, 2.6 to 6.2 feet below the water preventing risk of human contact. Did that study provide information about the pollutants which were closer to the surface of the sediment and which might be disturbed by people swimming in the water or using it for other recreational purposes?

ATSDR Response: This study of the Patroon Creek sediment sample did provide information about the pollutants closer to the surface of the sediment. The contaminant levels at the sediment/water interface are approximately 2 mg/kg of uranium, 90 mg/kg of lead, 1 mg/kg of cadmium, and 0.6 mg/kg of mercury. These levels are all well below their respective EPA preliminary remediation goals (PRGs). PRGs are risk-based concentrations used in the initial screening-level evaluations of environmental contamination. This information has also been added to the section discussing sediment contamination in the Patroon Creek watershed.

We do not, however, have information about the levels of contaminants that people, particularly children, could have been exposed to in the water and sediment in the past. The Patroon Creek watershed is located in an industrial area and has been subject to contamination from several point and non-point sources of pollution. We do know that exposure to contamination in the Patroon Creek Watershed would have been short-term, (i.e., during the warmer summer months when children are most likely to swim and play in water). Typically, illness as a result of exposure to chemicals comes from long-term daily exposure over many years. This would have been unlikely considering that most children would have played and swam in the watershed only in the summer months during their childhood years. Short-term, or acute, exposures will generally result in immediate illnesses only if the dose is very high.

70. Comment: The cleanup of the Patroon Creek is a must…

ATSDR Response: The Patroon Creek watershed is located in an industrial area and is subject to contamination from several point and non-point sources of pollution. Although not classified by New York State for primary contact recreation, it is reported that some parts of the Patroon Creek and Patroon Reservoir have been used for many years for swimming and wading by people living nearby.

A local university researcher collected a sediment core from the Patroon Reservoir, which is a little more than ½-mile downstream from the Colonie Site and the MerCo state superfund site. Uranium, lead, cadmium, and mercury were found in the core sample taken from below the sediment surface. The maximum concentrations were found in samples approximately 0.8 to 1.9

meters (or 2.6 to 6.2 feet) below the sediment/water interface. This means that although the levels of contaminants exceed EPA Region 9 PRGs for residential soil, people cannot presently encounter these contaminants in the sediment. Therefore, these sediments are not a hazard to public health.

71. Comment: Table 3 Data - There seems to be more than one version of the Dr. Arnason report on Patroon Reservoir. The first reviewed by ACE is titled "50+ year record of Cd, Hg, Pb, and U deposition in sediments of Patroon Reservoir, Albany County, NY, USA" and the second titled "40+ year record of Cd, Hg, Pb, and U deposition in sediments of Patroon Reservoir, Albany County, NY, USA". The major difference between the two reports is the peak concentrations; 1st report above 170 cm - Cd @ 13ppm, Pb @ 1811ppm, and U @ 160ppm; 2nd report above 168 cm Cd @ 25ppm, Pb @ 3600ppm, and U @ 320ppm. The two reports conflict by essentially doubling the peak concentrations. These results should be validated prior to inclusion in any health study. The NYSDEC also sent samples from Dr Arnason's core to the EPA for gamma and alpha spectroscopy. The EPA laboratory in Montgomery, Alabama identified the maximum result for gamma spectroscopy around 40 pCi/g and for alpha spectroscopy U234 @ 10.8 pCi/g, U235 @ 1.22 pCi/g, and U238@ 39.8 pCi/g. Assuming the average % mass DU identified during the Colonie removal action of 0.45% U-235 by weight, the specific activity is $5x10^5$ pCi/g (49 CFR 173.434) for total depleted uranium. The total depleted uranium would be calculated as follows.

The 160 mg/kg compares much closer to the EPA analytical results for total depleted uranium of 51.8 pCi/g then the 320 mg/kg report in the 2nd report issued by Dr. Arnason. The EPA gamma spectroscopy data also supports this conclusion. Based on the information for the Uranium, the values for the residual uranium are below the 25 mrem/yr uranium values as calculated in the Colonie Technical Memorandum). Please consider all data from the Patroon Creek Studies within the report.

ATSDR Response: It appears that the first report reviewed by ACE is an early unpublished version. The article reviewed by ATSDR (Arnason and Fletcher 2003) was published in *Environmental Pollution*, a peer-reviewed scientific journal. The information in the two reports is different, and the uranium data from the first report is similar to the EPA data provided by the commenter. However, even after reviewing the *higher* levels of contaminants from the article published in *Environmental Pollution* ATSDR determined that the contaminants in the Patroon Reservoir do not pose a public health hazard because people cannot presently encounter these contaminants in the sediment.

**Health Study**

72. Comment: A comprehensive epidemiological study is needed within a 20 mile radius of the Colonie NL site to identify the health problems associated with DU fallout.

ATSDR Response: On the basis of the information about air emissions and the deposition of DU in the soil around the NL plant, the highest levels of DU contamination occurred within a few blocks of the plant. This is the area in which we would expect to see health effects. Although others outside this area may have been exposed to DU air emissions from NL, they were not exposed at levels that would have caused them to be sick.

The NYSDOH conducted two investigations looking at cancer and other health effects in the area around the NL plant. The first (1981) investigation identified four census tracts near the

plant and looked at both the New York State Cancer Registry data from 1970 to 1976 and NYSDOH Office of Vital Statistics data from 1972 to 1978. NYSDOH then compared these data with data from three nearby census tracts. NYSDOH found an increased number of lung cancer cases in males 65 to 74 years of age. A follow up on these lung cancer patients found that most had a history of smoking. No increased number of kidney disease deaths, spontaneous fetal deaths, or kidney cancer was detected (NYSDOH 1981).

The second (1993) NYSDOH investigation looked at the cancer incidence in five ZIP Code areas in Colonie from 1978 to 1987. These data were compared with the expected cancer incidence for suburban areas in New York State (excluding New York City). The results showed an increased number of males with colon and rectal cancer and an increased number of females with cancer of the oral cavity (NYSDOH 1993). That said, however, this investigation covered a very large area with an estimated population in 1980 of 58,187 persons. Therefore, it can only provide information about the overall cancer incidence in this population; it can not provide any conclusions about the health of those who lived near the NL plant.

