

Public Health Assessment

Nuclear Fuel Services, Inc.
Erwin, Unicoi County, Tennessee
TND003095636



Prepared by

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

FOREWORD

The Agency for Toxic Substances and Disease Registry, ATSDR, is an agency of the U.S. Public Health Service. It was established by Congress in 1980 under the Comprehensive Environmental Response, Compensation, and Liability Act, also known as the *Superfund* law. This law set up a fund to identify and clean up our country's hazardous waste sites. The Environmental Protection Agency, EPA, and the individual states regulate the investigation and clean up of the sites.

Since 1986, ATSDR has been required by law to conduct a public health assessment at each of the sites on the EPA National Priorities List. The aim of these evaluations is to find out if people are being exposed to hazardous substances and, if so, whether that exposure is harmful and should be stopped or reduced. (The legal definition of a health assessment is included on the inside front cover.) If appropriate, ATSDR also conducts public health assessments when petitioned by concerned individuals. Public health assessments are carried out by environmental and health scientists from ATSDR and from the states with which ATSDR has cooperative agreements.

Exposure: As the first step in the evaluation, ATSDR scientists review environmental data to see how much contamination is at a site, where it is, and how people might come into contact with it. Generally, ATSDR does not collect its own environmental sampling data but reviews information provided by EPA, other government agencies, businesses, and the public. When there is not enough environmental information available, the report will indicate what further sampling data is needed.

Health Effects: If the review of the environmental data shows that people have or could come into contact with hazardous substances, ATSDR scientists then evaluate whether or not there will be any harmful effects from these exposures. The report focuses on public health, or the health impact on the community as a whole, rather than on individual risks. Again, ATSDR generally makes use of existing scientific information, which can include the results of medical, toxicologic and epidemiologic studies and the data collected in disease registries. The science of environmental health is still developing, and sometimes scientific information on the health effects of certain substances is not available. When this is so, the report will suggest what further research studies are needed.

Conclusions: The report presents conclusions about the level of health threat, if any, posed by a site and recommends ways to stop or reduce exposure in its public health action plan. ATSDR is primarily an advisory agency, so usually these reports identify what actions are appropriate to be undertaken by EPA, other responsible parties, or the research or education divisions of ATSDR. However, if there is an urgent health threat, ATSDR can issue a public health advisory warning people of the danger. ATSDR can also authorize health education or pilot studies of health effects, full-scale epidemiology studies, disease registries, surveillance studies or research on specific hazardous substances.

Interactive Process: The health assessment is an interactive process. ATSDR solicits and evaluates information from numerous city, state and federal agencies, the companies responsible

for cleaning up the site, and the community. It then shares its conclusions with them. Agencies are asked to respond to an early version of the report to make sure that the data they have provided is accurate and current. When informed of ATSDR's conclusions and recommendations, sometimes the agencies will begin to act on them before the final release of the report.

Community: ATSDR also needs to learn what people in the area know about the site and what concerns they may have about its impact on their health. Consequently, throughout the evaluation process, ATSDR actively gathers information and comments from the people who live or work near a site, including residents of the area, civic leaders, health professionals and community groups. To ensure that the report responds to the community's health concerns, an early version is also distributed to the public for their comments. All the comments received from the public are responded to in the final version of the report.

Comments: If, after reading this report, you have questions or comments, we encourage you to send them to us.

Letters should be addressed as follows:

Attention:
Manager, ATSDR Records Center
Agency for Toxic Substances and Disease Registry
1600 Clifton Road (E-60)
Atlanta, GA 30333

Table of Contents

Summary	1
Background.....	1
Site Description and History.....	1
Site Visit	5
Demographics, Land Use, and Natural Resource Use.....	5
Health Outcome Data.....	8
Community Health Concerns.....	8
Exposure Evaluation Process.....	18
Assessing Health Effects.....	19
Child Health Considerations	21
Conclusions.....	22
Recommendations.....	23
Public Health Action Plan.....	23
Author	23
References.....	24

List of Figures

Figure 1. NFS site location.	4
Figure 2. Demographic distribution around the NFS facility.	6
Figure 3. On-site and off-site monitoring well locations.....	11
Figure 4. Off site contamination, March 2000.....	16
Figure 5. Off site contamination, March 2001.....	17
Figure 6. Potential Exposure Pathways	19

List of Tables

Table 1. Contaminant concentrations in on-site wells	12
Table 2: Contaminant concentrations in off site groundwater; 3 year average	14
Table 3. Contaminant concentrations in off-site monitoring wells in 1997.	15

Summary

The Agency for Toxic Substances and Disease Registry (ATSDR) received a petition from an individual (the petitioner) to evaluate the Nuclear Fuel Services, Inc. (NFS) site for inclusion on the Superfund list. The concerns listed by the petitioner include contamination of groundwater with volatile organic compounds (VOCs) and the use of radioactive materials. Other concerns included cancer rates in the community and concern for the contamination of the Nolichucky River and releases to the air from plant operations. The petitioner also raises issues related to the NFS history of operational violations.

This public health assessment will only address the concerns raised regarding the presence of volatile organic compounds. The concerns regarding radioactive materials will not be addressed as explained in the following paragraph.

ATSDR Legislative Authority

ATSDR derives its authority to address environmental contaminant issues at this site from the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) as codified at 42 USC 9601 within the United States Code. However, CERCLA excludes any releases of specific radioactive materials that are considered source, byproduct, or special nuclear material (42 USC 9601(22)). Therefore, those portions of the petition request concerning releases or potential releases of various types of nuclear materials can not be addressed by this ATSDR public health assessment. ATSDR is investigating other avenues by which the petitioners concerns for the nuclear and radiological issues can be addressed. ATSDR will address the releases of volatile organic compounds to the air, surface water, and groundwater as well as the presence of uranium and other naturally occurring radioactive materials in the groundwater.

Background

Site Description and History

Nuclear Fuel Services, Inc. (NFS) operational history began in 1957 at Erwin, Tennessee. Initially, the facility was operated as the Davison Chemical Division of W.R. Grace Co. prior to being renamed as NFS (1).

Erwin is a town of about 6,000 people located in Unicoi County about 15 mi south of Johnson City and 120 mi northeast of Knoxville. Unicoi County covers about 200 square miles in northeast Tennessee and has a population of about 20,000 (Figure 1). The area surrounding Erwin is mostly within the Cherokee National Forest.

The land area of NFS, itself, covers approximately 64 acres in the southern part of Erwin. The site is bordered by Interstate 26, the Riverview Industrial Site, and property belonging to the CSX Railroad, both to the west. Interstate 26 lies north of the facility and the Love Chapel Elementary School is about 1 mile south of the site. NFS sits about 30 feet above the Nolichucky River that runs by Interstate 26; whereas, the mountains rise to about 5,000 feet a few miles from the site.

The town of Erwin and surrounding areas include residential, commercial, industrial, and farming areas. The site is underlain by unconsolidated alluvium at various depths

consisting of silts and clays, clayey sand, and sand with varying amounts of gravel and cobble. The alluvium coarsens with depth into cobbles and boulders. Alluvium is sediment such as a riverbed deposited by flowing water. This cobble/boulder zone overlies weathered, fractured bedrock consisting of steeply sloping beds of shale or shale interbedded with dolomite and siltstone (2).

One of the primary activities of NFS's Erwin Plant is to prepare high-enriched uranium to be processed into fuel for the Department of Energy's Naval Reactor Program. The US Department of Energy supplies the uranium processed at NFS for this and other purposes. Other activities performed at this facility include the processing of high-enriched uranium scrap to recover the uranium, laboratory operations for manufacturing support and new development, and waste treatment and packaging for shipment. NFS also performs commercial work for the private sector and leases space to the private sector at their facility. These activities include cleaning of uranium hexafluoride cylinders and downblending of high-enriched uranium and converting it to low-enriched uranium compounds (BLEU) to be used in the commercial sector. Other site activities include, or once included, converting uranium hexafluoride to either uranium oxides, uranium tetrafluoride, and/or metallic uranium. NFS also in the past manufactured reactor fuel materials composed of either uranium or thorium, and recovery of these isotopes, production of thorium metals, and production of mixed oxide fuels containing uranium.

NFS currently is regulated for environmental corrective action and decommissioning activities by the US Nuclear Regulatory Commission (NRC), the state, and the EPA. The facility is a licensee of the NRC and a permitted US Environmental Protection Agency (EPA) RCRA facility. A RCRA facility is regulated under the authority of the Resource Conservation and Recovery Act. As such, the facility must establish a system for controlling hazardous waste from its generation until its ultimate disposal. NFS is an active facility and CERCLA regulations do not necessarily apply as the law specifically excludes any releases from the nuclear fuel operations. These nuclear releases are under regulatory authority of the NRC and the hazardous waste and hazardous waste constituents are regulated by the EPA and the state.

Under regulatory oversight by the NRC, NFS is in the process of decommissioning on a project-by-project basis. This included the former pond area in the unused northern portion of the site or areas and buildings in need of decontamination to protect the environment, in accordance with NRC and all applicable federal and state regulations. Decommissioning is the process converting a nuclear facility to a condition that is safe to public health and safety or the environment. The decommissioning activities at NFS include removal of contaminated soils, sediments, debris, and disassembly of equipment and buildings. The wastes generated are recycled when possible or are containerized and then transported to EPA and NRC approved radioactive waste burial grounds in other states.

The site also generates low-level radiological waste generated from laboratory processes and trash. This waste also contains elemental mercury used during analytical testing of its products. This results in the generation of mixed wastes which are regulated by both the NRC and the EPA as well as the state. The laboratory trash consists generally of paper, gloves, and discarded laboratory equipment. EPA documentation states that the analytical procedure is necessary to confirm that the sample of NFS product meets applicable

customer quality standards. The nature of the product and specifics regarding the analysis are considered Confidential Restricted Data per the United States Department of Energy as it is related to national defense and security. The mercury is recycled as much as possible during the analytical procedure to limit the amount of mixed mercury waste generated.

In the early history of NFS, several processes required the use of degreasing agents containing volatile organic compounds (VOCs)¹ such as tetrachloroethylene (PCE). Since the 1970s, NFS stopped the use of VOCs in their processes although during its use, a large amount of VOCs were released to the environment via either spills (such as in the maintenance areas) or venting. Per applicable laws and permits in effect at the time, NFS also released radioactive materials into the waste holding areas, the on-site ponds. In 1991, NFS began partial remediation of the site. These activities included removing the sludges from Ponds 1, 2, and 3, and removal of accessible waste in the Pond 4 area. The removal was and continues to be under authorization from the NRC, EPA, and the state. Excavation of the low-level waste burial area began in 1997.

