Per the Federal Facility Agreement for Iowa Army Ammunition Plant, Article X.B.1, the attached document is the final version of the submitted document.

Public Health Assessment for

IOWA ARMY AMMUNITION PLANT
MIDDLETOWN, DES MOINES COUNTY, IOWA
CERCLIS NO. IA7213820445
DECEMBER 28, 1999

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

PUBLIC HEALTH ASSESSMENT

IOWA ARMY AMMUNITION PLANT

MIDDLETOWN, DES MOINES COUNTY, IOWA

CERCLIS NO. IA7213820445

Prepared by:

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

THE ATSDR PUBLIC HEALTH ASSESSMENT: A NOTE OF EXPLANATION

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

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

Use of trade names is for identification only and does not constitute endorsement by the Public Health Service or the U.S. Department of Health and Human Services.

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FOREWORD

The Agency for Toxic Substances and Disease Registry, ATSDR, 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. 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. The public health assessment program allows the scientists flexibility in the format or structure of their response to the public health issues at hazardous waste sites. For example, a public health assessment could be one document or it could be a compilation of several health consultations - the structure may vary from site to site. Nevertheless, the public health assessment process is not considered complete until the public health issues at the site are addressed.

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 evaluate whether or not these contacts may result in harmful effects. ATSDR recognizes that children, because of their play activities and their growing bodies, may be more vulnerable to these effects. As a policy, unless data are available to suggest otherwise, ATSDR considers children to be more sensitive and vulnerable to hazardous substances. Thus, the health impact to the children is considered first when evaluating the health threat to a community. The health impacts to other high risk groups within the community (such as the elderly, chronically ill, and people engaging in high risk practices) also receive special attention during the evaluation.

ATSDR uses existing scientific information, which can include the results of medical, toxicologic and epidemiologic studies and the data collected in disease registries, to determine the health effects that may result from exposures. 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 public health actions are needed.

Conclusions: The report presents conclusions about the public health threat, if any, posed by a site. When health threats have been determined for high risk groups (such as children, elderly, chronically ill, and people engaging in high risk practices), they will be summarized in the conclusion section of the report. Ways to stop or reduce exposure will then be recommended in the 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.

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: Chief, Program Evaluation, Records, and Information Services Branch, Agency for Toxic Substances and Disease Registry, 1600 Clifton Road (E-56), Atlanta, GA 30333.

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LIST OF ABBREVIATIONS

AEC	U.S. Atomic Energy Commission
ATSDR	Agency for Toxic Substances and Disease Registry
CAMU	Corrective Action Management Unit (also known as Trench 7)
EPA	U.S. Environmental Protection Agency
FFA	Federal Facility Agreement
FS	feasibility study
HAL	health advisory limit
IAAAP	Iowa Army Ammunition Plant
LAP	load, assemble, and pack
MCL	EPA's maximum contaminant level
NPDES	National Pollutant Discharge Elimination System
NTC	non-time critical
OU	operable unit
PA/SI	preliminary assessment/site investigation
PHAP	Public Health Action Plan
ppb	parts per billion
ppm	parts per million
RAB	Restoration Advisory Board
RCRA	Resource Conservation and Recovery Act Hazardous and Solid Waste Amendments
RDX	hexahydro-1,3,5-trinitro-1,3,5-triazine
RI	remedial investigation
SVOC	semi-volatile organic compound
TNT	trinitrotoluene
VOC	volatile organic compound

SUMMARY

Iowa Army Ammunition Plant (IAAAP) is an active 19,015-acre load, assemble, and pack (LAP) munitions facility in Middletown, Iowa. It lies in a rural agricultural area, surrounded by active corn and soybean farms and several hundred occupied residences. Since IAAAP operations began in 1941, the installation has used explosive materials and lead-based initiating compounds to produce projectiles, mortar rounds, warheads, demolition charges, anti-tank mines, and anti-personnel mines. From 1948 to 1975, the Atomic Energy Commission operated a portion of IAAAP to assemble nuclear weapons. Current LAP activities operate several production lines.

IAAAP was placed on the U.S. Environmental Protection Agency (EPA) National Priorities List in 1990, primarily because of contamination detected in groundwater and surface water. The primary contaminant of concern at this installation is hexahydro-1,3,5-trinitro-1,3,5-triazine (RDX), although other explosives, metals, volatile organic compounds, semi-volatile organic compounds, and radionuclides have been detected on the installation at levels above the Agency for Toxic Substances and Disease Registry (ATSDR) health-based comparison values. This public health assessment specifically addresses non-nuclear contaminants of concern. However, in response to recent community concerns regarding historical nuclear weapons operations, the Department of Energy and others are gathering additional data and information. When sufficient information becomes available, ATSDR will evaluate potential pathways of environmental exposure to radionuclides contamination at IAAAP and disclose its findings.

Community members have expressed concern about potential health effects associated with contaminants in groundwater, surface water, soil, sediment, locally-grown agricultural produce, local deer, and local cattle. ATSDR conducted a site visit in May 1998 and identified no immediate public health hazards.