73. Comment: On page 11, the report mentions an investigation by the New York State Department of Health which looked at cancer rates in five ZIP Codes areas in Colonie from 1978 to 1987. The results showed an increased number of males with colon and rectal cancer and females with cancer of the oral cavity. The investigation covered an area with a population of 58,000. According to recent demographics, approximately 10,000 people currently live near the NL site. The area covered by DOH's survey was too large to make a conclusion about whether cancer rates were affected by the NL site. Shouldn't a small survey be conducted which uses the cancer data from those who have lived near or are living near the NL site? Also, wouldn't a more recent study be informative as more people may have been diagnosed with cancer since 1987.

ATSDR Response: Different diseases have different causes; and looking at relevant scientific studies, we know that exposure to uranium can increase the risk of kidney disease and that inhaling DU dust particles and cigarette smoke could have increased risk of lung cancer. It has not been shown to cause other types of cancers. Colon, rectal, and oral cancer each have risk factors that are not associated with environmental exposure. Risk factors for colon and rectal cancers include heredity, diet, smoking, and alcohol. Risk factors for oral cancer include tobacco use, such as smoking and chewing.

Because the community directly surrounding the former NL facility is small, an epidemiologic, or statistical, study of area residents would not be likely to show any health effects that could be directly linked to emissions from the plant. Even if cases of kidney disease and lung cancer were found, it would be difficult to determine whether they were related to a specific environmental cause or to the natural incidence of disease within the general population.

More recent data on cancer incidence for this ZIP Code are available from the NYSDOH Cancer Surveillance Improvement Initiative, also known as the cancer mapping project. Information from this project, which tabulated observed and expected numbers of the four most frequently diagnosed cancers in the state by ZIP Code (breast, lung, prostate, and colorectal cancers), shows an elevation in lung cancer incidence in both males and females in ZIP 12205 in the years 1993–1997 (email from Barbara Metzger, NYSDOH). ATSDR concluded that the risk of developing lung cancer could increase among smokers living near the NL plant. However, because of the confounders associated with smoking, it would be nearly impossible to determine if the excess was due to environmental exposures from NL.

74. Comment: Why hasn't ATSDR done a study of the illnesses of people who have lived or are living near the plant have contracted to determine any pattern that might exist?

ATSDR Response: ATSDR received letters, emails, and telephone calls from many community members concerned that their illnesses were caused by exposure to contamination from NL. Many of these included different kinds of cancers. Different diseases have different causes and based on scientific studies, we know that exposure to DU can increase the risk of kidney disease and that inhaling DU dust particles and cigarette smoke could have increased risk of lung cancer. Studies do not show that DU will cause other diseases. The information collected from the community members indicates that the residents near NL suffer from many different illnesses; but there is no indication that the contamination from NL caused these illnesses.

A characterization of the types of illnesses in the community would not link the illnesses with any specific environmental factor, including chemicals released into the environment from the from the Colonie site. The best determinant of cause of an illness related to specific chemicals is characterization of an exposure pathway from the source of a chemical release to the community. ATSDR determined that DU was released into the environment and could have traveled through air in sufficient quantity and duration to impact the community, and inhalation of DU emissions may have increased the risk of kidney disease and that inhalation of DU dust particles and cigarette smoke could have increased risk of lung cancer.

75. Comment: The inadequate evaluations by the ATSDR (health consultation) and the Department of Health (cancer cluster investigations) do not do justice to addressing the community's concerns and question—what did NL's pollution do to my health? It is interesting that the priority community concern was not included in the ATSDR summary. Our organization and numerous residents told ATSDR officials that a community health study was the propriety action that everyone wanted. This was not mentioned in the community concern summary in the report.

ATSDR Response: The purpose of the health consultation is to review available information and data to determine what likely health effects would be expected. We looked extensively for exposures and determined that DU emissions from the NL plant could have increased the risk of kidney disease and that inhaling DU dust particles and cigarette smoke could have increased risk of lung cancer.

Studies do not show that DU will cause other diseases. The information collected from the community members indicates that the residents near NL suffer from many different illnesses; however there is no indication that the contamination from NL caused these illnesses.

ATSDR evaluated the potential for followup activities at the Colonie Site. Because the community directly surrounding the former NL facility is small, an epidemiologic, or statistical, study of area residents would not be likely to show any health effects that could be directly linked to emissions from the plant. Even if cases of kidney disease and lung cancer were found, it would be difficult to determine whether they were related to a specific environmental cause.

76. Comment: …[W]e request that ATSDR include a recommendation for a Community Health Surveillance investigation to fully evaluate exposures and adverse health outcomes or increases in illnesses, and issue recommendations to adequately address health risks and adverse health outcomes. A community-appointed Citizen Advisory Committee should have full input into the design and implementation of the health surveillance study.

ATSDR Response: ATSDR does not believe that conducting a community health surveillance investigation will answer the community's questions about whether the NL plant affected their health. An important consideration is whether a health study will provide scientifically useful results related to exposure and health effects. The small population of the Colonie community would make reaching a statistically reliable conclusion about health effects from the NL site very difficult. Large numbers are required to reliably detect small differences in the rates of disease. A study of the small area near the NL site is likely to miss a small difference (higher or lower) in disease rates when compared with a reference population. Also, other potential risk factors (e.g., heredity, diet, smoking, alcohol consumption, and other underlying health conditions) must be considered in addition to environmental factors.

77. Comment: The NYSDOH conducted two studies of cancer incidence in an area in the immediate vicinity of the NL plant.

**(a) The 1981 Study (NYSDOH 1981):**

This study looked at Cancer Registry data from 1970 to 1976 and Vital Statistics data from 1972 to 1978, comparing four census tracts near the plant with three "nearby" census tracts. "NYSDOH found an increased number of lung cancer cases in males 65 to 74 years old."