In 1992-93, a RCRA permit was jointly issued to NFS by EPA and the state for the operation of a mixed waste storage area. Additionally, this RCRA permit required the systematic investigation of releases of hazardous wastes constituents to the environment and the subsequent correction action and cleanup.

¹ In this document the term volatile organic compound, VOC, refers only to perchloroethylene (PCE) and its breakdown products.

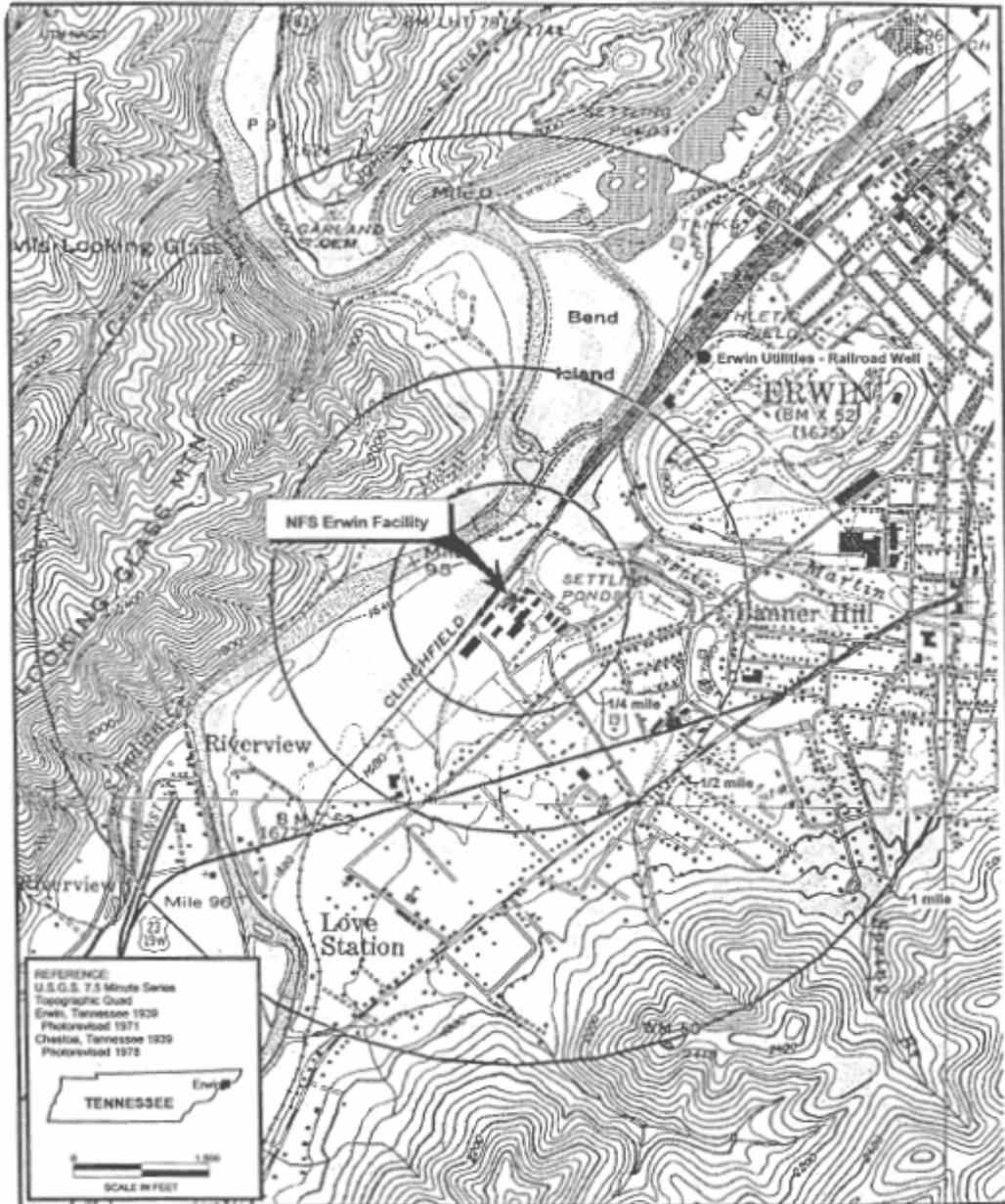


Figure 1. NFS site location.

In September 1996, pursuant to the RCRA permit investigations, the US EPA Region IV concluded that there was a plausible pathway for human exposure to the PCE plume in groundwater, but there was no current exposure. A pump and treat system was installed and operated to remediate the contaminant plume and prevent further migration.

In 2000, as part of a RCRA Corrective Measures Study, NFS developed a pilot study to enhance the anaerobic degradation of the VOCs contaminating the groundwater as this would accelerate the remediation. The field pilot study involved the injection of a molasses carbon source into the groundwater. As a carbon source, the molasses stimulates the naturally occurring bacteria in the groundwater to more efficiently degrade the VOCs. Besides reducing the concentration of VOCs, the system also immobilizes uranium migration by converting the uranium to an insoluble precipitate in the groundwater using a patented technology (3).

Current activities on the site include the processing of nuclear fuel products and the chemical conversion of these materials with the potential for production of ammonia gases or other nitrogen containing compounds.

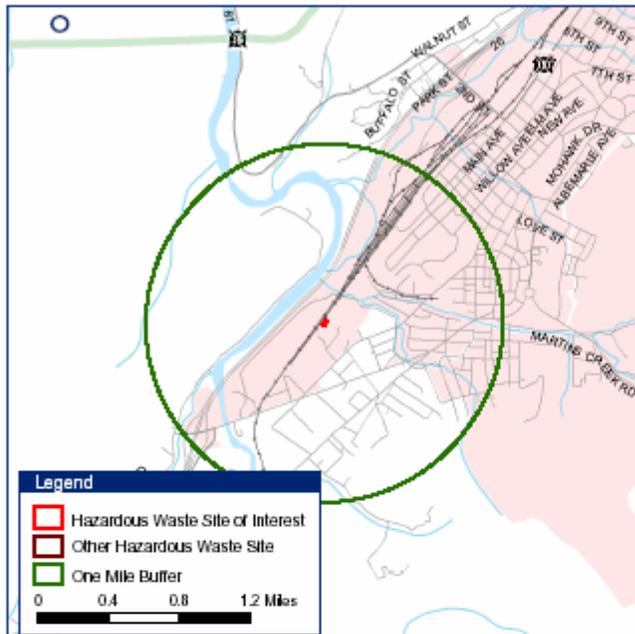
NFS has had numerous NRC violations resulting from poor documentation of chain of custody and location of special nuclear material. None of these violations was for actual loss of material, but for a lack of accounting for where quantities of material were moved within the facility.

Site Visit

In February 2006, representatives from ATSDR traveled to Erwin to meet with representatives from NFS, local officials, state and federal (NRC and EPA) regulators, the Tennessee Department of Health representative, a local plastics company downgradient from the site, and members of the public. During this visit, ATSDR collected community concerns. These concerns include releases of radioactive materials, safety issues, and emergency response and notification of the surrounding area. ATSDR also placed public announcements in local media outlets advertising the meetings and methods whereby community concerns could be relayed to ATSDR.

Demographics, Land Use, and Natural Resource Use

In the 2000 census, Unicoi County's population was 17,667 of which 51.2% were female. Its racial makeup was 98% white and 1.9% Hispanic or Latino. The average household size was 2.3 individuals. The population of Erwin was 5,610 with 53.7% of the population female. The racial composition was 97.8% white with 125 individuals of other racial backgrounds as defined by the US Census Bureau. Furthermore, 97.3% of the Erwin population lived in 1559 single family households with an average family of 2.2 individuals. Those between the ages of 18 and 65 numbered 4,503 with 299 below the age of 5 and the remaining population, 1283, 65 years of age or older (4). The population within a one mile radius of NFS was estimated to be 2,638 consisting of 186 children under the age of 6 and 472 females between the ages of 15 and 44, child-bearing age (Figure 2).

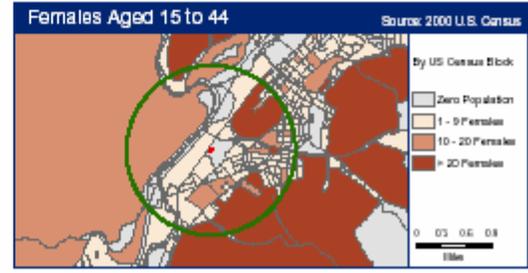
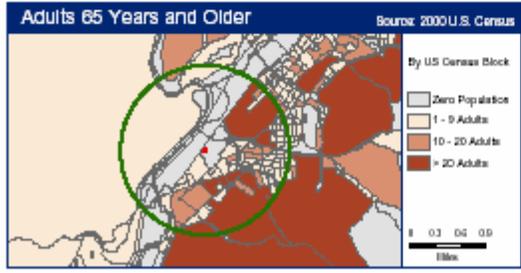
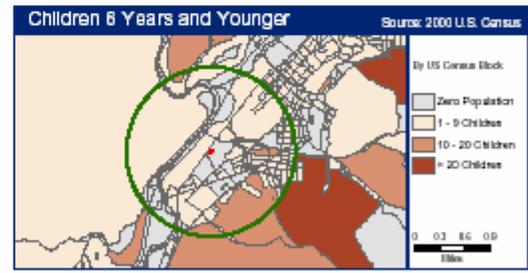
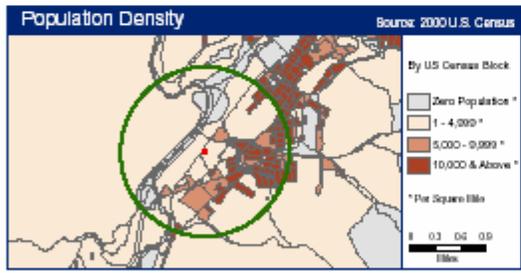


Demographic Statistics Within One Mile of Site*

Total Population	2,638
White Alone	2,598
Black Alone	2
Am. Indian & Alaska Native Alone	4
Asian Alone	0
Native Hawaiian & Other Pacific Islander Alone	3
Some Other Race Alone	9
Two or More Races	22
Hispanic or Latino**	53
Children Aged 6 and Younger	185
Adults Aged 65 and Older	618
Females Aged 15 to 44	472
Total Housing Units	1,234

Base Map Source: Geographic Data Technology, May 2005.
 Site Boundary Data Source: ATSDR Geospatial Research, Analysis, and Services Program, Current as of Generate Date (bottom left-hand corner).
 Coordinate System (All Panels): NAD 1983 StatePlane Tennessee FIPS 4100 Feet

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



GRASPMASTER 9.1 [BETA] - GENERATED: 03-14-2006

Figure 2. Demographic distribution around the NFS facility.