ATSDR performed a thorough review and evaluation of available groundwater data. RDX was detected in groundwater beneath IAAAP and off site, particularly south and southeast of military property. Five wells are located on site, but no one has ever used on-site groundwater as a source of drinking water (Hicks, 1999). Beginning in the 1980s, periodic monitoring of nearby private wells indicated that the water used by some local residents in the past did contain low levels of RDX. Past exposures, however, were minimized by aggressive Army efforts to provide bottled water and alternative drinking water sources to impacted individuals. In areas south and southeast of the installation potentially affected by off-site groundwater contamination, the Army connected residences to Rathbun Rural Water System drinking water, which is filtered and treated to meet all state and federal drinking water standards. In off-site areas where people may have ingested RDX-contaminated groundwater at levels above health-based guidelines, ATSDR determined that no apparent public health hazards exist due to short durations of exposure, low exposure doses, and/or remediation efforts by the Army. In addition, RDX concentrations in groundwater are apparently diminishing due to Army remediation efforts, natural attenuation, and/or natural dilution factors. To ensure continued delivery of safe drinking water, IAAAP has agreed to continue testing on- and off-site monitoring and production wells and to supply alternate drinking water sources should it

become necessary in the future. *For these reasons, ATSDR concludes that past consumption of groundwater poses no apparent public health hazard; present and future consumption poses no public health hazards.*

Discharges from IAAAP operations have contaminated on-site and off-site surface waters. Two watersheds, Brush Creek and Skunk River, have received the most contamination. ATSDR's review of surface water data found that trinitrotoluene (TNT) may have historically been a contaminant of concern. No available data exist, however, to quantify past TNT or RDX contamination levels. At the present, almost all surface waters accessible to the public appear uncontaminated, with RDX being the primary contaminant of concern in limited areas. Current RDX concentrations are at or slightly above EPA's lifetime health advisory levels for drinking water. Because no one drinks this surface water and only minimal exposures, if any, may occur via incidental ingestion and dermal contact from swimming or wading in the water, no public health hazards exist. Moreover, RDX concentrations in surface water continue to decrease due to Army remedial activities, natural attenuation, and/or natural dilution factors. *It is unlikely that surface water was a public health hazard in the past but, because of the lack of data, ATSDR concludes that past exposure to IAAAP-area surface water poses an indeterminate public health hazard. Current and future exposures to IAAAP-area surface water pose no apparent public health hazards.*

Forty-four sites at IAAAP were investigated for potential soil and sediment contamination, 33 of which were evaluated in detail by ATSDR due to their potential to impact underlying groundwater or to be accessed by the general public. At all 44 sites, ATSDR concluded that soil and sediment contaminants do not pose a public health hazard because either 1) publicly - accessible areas contain contaminant concentrations too low to pose health hazards; 2) exposure (past, present, and future) to the general public has been prevented; and/or 3) remedial activities have reduced or will reduce contaminant concentrations to levels that pose no public health threat. *ATSDR concludes that past, current, and future exposures to IAAAP soil and sediment pose no public health hazards.*

Lastly, ATSDR reviewed data on explosives uptake in agricultural produce, deer, and cattle to address community concerns about the safety of consuming local crops, venison, and beef. Toxicologic and ecological studies indicate that IAAAP crops are not bioaccumulating RDX and that they are safe for human consumption. In addition, studies at other Army facilities and laboratory studies suggest that deer and cattle do not bioaccumulate RDX in their tissue. *ATSDR concludes that past, present, and future consumption of local biota poses no public health hazards.*

BACKGROUND

Installation Description and History

The Iowa Army Ammunition Plant (IAAAP) is a load, assemble, and pack (LAP) munitions facility that began production in 1941 and continues to operate as a Government-owned, contractor-operated installation. IAAAP is located in the southeastern part of Iowa, near the town of Middletown, Des Moines County. It lies about 10 miles west of the Mississippi River and Burlington (Army, 1988). Less than a third of the IAAAP's 19,015-acre (30-square-mile) property is occupied by active or formerly-active production or storage facilities. The remaining land is evenly divided between leased agricultural acreage and woodlands (ACE, 1997a, 1998a).

Since 1941, IAAAP has produced projectiles, mortar rounds, warheads, demolition charges, anti-tank mines, and anti-personnel mines, but only a few production lines currently remain in operation. Components of these munitions, including primers, detonators, fuses, and boosters, have also been handled at the facility, primarily in the 1960s and 1970s. These LAP operations required use of explosive materials and lead-based initiating compounds (JAYCOR, 1994, 1996).