Since we know that airborne exposure from the NL plant certainly extends over a wide area, comparison of data from two tracts both "nearby" the plant does not establish an appropriate baseline for comparison. Results would be much clearer and the differences much greater if a more remote baseline had been used. Nonetheless it is very striking that a positive correlation to lung cancer was in fact found. Although the sample is too small to be decisive, these data immediately at hand suggest exactly the "link" of the sort which constitutes cause for very serious concern.

The report continues "A follow up on these lung cancer patients found that most had a history of smoking." This comment in no way detracts from the significance of the finding, since it is likely that the baseline community also included essentially the same proportion of smokers, while the near community had nonetheless "an increased rate of cancer." This increase is thus over a common baseline of smoking and remains an indication of a serious health hazard from airborne DU from the NL plant.

**(b) The 1993 Study (NYSDOH 1993):**

Here the incidence of cancer cases was compared to a state-wide data base. The ATSDR report comments that the sampled community of five ZIP Codes was too large "to provide any conclusions about the health of those who live near the NL plant."

The dismissal of the 1993 findings would appear to be in error, since it has now been decisively established, as shown above, that the area exposed to emissions from the NL stack includes a radius of many miles. The state-wide data probably represent a highly appropriate baseline for this study, and would similarly serve well in interpretation of the 1981 data. It may well be the case that the population of the five-zip-code community sampled was indeed exposed to airborne emissions from the NL plant, and this study may well be appropriate and fully valid.

This question is of great significance for the health of Capital District residents today. Since dust once deposited continues to recirculate, this is not a hazard which disappears with the passage of time. The fact that positive correlations have been found in both of these NYSDO[H] studies lend empirical support to the concern that a real health hazard exists.

Without a doubt, further studies should be made. As suggested earlier, one first stop might well be to study the local prevailing wind data together with the physics of deposition of airborne particles in smoke plumes, in order to identify those areas of the capital region on which epidemiological study might best focus.

The passage of a long period of time between the years in which emissions were occurring and the present in no way mitigates the significance of the study. Cancers may take many years to develop and manifest, while radioactive dust, once introduced in the environment, remains and recirculates.

ATSDR Response: (a) A review of the surveys completed by ORNL in the 1980s discloses that the majority of the off-site DU soil contamination was within a few blocks of the NL plant and followed the prevailing wind patterns. DU is very heavy, and our experience is that large volumes of DU from releases from the site would not be transported off-site to a great distance. It is true that DU air emissions went further than this area, but *not at levels that could have caused health effects*. For the NYSDOH 1981 study, the tracts nearby the plant were selected because they were out of the area of exposure, yet were a similar population to those adjacent to the NL plant. Although the results of the study indicate an increase in lung cancer, the NYSDOH found no geographic clustering of cases near the plant, near the known areas of contamination, or elsewhere (NYSDOH 1981). In addition, when the data was classified by sex, the excess of lung cancers was shown to be entirely in males. And when the data was further broken down by age group, the elevated tract rate was influenced by an especially high rate of lung cancer in males ages 65–74. Therefore, the increased cases of lung cancer cannot definitively be linked the NL's plant.

(b) The information about air emissions and the deposition of DU in the soil around the NL plant shows that the highest levels of DU contamination occurred within a few blocks of the plant. This is the area in which we would expect to see health effects. Although others outside this area may have been exposed to DU air emissions from NL, they were not exposed at levels that would have caused them to be sick.

In addition, the 1993 NYSDOH study found a statistically significant increase in colon and rectal cancer in men and oral cavity cancer in women. Colon, rectal, and oral cancer each have risk factors that are not associated with environmental exposure. Risk factors for colon and rectal cancers include heredity, diet, smoking, and alcohol. Risk factors for oral cancer include tobacco use, such as smoking and chewing.

The DU that was deposited in nearby vicinity properties was remediated in the 1980s (see page 18 and the response to comment 38 for more discussion). Therefore, there is no current health hazard from DU-contaminated soil. In addition, based on the information from the prevailing wind patterns and the ORNL vicinity property soil surveys in the 1980s, we know the areas that had the greatest soil contamination, and therefore the greatest exposures. However, because the community directly surrounding the former NL facility is small, an epidemiologic, or statistical, study of area residents would not be likely to show any health effects that could be directly linked to emissions from the plant. Even if cases of kidney disease and lung cancer were found, it would be difficult to determine whether they were related to a specific environmental cause or to the natural incidence of disease within the general population.

78. Comment: Though only preliminary and inadequate with respect to the problem which has now become evident, these two NYSDOH reports constitute positive epidemiological evidence

that airborne DU emissions from the NL stack do pose a health risk. As discussed above, this is a risk which does not mitigate with the passage of time. Airborne particles, once deposited, remain in the environment to recirculate by many processes while their radiation is essentially constant over time. Most importantly, radioactive DU particles, once introduced into the body, remain radioactive throughout a person's lifetime and may induce cancers at any later time. These past emissions therefore constitute a present and continuing threat to the health of residents in the impacted region, of which both area physicians and present and former residents need to be made aware.

Only in this way can the original question posed by ATSDR at the outset of its report be given a meaningful answer, namely:

"1. In the past, could people have potentially been exposed to harmful levels of DU by breathing air emissions from NL's chip burner and other onsite sources…?"

A new, systematic epidemiological study could provide an answer to this question.

ATSDR Response: The DU-contaminated soil was cleaned up by DOE in the 1980s and there is currently no hazard from DU in the soil.

In addition, as discussed earlier, DU is only weakly radioactive and the major concern is from chemical toxicity. One way in which radiation causes cancer is that an energetic particle is released, passes through tissue and hits DNA in a cell that is dividing. The more rapidly cells in tissue divide, the more likely that the cell in the tissue is a target for an effect by the radiation. The rate at which particles are released from DU is extremely low. The rate at which cells in the lung tissue divide and, therefore are susceptible, is also very low. The combination of these biological factors may be reasonably assumed to be the reason that uranium or DU has not been considered as a human carcinogen.