Within the vicinity of NFS lie three bodies of surface water--Banner Spring Branch, Martin Creek, and the Nolichucky River. Banner Spring Branch is completely contained within the NFS property boundary. The flow rates of these creeks range from 300 to 5,000 gallons per minute. Banner Spring Branch has now been channelized and diverted, no longer flowing through the NFS facility. It does follow the site boundary prior to emptying into Martin Creek at the northwest corner of the site. Prior to the channelization of Banner Spring Branch, the land was marshy and NFS constructed holding ponds in this area (1).

The state of Tennessee Wildlife Resources Agency, Fisheries Management Division maintains a state fish hatchery specializing in both rainbow trout and brown trout within a mile northeast of NFS. It has 14 outdoor concrete raceways, a hatchery building, and a manager's residence. The facility's water supply consists of about 30 artesian wells that are hydrologically upgradient from the NFS operations.

The Nolichucky River is a major river draining the Blue Ridge Mountains of western North Carolina and East Tennessee. The river enters Unicoi County, Tennessee, flowing through ranges known locally as the Bald Mountains and the Unaka Mountains. The flow rate of the river averages about 14,000 gallons per minute at Embreeville about 8 miles up river from the facility. The Nolicucky River ultimately flows into the French Broad River that, outside of Knoxville, Tennessee merges with the Holston River, forming the Tennessee River. The majority (64%) of the Nolichucky River watershed is in Tennessee with the remainder in North Carolina. Many of the streams in the watershed are impaired by silt accumulation and livestock grazing (5).

The City of Erwin obtains its drinking water from both springs and wells; 6 public supply wells are within 5 miles of NFS. The closest well, the Railroad Well, however, is about 0.5 miles north of NFS and hydrological tests indicate that this well does not draw from beneath the NFS nor from areas downgradient of the facility. NFS reports that there are no private wells between their operation and the river (6).

Groundwater under NFS and immediately downgradient is not used as a supply either to NFS or other industrial activities associated with the industrial park. The nearest well is upgradient (Railroad Well) and hydrological tests indicate that this well is not affected by draw down from water withdrawn beneath the NFS (7). The groundwater typically flows toward the north-northeast (6). Other water features include ephemeral springs that rapidly appear following local rains that average about 45 inches per year. The US Geological Service estimates that about 22% of the rain recharges the groundwater in the area.

Meteorological information for the Erwin area was obtained from documentation prepared for the Nuclear Regulatory Commission (8). The typical wind direction at the facility follows the valley topography in a southwest to northeast direction with an average wind speed of less than 8 miles per hour during daylight. Typically, the wind direction reverses directions during the evening hours. This reversal is related to unequal land heating and the presence of the mountains in the area.

Health Outcome Data

Health outcome data consist of information derived from databases such as morbidity/mortality data, cancer incidence, birth defects data or any site-specific community health records and/or health studies. Health outcome data can provide information on various aspects of the health of people living around site. It may reveal whether people living or working near a site are experiencing adverse health effects at a rate higher than would be expected to occur. Health outcome data can constitute a key source of information for conducting public health assessments. However, site-specific health outcome data are rarely available or of sufficient or adequate quality to enable linking health outcomes with site-related exposures. However, health outcome data will not prove a cause or an effect. Discussions were held with representatives of the Tennessee Department of Health, Johnson City office, and from the East Tennessee State University in Johnson City. The state has limited reliable health data for this area of Tennessee.

Community and Petitioner Health Concerns

Based on information received from the petitioner, the major community concern is cancer with 36 cancers reported in a self-administered survey in the area bordering the facility. The other concerns raised by the petitioner include degradation of the air and quality, and the perceived lack of environmental monitoring of these two potential pathways. ATSDR received additional public health concerns at two public meetings held in Erwin in February 2006. These concerns and the ATSDR response are included in Appendix A.

Environmental Contamination and Other Hazards

The Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) as codified at 42 USC 9601 within the United States Code gives the legislative authority to ATSDR to evaluate releases from hazardous waste sites. CERCLA further defines a release in many ways such as a spill, leak, emptying, discharge, leaching, dumping, or disposing of hazardous material in an uncontrolled manner. *However*, CERCLA also excludes any releases of specific radioactive materials that are considered source, byproduct, or special nuclear material (42 USC 9601(22)). By definition, source material is uranium and/or thorium in any physical or chemical form that contain by weight 1/20 of one percent (0.05 percent) or more of these elements. Source material does not include special nuclear material (SNM). SNM is material containing among other radionuclides, enriched uranium or plutonium. By-product material is any material made radioactive following exposure to SNM or the waste associated with ore processing.

ATSDR receives its authority to address hazardous releases from the CERCLA; therefore, those portions of the petition request concerning releases or potential releases of various types of nuclear materials can not be addressed by this public health assessment nor by ATSDR. ATSDR is investigating other avenues by which the petitioner concerns for the nuclear and radiological issues can be addressed. ATSDR will address the releases of volatile organic compounds to the air, surface water, and groundwater.

NFS conducted a remedial alternatives analysis (RAA) to select an appropriate technology for controlling and/or remediating groundwater. The RAA identified enhanced anaerobic bioremediation and reductive precipitation (EABRP) as the selected technology that would best remove the organic contaminants from the groundwater. This technology involves enhancing the natural biological degradation of the PCE and its degradation products. The system works by supplying an additional organic carbon source (molasses) as an energy substrate to the naturally occurring bacteria within the groundwater system. The molasses accelerates oxygen depletion in the water that is conducive to the degradation of the PCE through the removal of chlorine atoms (reductive dechlorination), replacing them with hydrogen atoms. NFS also adds ferrous sulfate that precipitates the soluble uranium as insoluble precipitate, thus immobilizing any uranium in the water.

On-Site Contamination

Prior to 1984, NFS disposed of various materials on their property as allowed by the laws in effect at that time. The disposal areas included landfills, ponds, and other types of impoundments such as trenches. To enable proper site assessment and site remediation, EPA initially divided the waste operations into 23 solid waste management units (SWMUs) and 7 areas of concern (AOC). Based on analyses of the SWMUs as required by the RCRA permit, 11 required no additional actions, 5 units are under institutional controls with the remaining SWMU requiring interim measures to alleviate waste issues. The AOC remedial activities included 4 areas under institutional control, 2 areas requiring either interim actions or remediation, and the remaining AOC, required no further action.

In 2005, planned activities for the SWMU and AOC locations included soil removal and confirmatory sampling, quarterly and annual inspections, groundwater remediation and related activities including pilot testing, installation of tanks to assist in the groundwater remediation, and additional sampling of surface water and sediments in the Nolichucky River (6).

Releases from NFS have contaminated the groundwater beneath the facility. An extensive monitoring program identified PCE, TCE, cis-1,2 DCE, vinyl chloride, and uranium in the water beneath the plant that flows toward the river. NFS installed a series of monitoring wells within their operational boundaries and another 21 monitoring wells off-site. Many of the well locations are depicted in Figure 3. In 1997, the NFS groundwater monitoring program consisted of sampling approximately 54 monitoring wells. The program's purpose was regulatory in design and helped to further define areas of groundwater contamination as well as its movements. Groundwater contamination is mostly associated with the former pond areas (SWMU 1, 2), underground storage tanks (SWMU 18), Building 130 Scale Pit (SWMU 20), and the radiological waste burial grounds (SWMU 9) (7). According to the Environmental Indicator assessments (9, 10, 11), the plume in 1996-2004 covered an area of approximately 13 acres (600 feet by 900 feet) in the northernmost portion of the facility and extended an additional 5 to 8 acres off the NFS property toward the Nolichucky River. The contaminants in the on-site plume included PCE, TCE, cis-1,2 DCE, vinyl chloride, and uranium; whereas, the off-site plume contains PCE, TCE, cis-1,2 DCE and vinyl chloride.

From these monitoring wells, NFS reported the concentrations of the contaminants in the groundwater within the facility boundary. The results of the onsite sampling, shown in Table 1, indicated that the average concentration of PCE was 1.7 milligrams per liter (mg/L) with the maximum measured concentration of 8.4 mg/L. The maximum concentrations of the PCE degradation products ranged from 1.6 mg/L for dichloroethylene to 0.01 mg/L for trichloroethylene and vinyl chloride. These results are also given in Table 1.

Monitoring data for the groundwater plume in 2002, indicated that the maximum concentration of PCE in the alluvial aquifer exceeded 13,000 micrograms per liter ($\mu\text{g/L}$) and extended beyond the west boundary of the facility toward the industrial park. According to the EPA, the apparent source of the PCE plume is one of the maintenance shop areas within the NFS fence line.