From 1948 to 1975, a portion of the installation (Line 1) was modified and operated by the U.S. Atomic Energy Commission (AEC) (later the Energy Research and Development Administration) (DOE, 1999). AEC added numerous facilities within Line 1 (Dames and Moore, 1989), but due to the nature of the AEC operations, little information is currently available on past Line 1 activities. It is known, however, that nuclear weapons were assembled at Line 1 using several high explosives and that radioactive materials were "received in a sealed configuration and were swipe tested for leaks before use" (JAYCOR, 1996; DOE, 1999).[1]

[1] This public health assessment specifically addresses non-nuclear issues related to IAAAP operations. ATSDR will, as necessary, review and report on environmental pathways of radioactive contamination, if any, and the potential public health implications.

Over the years, some IAAAP operations led to contamination of on-site waters and soils. The primary source of contamination at IAAAP may be attributed to past operating practices where explosives-contaminated wastewater and sludge were discharged to uncontrolled lagoons and impoundments on site (CDM, 1996; Environmental Research Group, Inc., 1982). Discharges and emissions also arose from areas where IAAAP burned explosives, conducted detonation tests, and disposed of miscellaneous solids. Other activities related to the operation and maintenance of IAAAP have resulted in fuels, solvents, and pesticides contamination.

On-site landfilling operations began in 1941 when IAAAP was constructed and continued until 1992. The Inert Landfill covers approximately 17 acres in the east-central portion of IAAAP. The landfill received materials such as residential and cafeteria refuse and garbage, plastic, tin cans, scrap lumber, empty fiber drums (crushed), unsalvageable paper and cardboard, and asbestos insulation (in double plastic bags). For several years in the early 1980s, a small portion of the landfill received other wastes, such as ash from the open burning of the contaminated waste processor, the explosive waste incinerator, and explosives and explosive-contaminated wastes (CDM, 1997). In 1994, this area (known as Trench 5) underwent closure pursuant to Resource Conservation and Recovery Act Hazardous and Solid Waste Amendments (RCRA) guidelines.

The principal installation contaminants are explosives. Hexahydro-1,3,5-trinitro-1,3,5-triazine (RDX) is currently the explosive of greatest potential concern to public health, but, historically, trinitrotoluene (TNT) may have been the most prevalent explosive. Pesticides, fuel products, volatile organic compounds (VOCs), semi-volatile organic compounds (SVOCs), and metals are also present in some on-site areas. Most of the contamination is contained within the industrial areas of IAAAP property, although some explosive-related contamination has migrated off site via groundwater and surface water (ACE 1997b,c). Surface water is the primary off-site migration pathway for IAAAP contaminants. The facility is drained by three primary creeks: Brush, Spring, and Long Creeks. Several small, unnamed creeks drain the southern and southwestern periphery of IAAAP. This drainage is intercepted by the Skunk River and flows

east, towards the Mississippi River. A small area in the northern portion of IAAAP (Yard L) drains into the Little Flint Creek Watershed.

Remedial and Regulatory History

Beginning in 1975 and continuing to the present, numerous investigations have been conducted by the Army, U.S. Environmental Protection Agency (EPA), and Army contractors to investigate on- and off-site environmental contamination resulting from IAAAP operations. In 1980, a Preliminary Assessment and Site Investigation (PA/SI) was conducted at IAAAP. Pursuant to the RCRA of 1984, EPA completed an assessment of the facility in 1987 and reported that releases had occurred. In 1986, EPA conducted a RCRA Facility Assessment. Limited sampling was performed and contamination was discovered at active and former hazardous waste treatment, storage, and disposal sites (EPA, 1991).

Primarily due to surface water contaminated with explosives leaving the installation boundary, IAAAP was proposed for EPA's National Priorities List (NPL) in August 1989 and listed in August 1990. On December 10, 1990, a Federal Facilities Agreements (FFA) between EPA and the Army became effective to clean up the installation. The FFA provides a framework for the investigation and cleanup of contamination at IAAAP.

In 1991, a subsequent PA/SI identified 44 sites of possible contamination. Of the 43 sites, 33 required further studies. In 1992, Remedial Investigation and Feasibility Study (RI/FS) activities began. To facilitate installation cleanup activities, the installation was divided into three Operable Units (OUs):

- Soils OU (OU #1)—addresses contamination in the soils.
- Groundwater OU (OU #3)—addresses contamination of groundwater within the IAAAP boundaries and potentially off-site contamination.

- Installation-wide OU (OU #4)—addresses institutional controls, previously unaddressed areas of soil contamination, VOC-contaminated media, ecological risks, long-term monitoring requirements, and any other unacceptable risks which may be identified and not addressed in either OU #1 or OU #3.

OU #2 was originally established for the non-time critical (NTC) soils removal actions. It was subsequently merged into OU #1 for simplicity and completeness (ACE, 1998b,c).