The available scientific information establishes that inhaling DU emissions could have increased the risk of kidney disease and that inhaling DU dust particles and cigarette smoke could have increased risk of lung cancer. However, we also know that the exposed population is small and an epidemiologic, or statistical, study of area residents would not be likely to show any health effects that could be directly linked to emissions from the plant. Even if cases of kidney disease and lung cancer were found, it would be difficult to determine whether they were related to a specific environmental cause or to the natural incidence of disease within the general population.

79. Comment: The issue of a more comprehensive health study must be addressed. Environmental epidemiology investigations must be very thorough. NL Industries must be held accountable. The report keeps stating that there are no health risks now—but there are piles of dirt still there. The damage was done long ago and we are seeing the health effects now.

ATSDR Response: Designing a study to determine the risk factors that contributed to the occurrence of disease in the community near the former NL plant would be difficult. A health study designed to evaluate the relationship between chemical releases from NL and health effects would not likely answer the question. An important consideration is whether a health study will provide scientifically useful results related to exposure and health effects. The small population of the Colonie community would make reaching a statistically reliable conclusion about health effects from the NL site very difficult. Large numbers are required to reliably detect small differences in the rates of disease. A study of the small area near the NL site is likely to miss a small difference (higher or lower) in disease rates when compared with a reference population.

Also, other potential risk factors (e.g., heredity, diet, smoking, alcohol consumption, and other underlying health conditions) must be considered in addition to environmental factors.

ACE is actively working to remediate the soil on the former NL property. They have shipped off-site more than 100,000 cubic yards of soil, which is disposed of at permitted facilities. In addition, air monitors are installed along the fence line to ensure that contaminated dust is not being blown off site. Therefore, there is currently no risk to the community from ACE's ongoing remedial activities.

80. Comment: Your conclusion that, "ATSDR concluded that no adverse health effects are expected to occur in children who contact DU-contaminated soil when playing or gardening, or when eating fruits and vegetables grown in DU-contaminated soil", is misleading. There is insufficient research on the health of effects of depleted uranium on children, especially in light of the fact that the air emissions of depleted uranium are unknown for a long period of time. **The World Health Organization states in a report that there is insufficient data on the health effects of depleted uranium on children**.

I feel that a comprehensive study of the children who lived in the area in the late 60s is of great importance at this time. Many of the people still live in the area and online resources make contact with those individuals relatively easy. I would be pleased to be involved in such a study, and have compiled a list of individuals who graduated in 1976 and lived near NL Industries.

ATSDR Response: Children differ from adults in their exposures and may differ in their susceptibility to hazardous chemicals. Children's unique physiology and behavior can influence the extent of their exposure. Specific information is not available on whether children are more susceptible than adults to the effects of uranium. There is, however, a great deal of information in the scientific literature about the health effects of workers and animals who have been exposed. In the absence of scientific studies specific to children, we rely on other data and use very conservative assumptions in our analyses to be protective of children.

On the basis of the information about where the DU traveled off site, we determined that the greatest health impact would have been to residents living within a few blocks of the NL plant. Because the community directly surrounding the former NL facility is small, an epidemiologic, or statistical, study of area residents would not be likely to show any health effects that could be directly linked to emissions from the plant. Even if cases of kidney disease and lung cancer were found, it would be difficult to determine whether they were related to a specific environmental cause or to the natural incidence of disease within the general population.

81. Comment: There is insufficient data available on emission rates for an extended period of time. The health outcome can not be determined, but this is a perfect opportunity to address exposure of children and women of childbearing age to the effects of depleted uranium. The endpoints of cancer are not the only possible health risk that may be increased, but appears to be the only end point studied. The people who lived in this area deserve a more comprehensive health study. They are at increased risk of disease, but are not offered the **health care needed to catch these diseases at an early point and increase their chance of having a positive outcome**. The health effects of exposure of low level depleted uranium may take decades to appear. This is our opportunity to do a comprehensive health study that includes all types of morbidity, not just cancer.

ATSDR Response: ATSDR believes that the available data, in conjunction with other information about the plant, was sufficient to make the health call that the risk of kidney disease was increased and that inhaling DU dust particles and cigarette smoke could have increased risk of lung cancer. The reason that we focused on these two diseases is because scientific studies have shown that exposure to DU can increase the risk of developing them.

After reviewing the information about where the DU traveled off site, we determined that the greatest health impact would have been to residents living within a few blocks of the NL plant. Because the community directly surrounding the former NL facility is small, an epidemiologic, or statistical, study of area residents would not be likely to show any health effects that could be directly linked to emissions from the plant. Even if cases of kidney disease and lung cancer were found, it would be difficult to determine whether they were related to a specific environmental cause or to the natural incidence of disease within the general population.

ATSDR does not provide health care to communities. We will, however, be working with the local medical community to provide information about environmental exposures and the health effects of DU.

82. Comment: [ATSDR's report states,] "NYSDOH conducted two investigations looking at cancer and other health effects in the area around the NL plant. The first (1981) investigation identified four census tracts near the plant and looked at both the New York State Cancer Registry data from 1970 to 1976 and NYSDOH Office of Vital Statistics data from 1972 to 1978."

A correct scientific methodology to this study would be to assess current medical histories of the people who were children during the time period of NL operation. Toxicologists have proven that for many chemicals, cancer may not develop until 10, 20 or even 30 years after the exposure has occurred. Many scientists believe that breast cancers, may start at very young ages and lie dormant for many years before being triggered to grow later in adulthood. I believe that my breast cancer was caused by living around NL industries and being exposed to their toxic emissions and toxic dumping of PCB's and other known carcinogenic substances for almost 20 years. Two of my brothers and I played in the Patroon Creek. We built rafts out of 55-gallon drums that we found there and sailed down Patroon Creek. We were intrigued by the pretty rainbow type colors that came out of those drums. We had no idea that NL was poisoning our playground and neighborhood. We used to play touch football on Magnus Meadow (the grassy lawn of NL). I believe that NL is responsible for the illnesses that my family is suffering.