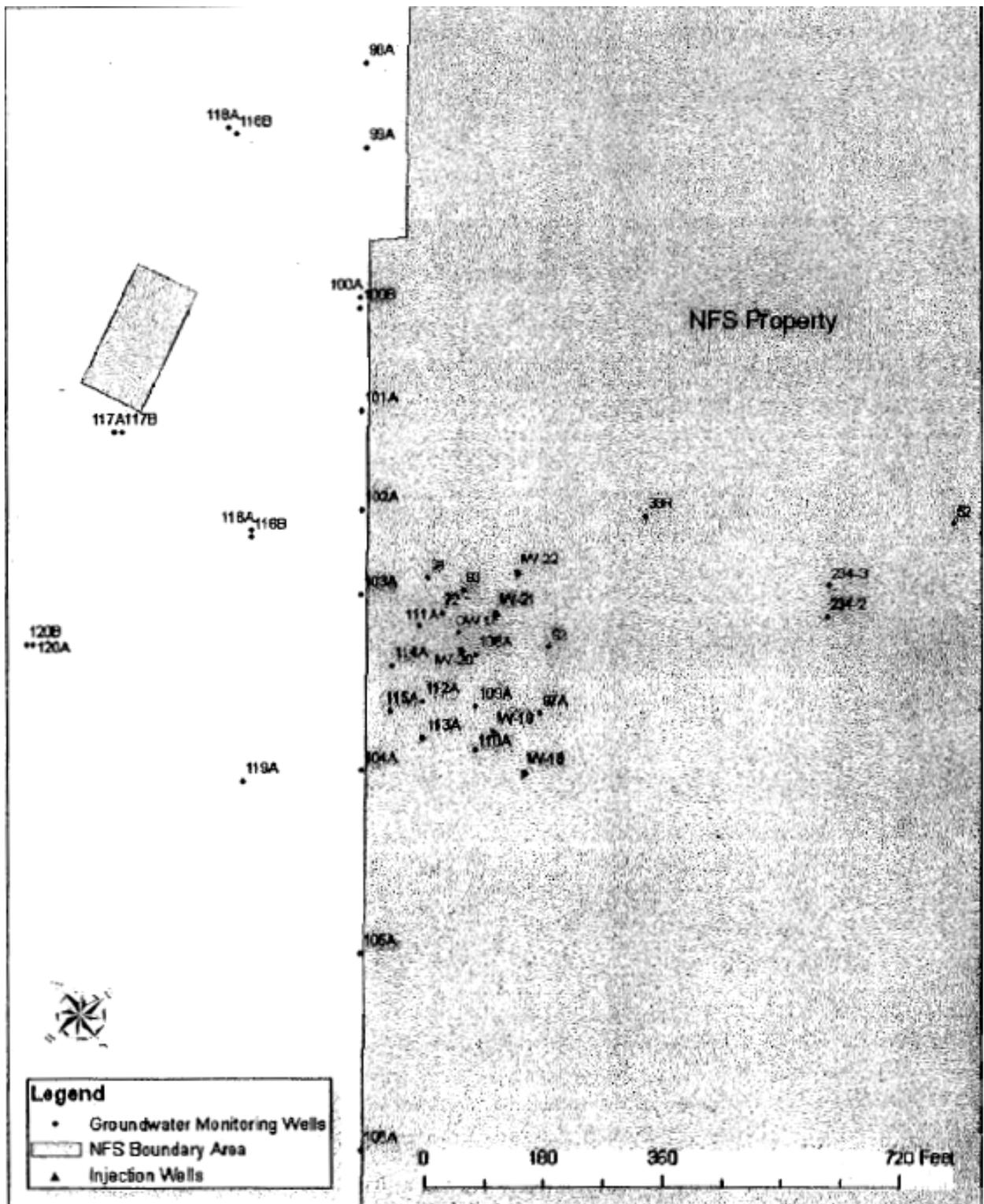


Figure 3. On-site and off-site monitoring well locations

Table 1. Contaminant concentrations in on-site wells*

Well Number	PCE	TCE	DCE	Vinyl Chloride	Tributyl phosphate
71	0.021	0.011	1.324	0.728	18.43
72	0.585	0.115	0.507	0.07	6.21
93	0.005	0.09	1.665	0.515	81
94	0.03	0.005	0.005	0.01	0.01
108a	4.8	0.005	0.005	0.01	0.55
109a	0.34	0.077	0.22	0.03	0.01
111a	8.4	0.005	0.6	0.01	0.01
112a	0.099	0.013	0.01	0.01	0.01
114a	0.009	0.005	0.005	0.01	0.01
114b	0.92	0.073	0.059	0.01	0.01
28	1.27	0.157	0.433	0.101	0.07
102a	0.944	0.028	0.029	0.006	0.02
103a	4.956	0.223	0.401	0.021	0.02
average	1.721	0.062	0.405	0.118	8.182
geometric mean†	0.294	0.027	0.095	0.029	0.103
MCL‡	0.005	0.005	0.07	0.002	--

*values expressed as milligrams per liter; data from the Groundwater risk assessment at Nuclear Fuel Services, Inc. and adjacent industrial park site (7)

†The geometric mean represents the central tendency of a distribution if the numbers do not appear to be evenly distributed.

‡MCL – maximum contaminant level, a legally enforceable concentration of contaminants in drinking water.

Environmental sampling and analyses of groundwater collected during RCRA activities indicated the presence of uranium, PCE, and its degradation products in the groundwater beneath the NFS facility. The uranium plume was about 0.7 acre (250' by 120') and exceeded the EPA Maximum Contaminant Level (MCL; 30 micrograms per liter; µg/L). Uranium concentration in the groundwater plume ranged from approximately 30 to 1,100 pCi/L. The area of the PCE groundwater plume exceeding the National Drinking Water Maximum Contaminant Level (MCL = 0.005 mg/L) was approximately 19 acres (1200 ft by 700 ft). PCE concentrations in this plume ranged from approximately 0.005 milligrams per liter (mg/L) to 14 mg/L. Associated PCE degradation product concentrations are also present in portions of the PCE groundwater plume (11).

Off-Site Contamination

Monitoring of organic contaminants outside the property boundary of NFS has been very limited. RCRA reports indicate there are 9 monitoring wells outside the fence line and west of the railroad property. Of these wells, Well 120 lies inside the boundary of the Riverview Industrial Park. The other wells, 116 through 118, are either outside the industrial park or between the park and NFS (Figure 3).

The sampling results have been reported in numerous RCRA Facility Investigation reports from the EPA. In 2002, a private engineering and environmental services company was hired by a facility in the industrial park to sample the monitoring well installed by NFS outside their boundaries and within the industrial park area.

Their results indicated the presence of volatile organic compounds as well as the presence of radioactive materials in the groundwater obtained from the industrial park. Table 2 shows the results of the sampling in these off-site wells and the Maximum Concentration Level (MCL) for these contaminants. The MCL is the federal limit for contaminants in drinking water. Table 3 gives the 3 year averages in these wells. During the sampling and monitoring effort in 2000, the extent of the groundwater plume was mapped with the results shown in Figure 4. At that time, the maximum concentration of PCE was 13 mg/L and the lowest concentration found was below the MCL for this contaminant and below the analytical limits of detection.

Within a year of the 2000 sampling round and following the bioremediation with molasses and iron, the plume had expanded as expected. However, the maximum contamination of PCE in the monitoring wells decreased, the maximum detected concentration was greater than 5 mg/L beneath the CSX property; the lowest concentration detected was less than 0.1 mg/L, was below the MCL for this contaminant and below the analytical limits of detection (Figure 5).

The naturally occurring radioactive elements uranium and thorium were detected in wells below the MCL for these contaminants. Other radioactive materials detected included technetium-99 and various plutonium isotopes. The technetium-99 was below the MCL for that radionuclide, as was the plutonium.

Releases to the atmosphere from NFS were not reported in any documentation supplied to ATSDR from the state or EPA. However, the EPA Toxic Release Inventory (TRI) database contains release information on over 500 chemicals or chemical categories from industrial processes. NFS reports their total chemical releases to the TRI system; however, neither uranium nor plutonium are required to be included in the TRI list of reported chemicals. Furthermore, concentrations are not reported, only the total amount of materials are given. The TRI data are available from the EPA on their internet site at the following web address: <http://www.epa.gov/tri/tridata/tri04/index.htm#what> (accessed on April 27, 2006).

The TRI data reported for 2004 indicates that NFS released 103 pounds of nitrates and nitrogen compounds to the air, 25,620 pounds to surface waters, and 4050 pounds were sent to EPA approved landfills. NFS does not perform environmental air sampling for non-radiological materials as this is not required for their operations.

Table 2: Contaminant concentrations in off site groundwater; 3 year average*

Contaminant and MCL†	Quarter 1 average mg/L	Quarter 2 average mg/L	Quarter 3 average mg/L	Quarter 4 average mg/L	3 year Average mg/L
Tetrachloroethylene 0.005 mg/L	0.442	0.484	0.479	0.413	0.455
Trichloroethylene 0.005 mg/L	0.02	0.019	0.019	0.017	0.019
Cis 1,2 dichloroethylene 0.07 mg/L	0.032	0.027	0.024	0.048	0.033
Trans 1,2 dichloroethylene 0.1 mg/L	0.013	0.009	0.008	0.009	0.010
Vinyl Chloride 0.002 mg/L	0.019	0.017	0.015	0.018	0.017

* data expressed in milligrams per liter of water; data derived from USEPA RCRA Facilities Investigation reports covering 2002, 2003, and 2004 for off-site monitoring wells

†Maximum Contaminant Level – legally enforceable concentration allowed in public drinking water

Physical and Other Hazards

No physical hazards to the public were observed at the site as the site has a physical security force to limit any trespassing. Worker safety and health is addressed by the site's health and safety plan associated with regulatory oversight by both the Nuclear Regulatory Commission and the Tennessee Occupational Safety and Health Administration.

No noticeable odors were detected during the site visit and facility tour which included portions of the blending facility.

Other hazards associated with the site are the presence of hazardous chemicals and radioactive materials, heavy equipment used in the ongoing remediation work and in normal plant operations.

Table 3. Contaminant concentrations in off-site monitoring wells in 1997*.

Well Number	Tetrachloro-ethylene (mg/L)	Trichloro-ethylene (mg/L)	Cis 1,2 dichloroethylene (mg/L)	Trans 1,2 dichloroethylene (mg/L)	Vinyl Chloride (mg/L)
116a	0.48	ND	ND	ND	ND
116b	2.4	0.091	0.11	ND	ND
117a	0.15	ND	ND	ND	ND
117b	0.5	ND	ND	ND	ND
118a	ND	0.005	0.003	ND	ND
118b	ND	0.011	0.007	ND	0.0002
119a	0.13	0.011	0.003	ND	ND
120a	0.29	0.016	0.012	ND	ND
120b	0.46	0.018	0.014	ND	ND
121a	0.062	0.005	0.003	ND	ND
121b	0.097	0.005	0.003	ND	ND
Average	0.416	0.022	0.022	ND	ND
MCL	0.005	0.005	0.07	0.01	0.002

*Data from Nuclear Fuel Services (1997).