After dividing the installation by OUs, the Army conducted investigations to better characterize contaminated media in the vicinity of IAAAP. In 1993, the installation completed supplemental subsurface soil and groundwater studies for the RI/FS. Results of the RI were documented in the report *Revised Draft Final Remedial Investigation/Risk Assessment, Iowa Army Ammunition Plant, Middletown, Iowa* (JAYCOR, 1996). In August 1996, the Army performed a installation-wide hydrogeologic evaluation at IAAAP to identify data gaps pertaining to groundwater and to recommend studies to address the data gaps. The draft *Basewide Hydrogeologic Evaluation* was submitted in November 1996. In late 1996, the Army conducted a supplemental RI aimed at addressing the identified data gaps. The final *Work Plan and Sampling and Analysis Plan* was submitted in April 1997 and field work was completed during the Spring and Summer 1997. Currently, the study looking at soil cleanup options is nearing completion and several removal actions are in progress (see Ongoing/Planned Soil Actions in the Public Health Action Plan section). Detailed summary reviews of most of these above investigations can be found in the *Revised Final Draft Remedial Investigation/Risk Assessment for IAAAP* (JAYCOR, 1996).

In general, however, past IAAAP investigations consistently revealed that two areas, the former Line 1 Impoundment and the Line 800 Pinkwater Lagoon, were the most contaminated locations on site (CDM, 1996; Dames and Moore, 1989). Both areas had the potential to leach contaminants into underlying groundwater. The migration of contaminated groundwater to nearby residential drinking water wells was once considered the greatest potential risk to human health by the Army and EPA (CDM, 1996). Thorough characterization of on- and off-site groundwater contamination, however, indicates that IAAAP-related contamination does not appear to threaten human health. ATSDR further discusses groundwater and other site-related

health issues in the "Exposure of Environmental Contamination and Potential Exposure Pathways," Table 2, and Appendix A of this report.

Demographics and Land Use

To characterize the local population and identify the presence of sensitive subpopulations, such as young children, ATSDR examines the demographics of the nearby communities. This information also provides detail on residential history in a particular area that helps ATSDR assess time frames of potential human exposure to contaminants. The demographic and housing data for IAAAP and the surrounding areas, particularly the areas south of the installation where groundwater contamination has migrated, are presented in this section.

IAAAP and Local Area Population and Housing Data

The demographic setting of IAAAP is characterized as rural. According to the 1990 U.S. Census, approximately 30% of the 42,600 Des Moines County residents live in rural areas, with a farm population of 1,571 (U.S. Census, 1990). Approximately 1,727 individuals (in approximately 769 housing units) reside within 1 mile of the installation. The most important population centers—in terms of size—are the towns of Burlington (population approximately 28,000), West Burlington (population approximately 3,000), Middletown (population approximately 400), Fort Madison, and Danville (Dames and Moore, 1989).

Because of IAAAP's rural demographic setting, relatively few people might potentially be exposed to installation-related contaminants. Prior to 1997, approximately 43 on-site housing units were used by contract personnel and their families. Located outside of the secured fence and more than 1,500 feet from the nearest site under investigation (JAYCOR, 1996), these houses were transferred by the Army to the city of Middletown in October 1997. The rural area south (downgradient) of IAAAP is sparsely populated. Approximately 50 people live in Augusta, an unincorporated town approximately 1 mile from the south-southwestern boundary

along the Skunk River. The most populated area to the south is Fort Madison which is approximately 10 miles to the south of IAAAP.

Land Use in the IAAAP Area

Land use on the IAAAP property consists of administrative and industrial operations (approximately 4,000 acres), leased agricultural use (approximately 7,750 acres), and forested land (approximately 7,500 acres). Some cow pasturing takes place in munition storage yards (ACE, 1998a). Crops grown in the area consist mostly of corn and soy beans.

Public access to the installation is restricted by contractor security measures, including perimeter fencing, but various recreational activities are allowed in some non-industrial, on-site areas. These recreational activities include hunting and fishing. Public access to many on-site contaminated areas, however, is prevented by secondary fencing surrounding installation facilities and industrial areas.

The groundwater aquifers directly underlying IAAAP do not supply any production wells for drinking water purposes (Hicks, 1999). Off site, however, the groundwater aquifers supply private production and irrigation wells. The nearest municipal wells are over 3 miles away and have not been impacted by IAAAP-related contamination, nor do they appear at-risk for future contamination from installation-related contaminants.

On-site surface water is not currently an integral part of IAAAP operations. Prior to 1977, however, IAAAP's primary drinking water source came from Long Lake (now known as Mathes Lake) and was treated at an on-site water treatment facility. In accordance with the State of Iowa Surface Water Quality Criteria, surface waters in the vicinity of IAAAP are no longer used as drinking water. In the past, several on-site creeks received untreated facility wastewater and explosives discharge from IAAAP. Currently, and in accordance with the National Pollutant Discharge Elimination System Permit signed with the state of Iowa, treated wastewater from the plant is discharged into Brush Creek and Long Creek. Some surface

waters on and near IAAAP are used for recreational activities, but these waters are uncontaminated.