ATSDR Response: ATSDR does not believe that conducting a community health survey by reviewing medical records of residents will answer the community's questions about whether or not the NL plant impacted their health. Such a survey could help to describe the health status of a particular community but would not explain why the health effects occurred. Designing a health study to determine the risk factors that contributed to the occurrence of disease in the community near the former NL would be difficult. A health study designed to evaluate the relationship between chemical releases from NL and health effects would not likely answer the question for several reasons. First, reliable information on past exposure is not known. Second, the small population would make it difficult to reach a statistically reliable conclusion. Finally, kidney disease, a health effect shown to be related to uranium exposure in the scientific literature, would likely not be seen in the community currently since releases into the air stopped in 1984. The New York State Department of Health has conducted three reviews of cancer incidence in the

area around the former NL. These analyses have shown elevations in lung cancer. A health study in a small population would make it very difficult to evaluate lung cancer further since smoking is a strong causal factor and past analyses by New York State Department of Health indicated that a large proportion of people with lung cancer were also smokers. To have a scientifically defensible study there must be a comparable population of unexposed people.

We know that children played on the NL property and in Patroon Creek. Little information is known about what was disposed of on the NL property. There are no disposal records or information about what was in the drums. There are, however, sampling data for surface soil on the NL site and there is no indication of widespread PCB contamination.

Different diseases have different causes and based on scientific studies, we know that exposure to DU can increase the risk of kidney disease and that inhaling DU dust particles and cigarette smoke could have increased risk of lung cancer. Studies do not show that DU will cause other diseases. The information about health effects collected from the community members indicates that the residents near NL suffer from many different illnesses; however there is no indication that the contamination from NL caused these illnesses.

83. Comment: [ATSDR's report states,] "The second (1993) NYSDOH investigation looked at the cancer incidence in five ZIP Code areas in Colonie from 1978 to 1987. These data were compared with the expected cancer incidence for suburban areas in New York State (excluding New York City). The results showed an increased number of males with colon and rectal cancer and an increased number of females with cancer of the oral cavity (NYSDOH 1993). That said, however, this investigation covered a very large area with an estimated population in 1980 of 58,187 persons. Therefore, it can only provide information about the overall cancer incidence in this population; it can not provide any conclusions about the health of those who lived near the NL plant."

This is an inappropriate comparison. The human population that lived near NL Industries from 1958 through operation closure should be assessed.

ATSDR Response: Even if cases of kidney disease and lung cancer were found, it would be difficult to determine whether they were related to a specific environmental cause. Because the area of concern around the former NL is small, there would be a large error in the estimate of rates of disease using such a small population. Analysis of cancer incidence rates at the ZIP Code level was used to reduce this error by using a larger population. The advantage of using a ZIP Code level analysis is achieving a better estimate of the true incidence rate, given that the population is larger. The disadvantage of analysis at the ZIP Code level is it is much larger than the area of concern and the rate for the ZIP Code may not be representative of the incidence rates around the former NL site.

84. Comment: [ATSDR's report states,] "Community members are concerned that past emissions from the site have caused adverse health effects such as various types of cancer, birth defects, Down syndrome, rashes, and endometriosis.

ATSDR reviewed the available scientific information about the health effects associated with both uranium and lead. Based on this information and the data available for the Colonie Site, ATSDR concludes that the levels of DU from the NL plant could have increased the risk of health effects in the community surrounding the plant. Although, as discussed previously, the extent to which these risks were increased is unknown. The uranium used at the plant, however,

was water-insoluble and would not have been easily absorbed by the body. In addition, many studies of uranium miners, millers, and processors showed no damage to skin after touching uranium. No currently available studies show a link between uranium and birth defects, Down syndrome, or endometriosis."

In order to correctly address this question, the human population who lived around NL during its operation needs to be assessed. The health effects processing fuel from enriched uranium needs to be addressed.

ATSDR Response: Because the area of concern around the former NL plant is small, it would be difficult to determine whether illnesses were related to a specific environmental cause. This is because there would be a large error in the estimate of rates of disease using such a small population. Analysis of cancer incidence rates at the ZIP Code level was used by NYSDOH in one of its health studies to reduce this error by using a larger population. The advantage of using a ZIP Code level analysis is achieving a better estimate of the true rate of disease since the population is larger. The disadvantage of analysis at the ZIP Code level is it is much larger than the area of concern and the rate for the ZIP Code may not be representative of the rates of disease around the former NL site.

The manufacturing processes at NL that used enriched uranium did not contribute significantly to the off-site contamination. In fact, the results of the offsite soil sampling show that the uranium contamination was depleted and not enriched. DU is pyrophoric, meaning that it can spontaneously ignite. The vicinity properties surrounding the NL plant were contaminated with DU because large amounts of DU were burned regularly in the chip burner to prevent the ignition of left over DU.

85. Comment: [ATSDR's report states,] "Based on the levels of DU found in soil, and the fact that the NL plant scaled down operations during the late 1970s and early 1980s (DOE 1989b), the earlier air emissions were probably higher than those documented between 1979 and 1984. ATSDR believes that the DU emissions at these high levels could have increased the risk of health effects—especially kidney disease—for people living near the plant…. Although how much the risk was increased is unknown ATSDR concludes that in the past, the uncharacterized emissions from the NL plant were a public health hazard to the community surrounding the plant."

Based on your agency's conclusion that the NL plant was a public health hazard, a comprehensive health assessment of the population who lived around the NL plant site should be conducted. This assessment should be completed in an impartial manner through the input from a community selected advisor.