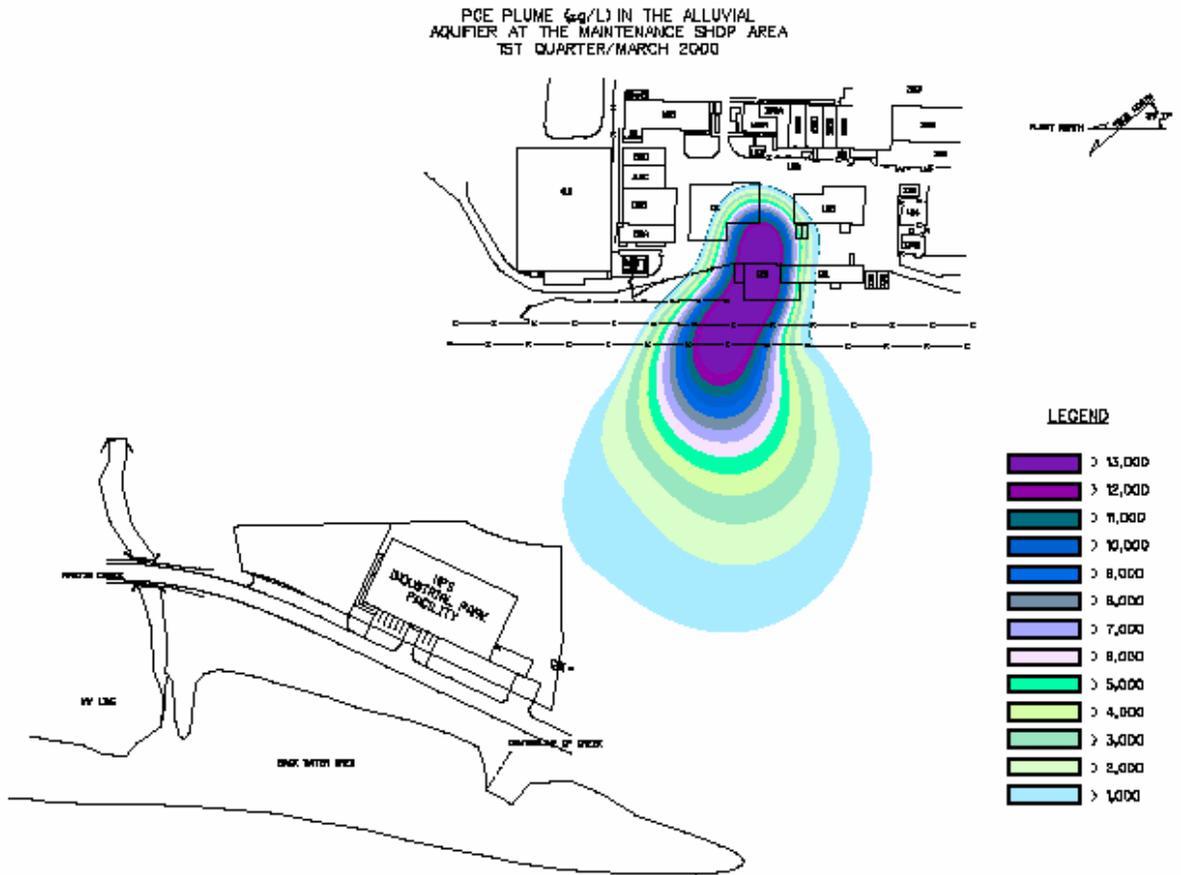


Figure 4. Off site contamination, March 2000



Figure 5. Off site contamination, March 2001

Pathways Analysis

An environmental exposure pathway consists of five elements:

(1) a source of contamination; (2) an environmental medium in which the contaminants may be present or into which it may migrate; (3) points of human exposure; (4) routes of human exposure, such as inhalation, ingestion or dermal absorption; and (5) a receptor population. A completed exposure pathway exists in the past, present, or future if all five of the elements of an exposure pathway link the contaminant source to a receptor population. A potential exposure pathway exists if there is insufficient data for one or more of the five elements linking the source of the contamination to the receptor population or if modeling replaces sampling data. A pathway can be eliminated if one or more of the five elements do not exist or the pathway is unlikely to occur. A future completed exposure pathway occurs when the contamination at a point of exposure exists and that contamination would expose a receptor population if the population were present. Future potential pathways exist if the contamination does not currently exist at a point of exposure but might migrate to some point of exposure. Figure 6 represents typical exposure pathways for a generic hazardous waste site.

The fact that completed exposure pathways exist at hazardous waste sites, does not necessarily suggest the potential for adverse health effects. The evaluation of the exposure pathways with respect to health effects appears in a subsequent section of this public health assessment.

This section contains discussion of the potential for contaminants to present public health hazards via environmental exposure pathways in the past, in the present, and in the future.

Exposure Evaluation Process

A release of a contaminant from a site does not always mean that the substance will have a negative impact on a member of the off-site community. For a substance to pose a potential health problem, exposure must first occur. Human exposure to a substance depends on whether a person comes in contact with the contaminant, for example by breathing, eating, drinking, or touching a substance containing it. If no one comes into contact with a contaminant, then no exposure occurs—and thus no health effects can occur. Even if the site is inaccessible to the public, contaminants can move through the environment to locations where people could come into contact with them.

ATSDR evaluates site conditions to determine if people could have been or could be exposed to site-related contaminants. When evaluating exposure pathways, ATSDR identifies whether exposure to contaminated media (soil, water, air, waste, or biota) has occurred, is occurring, or will occur through ingestion, dermal (skin) contact, or inhalation. ATSDR also identifies an exposure pathway as

The five elements of an exposure pathway are (1) source of contamination, (2) environmental media, (3) point of exposure, (4) route of human exposure, and (5) receptor population. The source of contamination is where the chemical or radioactive material was released. The environmental media (e.g., groundwater, soil, surface water, air) transport the contaminants. The point of exposure is where people come in contact with the contaminated media. The route of exposure (e.g., ingestion, inhalation, dermal contact) is how the contaminant enters the body. The people actually exposed are the receptor population.

completed or potential, or eliminates the pathway from further evaluation. Completed exposure pathways exist if all elements of a human exposure are present. A potential pathway is one that

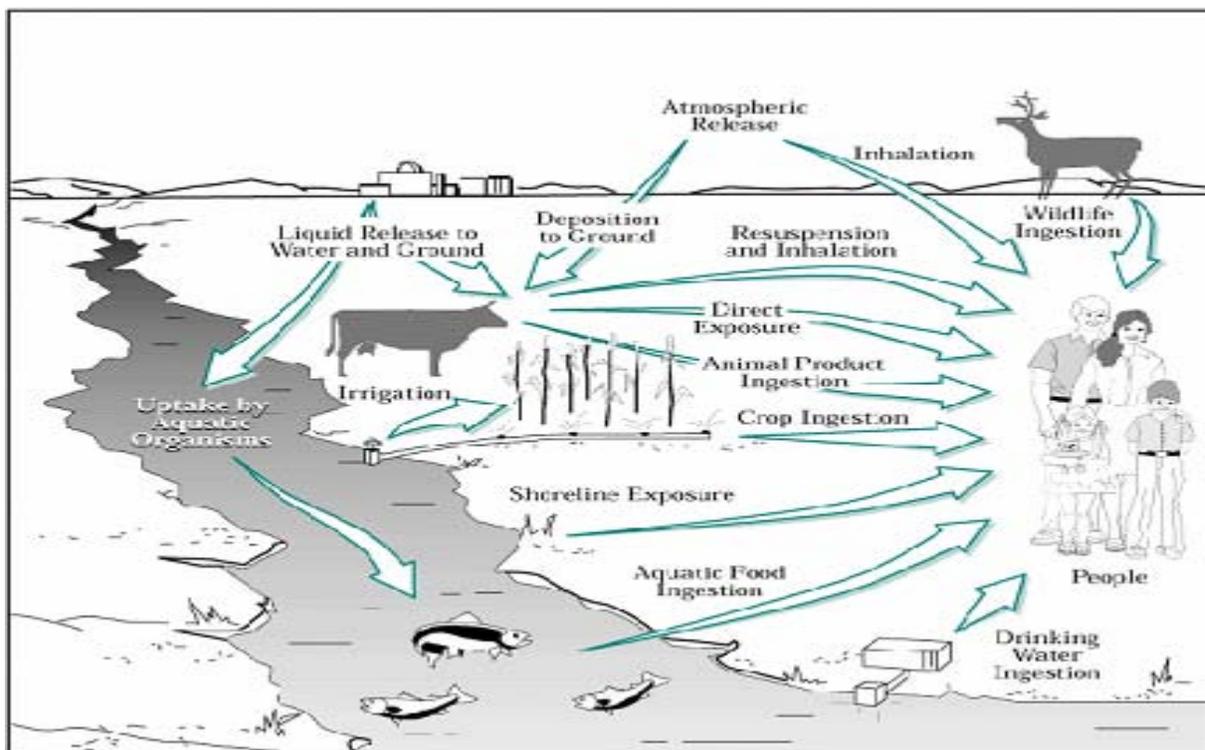


Figure 6. Potential Exposure Pathways

ATSDR cannot rule out because one or more of the pathway elements cannot be definitely proved or disproved. A pathway is eliminated if one or more of the elements are definitely absent.

Assessing Health Effects

Exposure does not always result in harmful health effects. The type and severity of health effects that a person can experience depend on the dose, which is based on age at exposure, the exposure rate (how much), the frequency and/or duration of exposure (how long), the route or pathway of exposure (breathing, eating, drinking, or skin contact), and the multiplicity of exposure (combination of contaminants). Once a person is exposed, characteristics such as his or her age, gender, nutritional status, genetics, lifestyle, and health status influence how he or she absorbs, distributes, metabolizes, and excretes the contaminant. The likelihood that adverse health outcomes will actually occur depends on site-specific conditions, individual lifestyle, and genetic factors that affect the route, magnitude, and duration of actual exposure—an environmental concentration alone will not cause an adverse health outcome.

More information about the ATSDR evaluation process can be found in ATSDR's Public Health Assessment Guidance Manual at <http://www.atsdr.cdc.gov/HAC/HAGM/> or by contacting ATSDR at 1-888-42-ATSDR. An interactive program that provides an

overview of the process ATSDR uses to evaluate whether people will be harmed by hazardous materials is available at <http://www.atsdr.cdc.gov/training/public-health-assessment-overview/html/index.html>.

A. Completed Exposure Pathways

This public health assessment focuses on exposures to volatile organic compound releases to the environment by way of the surface water, groundwater, and air. As stated earlier in this section, exposure pathways are complete when contaminants are traceable through the 5 elements comprising an exposure pathway.

Environmental sampling has shown the presence of volatile organic compounds in the groundwater. An evaluation of scenarios whereby an individual would consume this water indicates that groundwater is not a source of drinking water. Nor do data suggest that contaminants have migrated against the normal groundwater flow toward the Railroad Well that serves as a source of drinking water for the community. No data were identified indicating contamination of private wells by these contaminants.

NFS has sampled the Nolichucky River for the presence of volatile organic compounds. The sampling location was along the backwash areas near the mouth of Martin Creek. These data do not indicate the presence of volatile organic compounds contamination at levels of public health concern. Furthermore, this portion of the river is not used because of the nature and conditions of the marshy backwash area.

Data suggest that the groundwater beneath the NFS facility migrates toward the Nolichucky River and flows into the river. The State of Tennessee reported that the downstream quality of public water processed from the river is considered excellent.

The EPA Toxic Release Inventory data reports that NFS has released nitrate and other related compounds to the atmosphere. However, air sampling for these contaminants and other non-radiological contaminants has not occurred.