ATSDR Activities

In May 1998, ATSDR conducted a two-day site visit at IAAAP and met with Army representatives. ATSDR toured IAAAP facilities with several Army employees, some Restoration Advisory Board (RAB) Committee members, and one representative from the local media. The group viewed all investigation sites and remediation efforts, as well as off-site agricultural farms and houses south, southwest, and southeast of the facility. According to ATSDR discussions with the Army and RAB Committee members, no area residents expressed any specific health concerns that they attribute to IAAAP (ATSDR, 1998).

After the site visit, ATSDR contacted several community members by telephone. These community members were contacted because they had previously expressed concern about IAAAP operations. According to Army and EPA reports, these concerned community members had asked about potential environmental and health impacts associated with groundwater, surface water, soil, sediment, and local biota contamination. During ATSDR's discussions with these individuals, however, no area residents expressed any specific health concerns attributed to IAAAP. Currently, some community members seem to be concerned about the community members' relationships with the Army and whether or not the Army would take responsibility for cleaning up the contamination for which it is responsible. Some community members did share their observations and concerns about past levels of contamination of surface water and groundwater in the area to the south-southeast of IAAAP.

Quality Assurance and Quality Control

In preparing this public health assessment, ATSDR relied on the information provided in the referenced documents. Documents prepared for the CERCLA and RCRA programs must meet specific standards for adequate quality assurance and control measures for chain-of-custody

procedures, laboratory procedures, and data reporting. The validity of the analyses and conclusions drawn in this document are dependent upon the availability and reliability of the referenced information. The environmental data presented in this public health assessment are from Army and EPA reports; remedial site investigations of the RI/FS sites; quarterly groundwater monitoring data; and drinking and irrigation water data from IAAAP, municipal, and private wells.

EVALUATION OF ENVIRONMENTAL CONTAMINATION AND POTENTIAL EXPOSURE PATHWAYS

Introduction

In this section, exposure pathways are evaluated to determine whether people accessing or living near IAAAP could have been (past scenario), are (current scenario), or will be (future scenario) exposed to installation-related contaminants. In evaluating exposure pathways, ATSDR determines whether exposure to contaminated media has occurred, is occurring, or will occur through ingestion, dermal (skin) contact, or inhalation of contaminants. When exposure to contaminated media occurs, the exposure pathway is regarded as "complete." To determine whether completed pathways pose a potential health hazard, ATSDR compares contaminant concentrations to health-based comparison values. Comparison values are calculated from available scientific literature on exposure and health effects. These values, which are defined for each of the different media, reflect the estimated maximum contaminant concentration for a given chemical that is *not* likely to cause adverse health effects, given a standard daily ingestion rate and standard body weight. If contaminant concentrations are above comparison values, ATSDR further analyzes exposure variables (for example, duration and frequency) and the toxicology of the contaminant. This exposure evaluation process is summarized in Figure 3.

Contaminants have been detected in on-site groundwater, surface water, soil, sediment, and local biota and in off-site groundwater and surface water. RDX is the primary contaminant of

concern, although other explosive chemicals, VOCs, SVOCs, and some metals were detected at low concentrations. ATSDR evaluated available on- and off-site information on potential contamination in groundwater (Figures 4 and 5), surface water, soil, sediment, and local agricultural produce and deer to determine if these media pose any past, current, or future public health hazards. ATSDR concluded that public exposures to groundwater, surface water, soil, sediment, and local biota are not likely to result in adverse human health effects because, when detected, contaminant concentrations were too low to pose a health hazard and/or were not accessible to the general public. Information on these exposure pathways is summarized in Table 2 and the following text. A detailed evaluation of potential public health hazards associated with all 33 RI/FS sites is summarized in Appendix A. Figure 6 shows the locations of these 33 RI/FS sites, in addition to 11 other no further action sites identified during the PA/SI.

The following discussion evaluates community concerns about potential human exposure via contaminated groundwater, soil, sediment, and local biota. This section states each concern, presents a brief summary of ATSDR's conclusions, and describes in more detail any identified exposure pathways and the basis for ATSDR conclusions. ATSDR's conclusions regarding the past, present, and potential future exposures to various environmental media on and in the vicinity of IAAAP are based on the evaluation of data gathered from remedial site investigations, groundwater monitoring data, on- and off-site drinking water well data, and the observations compiled during site visits.

1. Concern: Groundwater

Could exposure to RDX or other contaminants in groundwater result in adverse human health effects for residents of neighboring communities or for former residents, employees, or visitors of IAAAP?

Conclusions

After detailed review of the available data, ATSDR has drawn several conclusions regarding past, present, and possible future exposures to contaminated groundwater at IAAAP. These conclusions are outlined below.

Present and Potential Future Exposures

- There is no on-site exposure to groundwater. IAAAP does not, and will not, use groundwater as potable water. IAAAP drinking water, supplied by the Burlington Municipal System, meets (and will continue to meet) federal and state drinking water standards (e.g., MCLs).