ATSDR Response: ATSDR does not believe that conducting a community health survey will answer the community's questions about whether or not the NL plant impacted their health. A door-to-door health survey could help to describe the health status of a particular community but would not explain why the health effects occurred. Designing a health study to determine the risk factors that contributed to the occurrence of disease in the community near the former NL would be difficult. A health study designed to evaluate the relationship between chemical releases from NL and health effects would not likely answer the question for several reasons. First, reliable information on past exposure is not known. Second, the small population would make it difficult to reach a statistically reliable conclusion. Finally, kidney disease—a health effect shown to be related to uranium exposure in the scientific literature—would likely not be seen in the

community currently since releases into the air stopped in 1984. The New York State Department of Health has conducted three reviews of cancer incidence in the area around the former NL. These analyses have shown elevations in lung cancer. A health study in a small population would make it very difficult to evaluate lung cancer further since smoking is a strong causal factor and past analyses by New York State Department of Health indicated that a large proportion of people with lung cancer were also smokers.

86. Comment: …[A]n epidemiologic study of the surrounding neighborhoods in Albany and Colonie is long overdue. Any such study should include the workers of the NL Industries plant as well. The science of epidemiology should be used to determine the effects of the NL pollution on the citizens of the area rather than the speculative guesswork performed to date. The human consequences resulting from the reckless operation of the NL plant should be determined in a much more scientific fashion. To date the Federal Government has made a much greater effort to clean up the NL site than it has to address the deleterious effects on its citizens. Note that the Formerly Utilized Sites Remedial Action Program was initiated by the Atomic Energy Commission in 1984 to remediate this site. This has been an ongoing endeavor. On the other hand, the human consequences have yet to be addressed by a proper epidemiologic survey. The fact that the uranium emissions by NL Industries during the late '70's and early '80's exceeded NESHAP's guidelines by a factor of 54,000, during a period of scaled down operations, gives rise to even more concerns regarding the extent of the exposure to the citizens during the period of peak operation. This situation is very troubling. What health problems can the citizens expect? What conditions should they be looking out for? A house to house survey of all citizens in the vicinity of the plant, including outreach to prior residents, would go a long way to answer some of these serious concerns.

ATSDR Response: ATSDR does not believe that conducting a community health survey will answer the community's questions about whether or not the NL plant impacted their health. A door-to-door health survey could help to describe the health status of a particular community but would not explain why the health effects occurred. Designing a health study to determine the risk factors that contributed to the occurrence of disease in the community near the former NL would be difficult. A health study designed to evaluate the relationship between chemical releases from NL and health effects would not likely answer the question for several reasons. First, reliable information on past exposure is not known. Second, the small population would make it difficult to reach a statistically reliable conclusion. Finally, kidney disease, a health effect shown to be related to uranium exposure in the scientific literature would likely not be seen in the community currently since releases into the air stopped in 1984. The New York State Department of Health has conducted three reviews of cancer incidence in the area around the former NL. These analyses have shown elevations in lung cancer. A health study in a small population would make it very difficult to evaluate lung cancer further since smoking is a strong causal factor and past analyses by New York State Department of Health indicated that a large proportion of people with lung cancer were also smokers. To have a scientifically defensible study there must be a comparable population of unexposed people.

**Cancer and other diseases**

87. Comment: I consulted the New York State Department of Health Cancer Registry for Colorectal Cancer Incidence for males that lived in my ZIP Code during the period 1993–1997 and noted that clearly establishes a 33% increase over the expected rate. Although I have lived in Colonie for 17 years, I was not familiar with the NL site until recently. In hindsight, I can tell

you I have passed by that site at least a few thousand times, and have lived within a couple of miles of the site during most of my residency.

ATSDR Response: DU affects the kidneys and the lungs and has not been shown to cause colorectal cancer. Although there are an increased number of colorectal cancers in the ZIP Code, it does not mean that the colorectal cancers were caused by the air emissions from NL. Several risk factors for colon and rectal cancers have been identified. These include heredity, diet, smoking, and alcohol.

88. Comment: I would like research done on the possibility that a number of cases of MS in a small geographical area could be attributed to the NL Plant in Colonie, NY.

I am requesting an alphabetical list to be compiled of streets within a three-mile radius of this NL Site. I am also requesting that this information be sent to all neurologists in the Capital District, so a count can be established as to the number of people who have worked, resided, or are still residing in the area, that have been treated in the neurologist's office for MS, since they have been in practice. I am also requesting that the alphabetical street list be sent to the MS society, so a count can be given as to the number of people they know that meet this criteria.

ATSDR Response: Different diseases have different causes and based on scientific studies, we know that exposure to DU can increase the risk of kidney disease and that inhaling DU dust particles and cigarette smoke could have increased risk of lung cancer. Studies do not show that DU will cause other diseases. The information about health effects collected from the community members indicates that the residents near NL suffer from many different illnesses; however there is no indication that the contamination from NL caused these illnesses.

ATSDR will be working with the local medical community to provide information about environmental exposures and the health effects of DU.

The National Multiple Sclerosis Society has an Upstate New York Chapter located in Albany. Their contact information is:

421 New Karner Rd, Suite 6

Albany, NY 12205

518-464-0630

http://www.nationalmssociety.org/NYR/home/

89. Comment: [ATSDR's report states,] "No increased number of kidney disease deaths, spontaneous fetal deaths, or kidney cancer was detected (NYSDOH 1981)."

I don't believe this to be true.

ATSDR Response: Different diseases have different causes and based on scientific studies, we know that exposure to DU can increase the risk of kidney disease and that inhaling DU dust particles and cigarette smoke could have increased risk of lung cancer. Studies do not show that DU will cause other diseases. The information collected from the community members indicates that the residents near NL suffer from many different illnesses; however current scientific information does not show that the contamination from NL caused these illnesses.

90. Comment: …[T]he Health Consultation does not include current research on the health effects of depleted uranium conducted by Alexandra Miller of the Armed Forces Radiobiology

Research Institute in Bethesda, MD. This research shows that human bone cells exposed to depleted uranium sustain immediate genetic damage, and that new cells have broken chromosomes or other genetic damage.