B. Potential Exposure Pathways

Nuclear Fuel Services, Inc. reported that they have not used PCE and its breakdown products since the 1970s. However, past uses resulted in spills, releasing the chemicals to the air and to the soils ultimately contaminating the groundwater. Groundwater sampling results and concentration maps for VOCs show very high levels of the contaminant suggesting that large volumes of these compounds were spilt on the ground around the maintenance areas prior to the 1970s on the NFS property. ATSDR did not locate any surface soil sampling or atmospheric sampling around these areas that occurred at the time of these spills. As VOCs are no longer used, there will be no current or future exposures to these contaminants via the air pathway. No current uses of groundwater occur in the downgradient areas and restrictions to the use of groundwater in this area are restricted.

Other potential exposure pathways that could result in human exposures include the release of nitrates and nitric acids as well as ammonia compounds to the surface and the air.

NFS is currently seeking a waste water permit to allow them to divert processing water, currently stored on site, to the municipal sewage system. Until that permit is granted, the potential for exposures to waste water containing nitrogen compounds such as ammonia exists.

Not directly related to site contaminants but associated with NFS is the firing range in Washington County used by their security forces. The contaminants associated with this type of activity include residue from spent gunpowder including various heavy metals and the heavy metals associated with the fired bullets. These heavy metals include, but are not limited to, copper, lead, zinc, steels, and brass. The concerns expressed to ATSDR include migration of these contaminants to local surface waters that serve as sources of public water supplies to downstream communities.

Public Health Implications

The Nuclear Fuel Services, Inc. site released volatile organic compounds to the ground, contaminating both surface soils on site and the groundwater. Although these releases occurred in the past, there are no current or future uses for the off-site groundwater as the community is on public water supplies. Furthermore, the public well closest to the facility is hydraulically upgradient and has not been impacted by these releases. Additionally, the facility-wide enhanced bioremediation and reductive dechlorination project (RCRA corrective action) has proven to be very effective at remediating the PCE contaminated groundwater.

Without a completed exposure pathway, adverse health effects related to these releases are unlikely.

C. Community Health Concerns Evaluation

Members of the community in Erwin and surrounding cities and towns have expressed a variety of concerns to ATSDR. The concerns ranged from impacts on environmental quality (air, water) in Erwin, other towns in Tennessee and North Carolina, perceived increases in cancer rates and self-reported cancer including colon and multiple myeloma, thyroid disease, Alzheimer's Disease, multiple sclerosis, skin, and joint ailments. Concern also was raised regarding the firearms training facility located in Washington County.

ATSDR addresses these comments and concerns in Appendix A, entitled "Public Concerns received by ATSDR following the February 2006 site visit."

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 behaviors that increase their exposure potential. Children are shorter than are adults; this means they breathe dust, soil, and vapors 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.

The evaluation performed by ATSDR at the Nuclear Fuel Services, Inc. site did not find any current exposure pathways for any chemical. Moreover, there is insufficient evidence to show completed exposure pathways to organic chemicals.

Conclusions

ATSDR has evaluated the releases of volatile organic compounds to the environment surrounding the Nuclear Fuel Services, Inc. facility in Erwin, Tennessee. The releases of these materials may occurred in the 1950s, 1960s, and 1970s; there was little or no monitoring of the environmental media at that time.

Current conditions related to the groundwater indicate that the groundwater is not being used as a source of drinking water nor has the contamination impacted public water sources. The level of contaminants in the bordering Nolichucky River are not at levels of a public health hazard.

Using the protocols developed by ATSDR to evaluate pathways of exposure to populations around potentially contaminated or contaminated sites, ATSDR considers the NFS facility hazard rankings as such:

1. Past Conditions – There is no verifiable information that groundwater was not used prior to the 1980s. Furthermore, there is a historical lack of both on-site and off-site sampling of atmospheric releases. ATSDR considers the site an **Indeterminant Public Health Hazard**. This category applies to sites where critical information is lacking (missing or has not yet been gathered) to support a judgment regarding the level of public health hazard from past exposures.
2. Current and Future Conditions –ATSDR ranks this site as **No Apparent Public Health Hazard**. As there are no completed exposure pathways existing whereby the groundwater would be used as a source of public water. Based on all available information, ATSDR concludes that although some exposure might be occurring as a result of site conditions via the atmospheric exposure pathways, exposures are not at levels likely to cause adverse health effects and thus the site does not pose a public health hazard.
3. As previously stated, CERCLA legislation directing ATSDR activities excludes the evaluation of the radioactive materials released from this site. The conclusions of this public health assessment do not apply to the issues surrounding the use of radioactive materials by the Nuclear Fuel Services, Inc.

Recommendations

ATSDR has evaluated the issues associated with the release of organic contaminants associated with the Nuclear Fuel Services, Inc. facility. Based on concerns received by ATSDR, the following recommendations are made:

1. A community education plan should be initiated by the appropriate agency to inform the area residents as to the nature and migration of the contaminants. This should include the movement of contaminants in the groundwater
2. ATSDR should meet with the public to discuss the findings of this public health assessment
3. If ATSDR receives any requests for a basic radiation safety and information presentation from the communities, those requests will be routed to both the Nuclear Regulatory Commission and Nuclear Fuel Services.
4. Inform the EPA about the concerns about lead exposure and migration as related to the gun range in Washington County.

Public Health Action Plan

ATSDR will coordinate with local officials and media outlets to set up public meetings to disseminate the findings of this public health assessment.

ATSDR will begin formulating an action plan to discuss the health impacts of the site to present to the public.

ATSDR will forward the concerns regarding the gun range to the site and to the EPA for their evaluation.

ATSDR will contact the local emergency response organizations and hospital for the purposes of their activities in event of NFS accidents.

Author

Paul A. Charp, Ph.D.

Senior Health Physicist

References

- 1 National Institute for Occupational Health and Safety (2006). Technical Basis Document An Exposure Matrix for W.R. Grace and Company in Erwin, Tennessee
- 2 Arcadis Geraghty & Miller, Inc. (1999). Revised groundwater flow and solute-transport modeling report. Nuclear Fuel Services, Inc., Erwin, Tennessee.
- 3 Morie CS, Greene J, Page GB, Ilgner B (2002). “Tetrachloroethylene and uranium remediation using IRZ®” in Gavaskar AR, Chen ASC (eds). Remediation of chlorinated and recalcitrant compounds—2002. Proceedings of the Third International Conference on Remediation of Chlorinated and Recalcitrant Compounds. (Monterey, CA 2002).
- 4 <http://factfinder.census.gov>
- 5 Tennessee Department of Environment and Conservation (2006). 2006 305(b) Report: The Status of Water Quality in Tennessee. Tennessee Department of Environment and Conservation, Nashville, Tennessee
- 6 Nuclear Fuel Services (2004). Facility Action Plan Revision 2 for Nuclear Fuel Services, Inc. Erwin, Tennessee. Prepared for the Tennessee Department of Environment & Conservation. Nuclear Fuel Services, December 2004.
- 7 Nuclear Fuel Services (1997). Groundwater risk assessment at Nuclear Fuel Services, Inc. and adjacent industrial park site. June 1997.
- 8 US Nuclear Regulatory Commission (2002). Environmental assessment for proposed license amendments to Special Nuclear Material License No. SNM-124 regarding downblending and oxide conversion of surplus high-enriched uranium. Docket 70-143.
- 9 EPA (1996). First Evaluation Memo of NFS status under the Environmental Indicator Codes CA725 and CA750. Prepared by EPA, September 11, 1996.
- 10 Tennessee Department of Environment and Conservation (2004). Environmental indicator evaluation memorandum (EI memo). Prepared by the Division of Solid Waste Management. November 19, 2004.
- 11 EPA (2002). RCRA Cleanup Reforms: Region 4 Success Story. Successful Pilot Test: Enhanced In-Situ Anaerobic Dechlorination of PCE and Reductive Precipitation of Uranium. (www.epa.gov/correctiveaction/success/r4s_nucl.pdf (accessed April 25, 2006).

Appendix A

ATSDR Response to Public Concerns received following the February 2006 site visit

Comment	Response
<p>I would like to know what became of the CDC study that took place many years ago in Erwin regarding the possible impact on public health by Nuclear Fuels Services. I personally know that this investigation took place, but there wasn't a public report citing the results of this study. Please inform me of those results.</p>	<p>ATSDR is unaware of any CDC studies performed many years ago. ATSDR did check with the National Institute of Occupational Health and Safety, CDC (NIOSH). They have been evaluating NFS as part of the Energy Employees Occupational Illness Compensation Program. Many of the NFS employees may qualify as Atomic Worker Employees. NIOSH met with several workers and former workers on July 21, 2005, to discuss this program. On February 14, 2006, NIOSH released their evaluation and the report is available at their web site: http://www.cdc.gov/niosh/ocas/wrgrace.html</p>
<p>My family is very concerned regarding the project in Erwin, Tenn. So much of what Tenn. does negatively impacts its neighbors in the valley.</p> <p>Please reconsider this project as I believe it could have a negative impact on our beautiful mountains.</p>	<p>Thank you for your concern. ATSDR accepted the petition request because of the concerns raised and the potential impact the contaminants could have on the surrounding area.</p>
<p>I, as so many others, have to work on the 16th and will not be able to attend the meetings that day concerning the health effects of the NFS site in Erwin, Tn.</p> <p>We live in Greeneville and Greene County Tn. (this is downstream on the Nolichucky river) this river is near the NFS site, and supplies our public water systems. We are VERY concerned with any health effects from this site.</p> <p>What are the known human health effects from exposure to the substances released at this NFS site in Erwin Tn.? When will the "public health assessment" be done? Will this be public information? Will appreciate your expedient reply on this matter</p>	<p>ATSDR has reviewed the contaminants from the site and the water quality of the Nolichucky River. The river data was obtained from the Tennessee Department of Environmental Conservation and the Southern Appalachian Man and the Biosphere Program. As stated in the public health assessment, there are no current completed exposure pathways at levels associated with human hazards; therefore, no adverse health effects would be expected.</p>
<p>I read the article published in The Erwin Record, Erwin, TN, on February 21, 2006, titled "Health agency hears concerns over illnesses feared from NFS". I live on Washington Street and I have been diagnosed with Multiple Sclerosis. I have had several lymph nodes removed due to unexplained fevers, weight loss, lymphadenopathy, etc. My illness developed when I moved to Washington Street. My house was built in the 1930's and we have done extensive remodeling since we moved in. I worked inside this home doing medical transcription spending all my time there from the time we moved in until</p>	<p>Although multiple sclerosis (MS) is the most common neurological disease disabling young adults in the United States, the cause of this disease is unknown. Evidence indicates that it is a complex disease with multiple causes determined by both environmental factors and genetic susceptibility. The ATSDR Division of Health Studies is currently working on two studies concerning MS. These are "Determining Prevalence of Multiple Sclerosis and</p>