- In 1993, off-site contamination of private drinking water wells with explosives was confirmed and the IAAAP offered to connect residents in the contaminated area to the Rathbun Rural Water System. One hundred and fifty-four residences accepted the Army's offer, while 15 households declined. Those 154 residences who connected to the Rathbun Rural Water System eliminated the present and potential future exposure pathways via contaminated drinking water. Of those who declined, 14 households use uncontaminated private wells that are periodically monitored by the Army. The remaining household knowingly uses a private well that does not meet federal and state drinking water standards. The Army has repeatedly advised the household to abandon the well, but the fully-informed residents continue to drink well water and knowingly accept any associated risks.

- ATSDR concludes that present and potential future exposures to RDX-contaminated groundwater, both on and off site, are not likely to occur or result in health effects.

Past Exposures

- Past activities at IAAAP affected groundwater underlying and south of military property. RDX is the main contaminant of concern.

- Five on-site production wells were active from 1941 until 1977, but these wells were never used for drinking water purposes so people living, working, or visiting IAAAP were not exposed to RDX-contaminated groundwater.

- People living south and southeast of IAAAP may have been exposed to RDX-contaminated drinking water in the past. The first documented detections of RDX in two drinking water wells was in 1992. The initial date of contamination remains unknown, but these two wells did not contain RDX-contaminated groundwater in 1985.

- Local residents living south and southeast of IAAAP were connected to the Rathbun Rural Water System after groundwater contamination was detected in 1992.

- ATSDR concludes that groundwater contamination from IAAAP posed no public health hazards because: 1) contaminant concentrations detected were too low to pose health hazards; 2) past exposure to the general public was extremely limited; and/or 3) interim actions minimized or prevented exposures.

Discussion

IAAAP's Hydrogeology

The two main aquifers affected at IAAAP are the loess/till aquifer (drift aquifer) and the underlying upper bedrock aquifer. The majority of contaminant movement takes place in the drift aquifer. The groundwater table in the drift aquifer generally occurs within 10 feet of the ground surface, and often less. Shallow groundwater flow closely parallels the ground surface. Thus, shallow groundwater flow throughout the installation is from high points, including most of the Line and Yard areas, toward surface drainages, particularly the larger streams such as Spring, Brush, and Long Creeks and the Skunk River. The water in the upper bedrock aquifer generally flows to the south and east, toward the Skunk and Mississippi Rivers. In some on-site areas, including the southwestern part of IAAAP, the upper bedrock aquifer is exposed at ground surface and discharges into surface waters. Elsewhere at IAAAP, the upper bedrock aquifer lies at depths of more than 50 or 100 feet.

Groundwater Use

IAAAP has five on-site production wells, none of which have ever been used for drinking water purposes. Four of these five wells were installed in 1941 and remained functional until 1977, when IAAAP began using public water from the city of Burlington.[2] Three of these on-site wells were never used, apparently due to low recharge rates. The fourth well served (but was never used) as an alternate water source for the water treatment facility (Hicks, 1999). In 1981, IAAAP installed a fifth on-site well to provide sanitary water to the facility buildings. It currently supplies sanitary water to the MILVAN Facility and there are no plans to abandon it. Because none of the on-site wells ever supplied IAAAP drinking water, exposure to on-site RDX-contaminated groundwater never occurred.

IAAAP does not control the use of groundwater once it migrates off property boundaries. Prior to the early 1990s, all local residents south and southeast of the installation used private wells for drinking and irrigation. After groundwater contamination was documented in 1992, all potentially-impacted households were afforded the opportunity to connect to the Rathbun Rural Water System at the Army's expense (Allison, 1999a). By the fall of 1994, 154 residents living south and southeast of IAAAP were connected to the Rathbun Rural Water System. Rathbun water is filtered and treated to meet all federal and state drinking water standards. The closest public or municipal wells are located over 3 miles away from IAAAP property and are not at risk from installation-related contamination.

According to Army accounts, 15 households refused the Army's offer to connect local residences to the Rathbun Rural Water System (Allison, 1999a). Fourteen of these 15 households draw water from uncontaminated aquifers so no past or current exposures to contaminants have occurred. The fifteenth household obtains its well water from an aquifer impacted by RDX. The Army did connect this residence to the Rathbun Rural Water System in 1993, but the individuals at the residence refused to abandon the private well. Instead, the

[2] Prior to 1977, IAAAP's primary drinking water source came from Mathes Lake and was treated at an on-site water treatment facility.

residents connected the contaminated well to another structure on the property. The well (identified as Well 2 in the Groundwater Quality section below) provides all potable water to this other structure. Despite repeated Army outreach efforts and recommendations to abandon the well, the household chooses to continue to use the well for domestic purposes and to knowledgeably assume any associated risks with drinking this water. Except for this one household, no one is exposed to potentially harmful levels of contaminants because all local drinking water meets (and will continue to meet) federal and state drinking water standards. It has, however, been reported to ATSDR by local residents that some other residents' wells are still used for irrigation and some residents now apparently utilize some of those wells for bathing and other purposes not directly involved with drinking or cooking.