ATSDR Response: During the Persian Gulf War in the early 1990s there were a small number of friendly fire incidents that resulted in military personnel being wounded by fragments of DU munitions. To investigate the health effects of embedded fragments of DU, the Armed Forces Radiobiology Research Institute conducted studies on 1) rodents implanted with DU pellets and 2) DU exposure *in vitro* to immortalized human osteoblast cells.

The results of the rodent studies indicated that uranium from the DU fragments distributed to tissues far removed from the implantation sites. However, despite levels of uranium in the kidney that were nephrotoxic after acute exposure, no histological or functional kidney toxicity was observed (McClain et al 2001). The results of DU exposure *in vitro* to immortalized human osteoblast cells indicated that DU was mutagenic to these cells (Miller et al 2002). However, immortalized human osteoblast cells are cancerous bone cells and are not reflective of healthy human cells. Also, *in vitro* exposure involves exposing the cells in an artificial environment outside the living organism. In the health consultation, ATSDR cited several epidemiological studies of workers who inhaled uranium. These studies are more representative of the types of exposures to residents near the NL plant.

Several studies of veterans from the 1991 Gulf War with embedded fragments of DU shrapnel have been conducted by the Department of Veteran Affairs Medical Center in cooperation with the University of Maryland School of Medicine. The purpose of these studies is to determine the long-term health consequences of continuous exposure to DU from retained shrapnel. Urinalysis of these veterans has shown elevated urinary uranium levels over a 10-year period as compared with veterans who had no retained uranium shrapnel. The steady-state excretion of uranium in the urine is presumably from ongoing mobilization of DU from fragments oxidizing in the body.

The veterans with embedded uranium shrapnel had no differences in renal function as compared with the other group (Hooper et al 1999; McDiarmid et al 2000; McDiarmid et al 2001a; McDiarmid et al 2001b; McDiarmid et al 2004), although subtle changes in some proximal tubular parameters over the 10-year follow-up may suggest early, although not clinically significant, effects of uranium exposure. These studies showed no differences in blood chemistry and hematology tests, hormone tests, and semen analyses (McDiarmid et al 2001a; McDiarmid et al 2001b; McDiarmid et al 2004). Neurocognitive tests in earlier studies showed a relationship between performance and urine uranium. However, neurocognitive tests in a later round of the studies showed no significant differences between those with embedded uranium shrapnel and those without (McDiarmid et al 2000; McDiarmid et al 2001a; McDiarmid et al 2001b; McDiarmid et al 2004). Mixed genotoxic results were observed in the 10-year follow-up. (McDiarmid et al 2004). The researchers stated that this area requires further study.

These studies have shown that, at least during the first decade of exposure, there are no adverse health consequences from embedded uranium. Although the pathway of exposure is different, it still indicates that long-term elevated levels of depleted uranium in the body are not causing illnesses in these soldiers.

**Public Health Registry**

91. Comment: As a cancer victim, I must tell you I am somewhat puzzled by the conclusion drawn in that report without consideration of a solution. On page 26 you state: "ATSDR believes that the DU emissions at these high levels could have increased the risk of health effects…" yet, to date, you have failed to establish a public health registry to deal with the health of this community in the aftermath of these events.

ATSDR Response: ATSDR has a National Exposure Registry (NER) to collect information about people's exposure to certain chemicals. Currently, ATSDR has five sub-registries for the following chemicals: tremolite asbestos, trichloroethylene, trichloroethane, benzene, and dioxin. The registries are not site-specific; rather, people who live near sites with a specific contaminant may be included if there is a sub-registry for that chemical. When deciding to place a chemical on a sub-registry, ATSDR looks for several factors relating to human exposure to that chemical. One of these factors is whether or not the chemical is present at more than 100 sites in ATSDR's database of hazardous waste sites. Depleted uranium is found at 85 sites in ATSDR's database.

ATSDR is developing other public health activities for the residents near the Colonie Site. ATSDR will provide health education to local health care providers including health information related to taking patients' environmental exposure histories and available contaminant-specific case studies and fact sheets. In addition, ATSDR is assessing the feasibility of looking at the health effects in former workers of the NL facility.

92. Comment: With so many elements of the ATSDR report under question, I wonder: Why an impartial and independent study and investigation by competent physicists and medical doctors has not already been begun? Why a public health registry has not been established?

ATSDR Response: ATSDR is an independent advisory public health agency. ATSDR staff includes experts in the field of medicine, community involvement, environmental health science, health physics, toxicology, health education, and epidemiology, as well as other public health professions. ATSDR's Colonie Site team includes personnel from many of these fields and every report that ATSDR releases is reviewed by experts in these various subjects.

Please see response to comment 91 for more information about ATSDR's National Exposure Registry.

**Volatile organic compounds (VOCs)**

93. Comment: We are concerned about the homes that have contaminated VOC vapors in the basements *above* the federal guidance levels. We request that ATSDR recommend immediate action be taken by the Army Corps to address this health risk.

ATSDR Response: Many of the federal guidance levels (e.g., preliminary remediation goals, or PRGs) are risk-based concentrations derived from standardized equations combining exposure information assumptions with EPA toxicity data. They are used for site screening and as initial cleanup goals, if applicable. ATSDR's comparison values are strictly screening values used to facilitate the initial selection of site-specific chemical substances for further evaluation of potential health effects. Concentrations at or below ATSDR's comparison values could reasonably be considered safe.

Only one sample from either of the sampling rounds exceeded ATSDR's comparison values. A sample of benzene taken from location three measured 48 µg/$m^3$ in the July/August 2002 sampling round. ATSDR's comparison value is 30 µg/$m^3$. However, during the January 2003 sampling round, the sample at this location measured 5 µg/$m^3$. ATSDR evaluated exposure to VOC vapors based on levels that would cause health risk and we believe that there is no risk to people's health from the levels of VOCs in the basements.

ACE conducted a third round of indoor air sampling in the Yardboro Avenue homes in late February 2004 and will conduct a fourth round in the winter of 2004/2005.