<p>approximately a year ago. My health continued to deteriorate during this period of time. I began working outside my home a year ago and I have improved considerably since then. I have been told by many well-educated individuals that there may be something in my home environment that caused my illness. With the continued improvement in my health after getting away from the house during the day and now this article, I believe there may be something to this assumption.</p>	<p>Amyotrophic Lateral Sclerosis (ALS) in Communities Living Around Hazardous Waste Sites” and “Case-Control Study of Environmental Exposures and Genetic Susceptibility with Multiple Sclerosis.” You can reach the division by calling toll-free 1-888-422-8737 (1-888-42-ATSDR)</p>
<p>I grew up in the big green two-story house which I think is now owned by NFS. When W.R. Grace built “the plant” down where Mrs. Home’s frog pond used to be, we had no idea what was in store. The security and regulations then were few and far between. As kids, we would still go down there and walk around the fence to see the stuff that leaked out of the big tanks. The ground was always wet. When we heard the alarm go off, we ran to the upstairs bedroom to watch the men in white suits run up the hill. Orange smoke came out of the smokestacks. My aunt was a secretary there and one night came and took us away from our house because “something” was about to happen “down at the plant”. Never knew what. I know we ate radiation straight from Mama’s garden. Our beloved little dog died of cancer. My dad died at 56 with colon cancer. Our next door neighbor died of colon cancer; I doubt she was 60. A friend and close neighbor had extensive colon cancer in his early 30’s. I had a huge lymphoma removed from my heart at the age of 30. My brother had kidney failure in his early 30’s. My sister and I both have thyroid nodules and weird protein levels in our blood that can lead to multiple myelosis. These all have to be watched closely. At the age of only 64, I also have an autoimmune disease that makes life difficult. People in Erwin are still brainwashed about NFS. Those that know the truth have died or moved away. My mother died of heart failure at 65. I believe her heart was broken.</p>	<p>According to the American Cancer Society (www.cancer.org), colon cancer is the third most common cancer in the country and risk factors include family history of colon cancer or polyps, diet, weight, alcohol consumption, and smoking. The risk of colon cancer also increases after age 50.</p> <p>ATSDR has had much experience with issues related to the thyroid gland. Thyroid nodules are common in the population with their presence in women greater than in men, the cause of which are usually unknown. What is known, however, is that radiation-induced thyroid disease is associated with the intake of radioactive iodine. These were not present at NFS in the past nor are they currently present, based on the operational history and nuclear materials used at the site.</p> <p>The autoimmune organizations, (www.aaarda.org) indicate that about 75 percent of autoimmune diseases occur in women, most frequently during the childbearing years. These types of diseases are the 4th leading cause of disability in women. As with cancer, little is known about the causes of autoimmune disease.</p>
<p>I live in the NC county (Yancey) adjacent to and downwind from Erwin TN. As a (now retired) health care professional, I have observed over many years what appears to be higher than average occurrences per capita of several debilitating diseases here. Multiple sclerosis, various unusual types of cancer, spina bifida, clefting/midline developmental disabilities among others are more prevalent in the local population than would be expected. While nobody is yet able, or</p>	<p>Wind data collected during the 1990s show that the predominant wind direction at the plant is from the southwest to the northeast during the day, reversing at night. This places Yancey County outside the area that would be influenced by any air releases as the county is southeast of the site and separated by the mountains.</p>

<p>willing to point the finger toward the Erwin plant (or Oak Ridge for that matter) there is suspicion that airborne products from this facility passing through this area in highest concentration could be a factor in these statistics. Certainly further study is warranted.</p>	<p>ATSDR is in the process of completing public health assessments for Oak Ridge facilities operated by the Department of Energy. Besides soil, water, and biota, the agency also evaluated air releases. Our findings were that no air releases would have impacted Yancey County for several reasons. These include the fact that wind directions in the Oak Ridge area follow the valleys running from the west to the east. The height of the Oak Ridge releases was not sufficient for any contaminants to travel the approximate 125 miles between your county and the facility, especially as the mountain terrain would effectively block those releases.</p>
<p>We have been concerned for years about the nuclear fuel plant in Erwin. We are downwind here in Yancey County and we have a higher than normal incidence of certain cancers. I object to any expansion of that facility, and also to the recently announced plans to ship more waste to Barnwell SC.</p> <p>If you are looking for answers to specific questions, contact me.</p>	<p>The weather data for Erwin shows that the predominant wind direction is from the south or southwest at about 10 miles per hour. Yancey County is southeast of Erwin would not receive sufficient winds because of its direction and the intervening mountains.</p>
<p>I would like to send an email to Marilyn Palmer re growing up very close to NFS</p>	<p>Marilyn Palmer's email address is myr4@cdc. She can also be reached by calling toll-free 1-888-422-8737 (1-888-42-ATSDR)</p>
<p>My daughter lived almost all of her childhood in Yancey County. She had thyroid cancer. Her thyroid was removed and she had to take iodine radiation two times. She seems to be fine now.</p> <p>I also had two cats die of cancer.</p> <p>If you need to contact me, do so by e-mail. I am living in Mexico at this point.</p>	<p>Typically thyroid cancer is associated with the intake of radioactive iodine, produced by nuclear reactors or atomic weapons testing. There is no indication in NIOSH documents that NFS used radioactive iodine in their processes.</p>
<p>I am the sister of [name withheld – medical confidentiality] and all she has stated is true. I have two friends that worked in the chemical department at NFS before regulations were implemented. Both now have a lot of health issues. One friend has hand skin problems and the other friend has growths on hand and feet joints and also has muscle problems.</p>	

Before I begin please let me apologize for using all capital letters. I cannot type, I use one finger to type and I am also a bad speller.

I am writing about Nuclear Fuel Services, Inc. in Erwin, Tn. They process radioactive material that is too dangerous a practice to continue.

There location near the Nolichucky River where the Jonesborough water department gets their water could be harmed by contaminants leaching into the river. The river is also used for white water rafting and sport fishing.

I live about seven miles by road from their site and probably closer if there was an accident that could contaminate the air.

I would also like to make you aware of another problem I have with Nuclear Fuel Services lack of concern for people and the environment

Nuclear Fuel Services located in Unicoi County needed a shooting range so that there rent a cop security force could train/qualify. According to Nuclear Fuel Services to meet federal regulations.

Some how they got Washington County (where I live) to let them have it here. This shooting range is at the foot of Cherokee National Forest. It is right next to a road, along side a sawmill, very close to peoples homes and within a quarter mile of the Nolichucky River. There is also a stream called dry creek only a short distance away which flows into the Nolichucky River. The roadside ditches which flow into dry creek and the Nolichucky River are down hill from where they are shooting. This is the same river where Jonesborough gets its water and the same river that they can contaminate in Erwin.

There is a pump station on the river that pumps water to the treatment plant, all in close proximity to the shooting range, about a quarter mile each way.

The problem with this range is that it is wide open! They shoot lead bullets into the ground. There is no way to stop a stray round from killing people.

Nuclear Fuel Services not only has their people shooting there they also let many of the local and state cops use it, they use hand and long guns plus full automatic weapons. There is also grenades used and the Tennessee highway patrol explodes bombs.

All the lead and powder residue end up leaching into the drinking water used

The EPA does not certify, approve, or manage the lead migration issues associated with gun ranges. However the EPA has published national guidance on best management practices to assist owners and operators of lead issues associated with gun ranges located outdoors. The guidance can be found at <http://www.epa.gov/region2/waste/leadshot/> (accessed on May 2, 2006). The US Department of Interior also has information on gun range management that can be found at <http://www.doi.gov/greening/sustain/shooting.html> (accessed May 2, 2006). Lead bullets also must dissolve before they enter the water supply. Acidic soils and acid rain can result in a very slow dissolving of these bullets. The acidic conditions at the range can be controlled with the application of materials such as lime. We will inform NFS of your concern.

<p>by thousands of people. There are also a lot livestock, cows and horses that drink untreated ground water. This also effects the fish in the Nolichucky River along with other wildlife, deer, birds and any other living things that need water.</p> <p>I would like to comment on something I noticed while reading about ATSDR. Why do you not include noise as a community health concern, I think it should be included. If you were here when Nuclear Fuel Services rent a cops, the Tennessee highway patrol or the Unicoi swat team were shooting, exploding bombs and grenades I think you would agree that noise is a pollution.</p> <p>Please help!</p>	<p>ATSDR was established by Congress to review the health effects resulting from exposures to chemical contaminants present in the environment from hazardous waste sites. Noise is considered a physical hazard and noise level limits are established by the National Institute for Occupational Safety and Health. We will inform them of your concern.</p>
<p>I was not able to attend your open meeting concerning Nuclear Fuel Services in Erwin, TN on Feb.16, 2006. I do have the following comments to make concerning NFS. My back ground includes military service as an optometrist and being trained as the Nuclear, Biological and Chemical Warfare Officer for Bassett Army Hospital in Fairbanks, Alaska. Since living in Erwin I have served on The Unicoi Co. Board of Health, The School Board and as a County Commissioner:</p> <p>My family and I moved to Erwin in May of 1974. At that time we lived in a house adjacent to NFS property. I had looked at the NFS facility and made the decision that I was not placing my family's health in jeopardy by living close to NFS. We lived adjacent to NFS for more than two years with no unusual health problems. I raised three children at that house arid all of them are in good health. Two of the three have healthy children of their own.</p> <p>I provided safety glasses for NFS employees from 1976 through 1999. I was not an employee of NFS, but I was a contractor for safety glasses. In my optometry practice in Erwin since 1974, I have not noticed any unusual ocular health problems which would indicate any damage related to radiation. The cataract rate of persons living in the NFS Plant vicinity does not seem to be higher than the general Unicoi County area, and the Unicoi County rate does not seem to be higher than the national averages. I had one employee of NFS with a benign iris tumor arid I do not recall any retinal tumors from NFS employees. I find it interesting that people from outside of our community seem to complain the most If there is a health issue It is mental stress placed on our</p>	<p>Thank you for your comment.</p>