Groundwater Quality

ATSDR's records search found that in the early 1950s, IAAAP discharges were suspected of contaminating a few shallow wells located close to Brush Creek outside of the IAAAP property. ATSDR was unable to locate any studies or data to confirm or quantify these events. This problem was reportedly (IAAAP records) alleviated by making changes in disposal methods, including treatment and filtration of process waters prior to discharge.

Quantitative groundwater monitoring began at IAAAP and off-site locations in the 1980s. RDX is the only contaminant that has been detected above ATSDR comparison values in off-site groundwater. Underlying different sites within IAAAP, however, on-site groundwater contained contaminants variably exceeding proposed site cleanup goals, including:

- **Explosives**: RDX, HMX, 1,3,5-TNB, 2,4,6-TNT, 1,3-DNB, 2,4-DNT, 2,6-DNT, and nitrobenzene
- **VOCs**: acetone, benzene, freon, methylene chloride, 1,1-dichloroethane, 1,1-dichloroethylene, trichloroethylene, 1,1,1-trichloroethane, and methyl ethyl ketone
- **Metals**: barium, cadmium, lead, iron, and manganese

- **SVOC**: bis(2-ethylhexyl)phthalate
- **Radionuclides**: Radium 226/228 and gross alpha

Because contaminants underlying IAAAP are inaccessible and groundwater is not used as a source of drinking water, there is no exposure (past, present, or potential future) to these contaminants on site (Marquess, 1997; Mason and Hanger Corporation, 1997).

In 1985, the Army sampled off-site private wells adjacent to IAAAP's southern boundary. Contaminants were not detected in any off-site wells and all well water met federal and state drinking water standards (AEHA, 1985).

Off-site contamination was first detected above ATSDR comparison values in September 1992 during Phase I of the RI. Groundwater samples were collected from six residential wells (Well 1 through Well 6 in Table 1) located on the south/southeast border of IAAAP in the Brush Creek watershed. Well 1 and Well 2 contained explosives at levels (15.5 parts per billion [ppb] and 27.5 ppb, respectively) above the available screening value, EPA's lifetime health advisory limit (HAL), of 2.0 ppb for RDX. These wells were re-sampled on March 15, 1993; the presence of RDX at similar levels in the same wells was confirmed (ACE, 1997b,c).

In response to the findings of off-site contamination during the Phase I RI, the Army conducted an extensive off-site sampling and analysis program. This program investigated all residences located in areas of suspected groundwater contamination and in the watersheds associated with surface water leaving the IAAAP. The Phase II RI, beginning in April 1993, included the sampling of 54 residential wells in the IAAAP vicinity. Three wells (Well 7, Well 8, and Well 9 in Table 1) contained RDX above the HAL of 2.0 ppb. Two of these residences are located at the extreme southwest boundary of IAAAP, near the town of Augusta, on a tributary of the Skunk River. The third residence is located along the Brush Creek watershed adjacent to the first two homeowners whose wells tested positive for RDX. Because all reported RDX values were near the HAL of 2.0 ppb, the wells were re-sampled to corroborate initial sampling results.

The second round of well samples at the three affected residences showed RDX contamination at similar levels (ACE, 1997b,c).

Table 1: RI Groundwater Results

Sample/ Re-sample (Well name assigned during Phase I RI)	Well Depth (Feet Below Ground Surface)	Watershed	ATSDR Comparison Value[a]	Maximum RDX Concentration	When Detected
Well 1 (RBW-GW-25)	35	Brush Creek	2.0 ppb[b]	15.5 ppb 16.0 ppb 6.0 ppb	September 1992 March 1993 August 1998
Well 2 (RBW-GW-26)	45	Brush Creek	2.0 ppb	27.5 ppb 22.8 ppb 6.2 ppb	September 1992 March 1993 August 1998
Well 3 (RBW-GW-27)	40	Brush Creek	2.0 ppb	<2 ppb <2 ppb	September 1992 March 1993
Well 4 (RBW-GW-28)	28	Brush Creek	2.0 ppb	<2 ppb <2 ppb	September 1992 March 1993
Well 5 (RBW-GW-29)	35	Brush Creek	2.0 ppb	<2 ppb <2 ppb	September 1992 March 1993
Well 6 (RBW-GW-30)	800	Brush Creek	2.0 ppb	<2 ppb <2 ppb	September 1992 March 1993
Well 7	60	Skunk River Tributary	2.0 ppb	2.1 ppb 2.9 ppb <2 ppb	April 1993 May 1993 August 1998
Well 8	60	Skunk River Tributary	2.0 ppb	3.3 ppb 3.3 ppb	April 1993 May 1993
Well 9	40	Brush Creek	2.0 ppb	2.1 ppb 6.7 ppb	April 1993 May 1993

[a] = U.S. Environmental Protection Agency's lifetime health advisory limit
[b] = ppb = parts per billion

Sources: (Allison, 1999b; Plant Protection Office, 1998; ACE, 1997b,c; JAYCOR, 1996)

The Army's most recent sampling event, a supplemental groundwater investigation conducted in August 1998, indicates that RDX concentrations have decreased since 1993. Two wells (Wells 1 and 2) currently contain detectable concentrations of RDX (6.0 ppb and 6.2 ppb, respectively) (ARDL, 1998).