94. Comment: …[M]ore information is needed about VOCs in the groundwater.

ATSDR Response: ACE has been monitoring the groundwater both beneath the Colonie Site and off-site. They issue groundwater monitoring reports twice per year. In addition ACE, under the regulation of NYSDEC, will be following a plan of action for groundwater remediation as outlined in the groundwater feasibility study. It is important to note that this groundwater is not used for the municipal drinking water supply, nor are there any private wells in the area.

ACE has also conducted two sampling rounds of indoor air in homes above the contaminated groundwater. ATSDR has reviewed these data and determined that there is no public health hazard from VOC in indoor air. ACE conducted a third round of indoor air sampling in the Yardboro Avenue homes in late February 2004 and will conduct a fourth round in the winter of 2004/2005.

95. Comment: On page 22 of the report, ATSDR concludes that there are not currently any health effects from VOCs in indoor air caused by the groundwater contamination. ATSDR also concludes that health effects are not likely in the future. What does ATSDR base this conclusion on? What is the probability of VOCs increasing to a level which could cause health effects between the time indoor air samples were taken and the remedial action is taken to remove the groundwater contamination?

ATSDR Response: ATSDR believes that there will not be a health hazard from VOCs in indoor air in the future. This is based on several factors, including the movement of the contaminated groundwater, the levels of contaminants in the groundwater, and the continued monitoring of the groundwater contamination, ACE's continued monitoring of indoor air, and ATSDR's experience with indoor air vapor intrusion at other sites. Under the direction of NYSDOH, ACE agreed to collect another set of concurrent indoor air, outdoor air, and sub-slab soil gas samples to be able to evaluate future impacts. In addition ACE, under the regulation of NYSDEC, will be following a plan of action for groundwater remediation as outlined in the Groundwater Feasibility Study. This feasibility study and the selection of the remedial alternatives will take into account the results of the human health risk assessment completed by ACE.

**Cadmium**

96. Comment: Your conclusion that the risk of kidney disease and lung cancer in smokers is very important, but you failed to thoroughly examine exposure of other chemicals / toxic substances that were released by NL Industries. Two very important examples are dioxins and cadmium.

The following quotes are from ATSDR's ToxFAQs available at http://www.atsdr.cdc.gov/tfacts5.html:

"**Cadmium particles in air can travel long distances before falling to the ground or water**."

"**Cadmium stays in the body a very long time and can build up from many years of exposure to low levels**."

ATSDR has not examined the exposure route of cadmium, nor health effects in the community surrounding the former NL Industries site. I personally have various health problems that I believe may be related to my exposure of cadmium and depleted uranium from the NL Industries site. I would be glad to supply a list of health issues and research supporting why I feel my health has been impacted by living in close proximity to NL Industries.

ATSDR Response: We would not expect to find cadmium from air emissions in the soil surrounding the Colonie site. DU contamination of the vicinity properties resulted primarily from airborne emissions from the plant due to incineration of uranium shavings and grindings resulting from the fabrication components (DOE 1992). Some materials, including uranium, thorium, and other chemicals were buried in the former Patroon Lake area (DOE 1992) and this area has been remediated by the ACE.

There are some on- and off-site soil sampling data for cadmium. The soil collected by NYSDOH and NYSDEC in May 2003 in the Yardboro Avenue area was analyzed for a series of metals, including cadmium. The samples contained 2 mg/kg of cadmium or less. In addition, the four soil samples taken by NYSDOH in 1992 all are below 2 mg/kg of cadmium. Levels of cadmium in soil samples on-site range from not detected to 19.6 mg/kg.

97. Comment: I do not believe your conclusion that exposure to vegetables in gardens has been thoroughly examined. Plants have been used in a process called phytoremediation to removed toxins and heavy metals from soils. Some plants are able to concentrate toxins from the soil. You discuss only depleted uranium and lead, excluding the many other metals and toxins released from the NL Industries site. I have been unable to find any reports of cadmium and other heavy metal measured off the NL site, other than Yardboro Ave.

**Garlic, parsnips, potato, carrot, beetroot, spinach and Silverbeet have a high susceptibility to cadmium uptake**. These types of vegetables quite likely were grown in gardens surrounding the NL Industries site.

Your conclusion is misleading. A thorough investigation of toxins in the soil used for gardening has not been fully examine, and is most likely an exposure route for many people with gardens in the close proximity to the NL Industries site.

ATSDR Response: We would not expect to find cadmium from air emissions in the soil surrounding the Colonie site. DU contamination of the vicinity properties resulted primarily from airborne emissions from the plant due to incineration of uranium shavings and grindings resulting from the fabrication components (DOE 1992). Cadmium, which was probably used as part of the plating operations, and other chemicals were buried in the former Patroon Lake area along with other chemicals (DOE).

There are some on- and off-site soil sampling data for cadmium. The soil collected by NYSDOH and NYSDEC in May 2003 in the Yardboro Avenue area was analyzed for a series of metals, including cadmium. The samples contained 2 mg/kg of cadmium or less. In addition, the four soil samples taken by NYSDOH in 1992 all are below 2 mg/kg of cadmium. Levels of soil samples onsite range from not detected to 19.6 mg/kg.

EPA considered plant uptake of metals including cadmium in its soil screening guidance (EPA 1996). This section contains a detailed discussion regarding metal uptake in plants and defines

cadmium concentrations in soil that would not result in harmful levels of cadmium in home grown vegetables. The soil concentrations we based on conservative modeling used to develop federal legislation controlling the land application of sewage sludge. EPA defined a cadmium concentration of 24 mg/kg in soil below which there was no likelihood of significant cadmium uptake in home grown vegetables that would pose a health threat to people.

**ACE Work**

98. Comment: According to the report, the ACE has begun a health risk assessment to evaluate both the human health and ecological impacts of groundwater contamination. When can we expect the results of this report?

ATSDR Response: The draft final risk assessment for the Colonie Site was released to NYSDEC and NYSDOH for review in early April 2004. The final Risk Assessment was released to the public in September 2004.

## G. NYSDOH Lead Information Sheet

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