<p>citizens by people from other locations.</p> <p>It is my opinion that NFS is a good member of our community. They have demonstrated their concerns for our community by being active in the United Way, Chamber of Commerce and have added a lot of support for our school system. They have also provided the best job opportunities for Unicoi County residents of any of our plants. I am proud to have NFS in our community.</p> <p>I appreciate the positive attitude that you displayed on your trip to Erwin.</p>	
<p>Erwin drinking water contamination -- especially of the Railroad Well -- is the main issue that the ATSDR needs to investigate, in my opinion. In a package postmarked April 1st, you will receive materials that support my concerns about the health impacts of heavy metal, chemical & radiologic contaminants that have entered Erwin's ground and drinking water due to NFS's operations in Erwin. NFS also discharges into the Nolichucky River, the source of Jonesborough's & Greeneville's municipal water supplies. The Blended Low Enriched Uranium project at NFS is projected to increase the discharges into the Nolichucky of Uranium, Thorium and Plutonium -- the latter two by hundreds of thousands of times. Please look for my package of materials early in the next business week.</p>	<p>ATSDR reviewed various data sources in which groundwater was tested, sampled, and characterized with respect to groundwater flow. In these documents, the evidence is clear that the contamination in the groundwater associated with NFS does not impact the Railroad Well. As you know, this well is about ½ mile north of the facility. Studies of the water-table height indicate that the well is up-gradient (up-stream).</p>
<p>hi, questions on what contaminants and their results in humans if exposed during childhood to adult. In reference to personal issues dealing with children born around 1955. I know several people ages 50-60 that were born and raised in Erwin that now suffer from Alzheimer symptoms with no parental history of Alzheimer's. Seems to be more than just happens stance for such a small town with so many people in the average age group of early 50-60 to be having memory loss and unable to function.</p>	<p>ATSDR has no information regarding an association of the site organic contaminants in groundwater and the occurrence of Alzheimer's Disease. According to the Alzheimer's Association, the disease is the most common form of dementia. Age is the greatest known risk factor and most individuals with the illness are 65 and older. The likelihood of developing Alzheimer's approximately doubles every five years after age 65. After age 85, the risk reaches nearly 50 percent. For more information, please visit their internet site at www.alz.org</p> <p>Furthermore, ATSDR was not able to identify any pathway whereby organic contaminants could have impacted the population around the site as the ground water is not used as a public water supply.</p>

<p>It seems that weekly we hear of more who are victims of cancer, some very young children. Since I am not a health professional, I do not know why. Did the Japanese not have much cancer after World War II?</p> <p>Our drinking water comes from the Nolichucky River, some 25-30 miles downstream from Erwin. If it is allowed to continue to operate it could cause unhealthy, lasting results for an extended area since the river flows finally into the Gulf.</p>	<p>It is true that the Japanese survivors of the atomic bombing did develop cancer. However, the doses they received were quite different from the doses of radiation released by NFS as reported to state and federal regulators. By law, ATSDR is not permitted to evaluate radionuclide releases from sites such as NFS.</p> <p>ATSDR, however, did evaluate the water quality of the Nolichucky River as it is a source of drinking water for both the towns of Greeneville and Jonesborough. The evaluation used data from the state as well as a public/private group, Southern Appalachian Man and the Biosphere Program, indicates that although the river itself has pollution issues, the quality of the drinking water produced by these two towns is of excellent quality.</p>
<p>My concern is for the school children in Erwin and for those of us who must drink the water from the Nolichucky River.</p> <p>What provisions do you have in place to protect the school children in Erwin, and those of us who must drink the water from the Nolichucky River in the event of a nuclear release from NFS. Last winter, floodwater rose to within one foot of Highway 81 near the Devil's Looking Glass, a rock formation over the fault line.</p> <p>What is the travel time via groundwater from the NFS plant to the Nolichucky River? What is the setback distance from the plant for land-based unauthorized vehicles? And what protection is in place to deter saboteurs from using weapons of war aimed at this plant?</p> <p>I suggest that you get some gas masks that fit the school children in Erwin along with a supply of potassium iodide tablets.</p> <p>I further suggest that you see that the water companies have filters that filter out nuclear contamination.</p> <p>We need an immediate warning system to inform school authorities, and the water companies of nuclear releases, i.e., telephone backed up by ham radio.</p>	<p>ATSDR is aware of the water quality of the Nolichucky River. The City of Erwin obtains their drinking water from groundwater wells that are not impacted by operations at NFS. The Tennessee Division of Water Supply considers the intakes at Jonesborough and Greeneville to be a high susceptibility based on the upstream industrialized areas as well as both urban and rural areas. The Clean Water Act classifies the river as not meeting water quality standards or which has impaired uses. Nonetheless, the City of Jonesborough does have an excellent water quality in their drinking water supply.</p>

<p>NFS owns 17 acres in Washington County for a firing range where target practice and explosives may be causing the ground and surface water to become contaminated with lead and other toxins. The range is across from Dry Creek which runs into the Nolichucky River just upstream of the town of Jonesborough drinking water intake pipe.</p> <p>My personal concern that the surface and groundwater sources of Erwin, Jonesborough, and Greeneville municipal drinking water supplies may be tainted by a cocktail of chemicals and radionuclides deposited on the ground or discharged into surface water.</p> <p>I believe it is imperative for the ATSDR to analyze the constituent elements in the Railroad Well especially. That well could be the mechanism by which groundwater contamination is distributed to Erwin homes and businesses. The Sierra Club and the Tennessee Clean Water Network wanted to pay for analysis of a water sample from the well. We were hoping to test for Technetium-99.</p>	<p>ATSDR has reviewed various data sources concerning the drinking water quality for both Jonesborough and Greeneville. The state of Tennessee has classified the Nolichucky River as an impacted stream. However, the quality of the water following treatment by the water utilities is considered excellent quality.</p> <p>If one is on a private well, ATSDR recommends that a test of the well water be performed to include not only chemical contamination but coliform contamination.</p>
<p>We grew up in Erwin, back in the early 60's where the nuclear plant is. We swam in the swimming pool that had water furnished from the water that was a drain off from the nuclear plant. Now we all have these diseases and want to know if they are related. We don't think they had the regulations in the 60's that they do now. Any information would be appreciated. A lot of people have moved away so we don't know their status, but would love to know any information you could provide. The plant is called Nuclear Fuel Services in Erwin, Tn.</p>	<p>ATSDR is attempting to locate the position of the swimming pool as current documentation does not indicate its presence.</p> <p>You are correct with regards to the regulations. Nuclear regulations as well as chemical regulations have changed since the 1960s. The Nuclear Regulatory Commission updated their protection regulations (10 CFR 20) in the 1970s and again in the 1990s.</p>
<p>Although not directly related to ATSDR – an individual believes that cancer rates in Unicoi county have tripled since 1980.</p>	<p>ATSDR received several comments and correspondence regarding the cancer rates in Unicoi County and Erwin. Many of these concerns were based on knowledge or interviews with local residents. These are called door-to-door surveys and are not considered usable. Cancer is a group of diseases with many potential causes and affected tissues such as the prostate, lung, breast, liver, and colon.</p>

	States attempt to establish and maintain cancer registries; however, the Tennessee registry is not of sufficient quality to verify local assertions.
According the Guinness Book of World Records, in 1981 or 1982, NFS released tons of uranium. The following year edition of the book did not have the information.	ATSDR is attempting to contact the Guinness publisher to obtain copies of the report. We have also tried to find documentation on the internet and various library sources in Atlanta.
Surface water monitoring in 2002 indicated cyanide in Banner Spring Branch, a creek that flows through NFS's reservation then into the Nolichucky River.	In the information you supplied, the cyanide was attributed to Solid Waste Management Unit (SWMU) 1 in the north part of the site. As of 2006, Banner Spring Branch has been rerouted and is not in contact with that portion of the site. SWMU 1 is currently undergoing remediation with the contaminated soil being removed
There are a number of fault lines in close proximity to NFS. It is my understanding that those fault lines could enable contaminants to travel a considerable distance. Please also note that may area residents (like me) take their drinking water from wells.	The fault line maps you provided to ATSDR show that the site lies between two fault lines. Since they do not extend through the NFS property, it is highly unlikely that contaminants would move through the fault lines directly. If one is on a private well, ATSDR recommends that a test of the well water be performed to include not only chemical contamination but coliform contamination.
In 1998, NFS underestimated the wastewater COD (chemical oxygen demand). The site claims it was based on an incorrect calculation method. This error was not noticed by TDEC (Tennessee Department of Environmental Conservation). What other discharges has NFS failed to report or has NFS under-reported?	This issue is of a regulatory nature. ATSDR suggests you contact either the Tennessee Department of Environmental Conservation or the US EPA.
An indication of the very generic and infrequent sampling (only monthly) done by TDEC is attached. Greeneville also samples for gross alpha and gross beta, but only monthly and with so large a margin of error to make the data almost useless for public	Under typical environmental monitoring guidelines, monthly surface water samples are normal, even around nuclear and non-nuclear power plants. The EPA regulations for drinking water outline the steps of the analyses to be performed on drinking water samples. Since the concentrations of gross alpha radiation and gross beta radiation reported by the state

<p>oversight.</p> <p>Data prepared by the commentor indicates that NFS contributes to water and sediment significant alpha emitters, especially in Banner Spring Branch and Martin's Creek – both of which flow into the Nolichucky River</p>	<p>are below the Maximum Contaminant Levels, no further analyses are warranted.</p>
<p>A letter to Tennessee Congressman Bill Jenkins requesting that he direct ATSDR to conduct a thorough analysis of the rate of cancer in Erwin even if the ATSDR needs to perform primary data collection to fulfill this mandate. This request relates to the claim of the commentor that on Washington Street there are 40 households and 19 cancers and non-Hodgkins lymphomas are directly linked to exposure to radioactivity.</p>	<p>ATSDR considers additional health activities if the pathway analysis indicates contaminants have intercepted a media that is used for human consumption and that the concentration in that medium is present at a level considered a public health hazard. The evaluation of the chemical contaminants at the Nuclear Fuel Services site showed to ATSDR that the organic chemicals in the groundwater do not impact the public water supplies in Erwin and the public water quality of the communities downstream is classified as excellent by the State of Tennessee.</p>
<p>I am concerned that Nuclear Fuels has no method of informing the public of any emergencies. There does not appear to an alert system. I would also like a public meeting to discuss radiation and health, detection, emergency response (verbal communication to ATSDR during the February 2006 meetings).</p>	<p>ATSDR will contact the local emergency responders and hospitals to ascertain the plans in place with NFS. ATSDR will be glad to hold meetings to discuss the radiation and health issues in a general discussion. However, as mentioned in this document, we cannot legally discuss operations at the NFS facility.</p>

ATSDR also received concerns regarding the use of nuclear materials at NFS. However, the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA, Superfund) excludes facilities such as Nuclear Fuel Services, Inc. from evaluation by ATSDR. ATSDR has forwarded these concerns to the US Environmental Protection Agency (EPA), the US Nuclear Regulatory Commission (NRC), the State of Tennessee, and Nuclear Fuel Services, Inc. for their information.