These studies indicate that off-site groundwater contamination appears limited to areas surrounding Brush Creek and the southern boundary of IAAAP. Current concentrations of off-site RDX-contaminated groundwater near the IAAAP boundary are generally less than 10 ppb (ACE, 1997b,c). Concentrations have been observed to be more diluted with greater distance from the installation. Due to natural dilution factors, RDX concentrations in groundwater may decrease further with time.

Potential Human Health Hazards from Past Off-site Exposures

Although not well documented in the administrative record for this installation, the earliest indication of off-site contamination noted in the area south of IAAAP dates to the 1950s. At this time, contamination in surface water was noted. Shortly thereafter, the Army first provided bottled water and then provided individual household water filtration units to some area residents to ensure the availability of safe drinking water. Also during this time interval, some area residents hauled water for their domestic animals.

In the early 1970s, contaminant levels had reportedly declined and, in 1973, the Army ceased to provide funding for the continued use of individual household water filters. Some area residents continued to use these filters for a while, but most residents started to use bottled water for drinking water and cooking purposes. No data are available to quantify the actual levels of RDX-contamination in drinking water or the time interval(s) that contaminated water may have been ingested. Thus, ATSDR is not able to evaluate the possible health hazards associated with this past episode of off-site contamination. The measures taken by the Army and the residents themselves during this time period were protective of public health and the ingestion of contaminated groundwater was probably minimized or largely eliminated.

Beginning in 1975 and continuing to present, the numerous investigations conducted by the Army and EPA provide sufficient data for ATSDR to evaluate past off-site exposure to contaminated groundwater.

In 1985, community residents living along the southern border of IAAAP expressed concern about potential environmental impacts of disposed wastes and the migration of contaminants from IAAAP into their private drinking water wells adjacent to Long Creek. Suspecting munitions or radiological contamination (emanating from past AEC activities at IAAAP), the Army and EPA thoroughly investigated the matter and sampled local groundwater. No organic constituents were detected and all metals concentrations met regulatory standards in the potable water consumed by the residents. This, combined with the absence of contaminants at the perimeter monitoring wells on site, indicates that no contamination was emanating from IAAAP and impacting off-site potable water supplies at the time.

When RDX was detected in private wells in 1992, the Army immediately provided bottled water to all affected residences. The Army then contracted with the Burlington Municipal System and Rathbun Water Company to connect 154 residences in the area to the public water supply. Even though most residences were not directly impacted by groundwater contamination, the Army took preventative measures and conservatively defined the affected area as all residences south of the IAAAP, between Brush Creek at the IAAAP's southeastern boundary, to an unnamed tributary south of Line 3A, at the IAAAP's southwestern boundary, south to the Skunk River. Fifteen households in this area declined the Army's offer to connect them to the Rathbun Rural Water System. Fourteen of these 15 households use uncontaminated private wells. The fifteenth household knowingly chooses to continue to use a well that draws from a contaminated aquifer despite the Army's repeated recommendations to discontinue using this private well water.

ATSDR Exposure Dose Estimates[3]

To evaluate whether health hazards are associated with exposure to area groundwater, ATSDR estimated the potential exposure doses for adults and children who drank water from affected wells. To estimate human exposure doses, ATSDR used very conservative assumptions believed to greatly overestimate the levels of actual exposure. These assumptions, ATSDR's methods, and the estimated exposure doses for ingestion of RDX-contaminated water are provided in Appendix B.

The estimated doses for an adult and a child are less than those associated with adverse health effects. ***ATSDR, therefore, concludes that off-site past exposure to RDX-contaminated groundwater via private drinking wells posed no apparent public health hazards.***

2. Concern: Surface Water

Could exposure to RDX or other contaminants in surface water result in adverse human health effects for people exposed to Skunk River, Brush Creek, Spring Creek, Long Creek, and other surface water bodies near IAAAP?

Conclusions

- Past activities at IAAAP affected surface water in Brush, Long, and Spring Creeks and some un-named Skunk River tributaries. Other on-site surface water bodies have remained uncontaminated by site contaminants.
- Historically, TNT may have been the primary contaminant of concern, but currently RDX is the most prevalent contaminant in surface water.
- It is unlikely that surface water was a public health hazard in the past but, because quantitative historical water quality data do not exist for the IAAAP

[3] ATSDR's estimated exposure doses are calculated for the general population in the IAAAP vicinity and may not accurately reflect exposure for the one household that has ignored repeated Army recommendations to abandon their private well. For this household, the exposure period was approximately twice as long. According to ATSDR estimates, doubling the exposure period is not associated with an increased incidence in noncancer effects in adults, but it may increase the susceptibility of children to noncancer effects (see Appendix B).

area, ATSDR concludes that past surface water exposure poses an indeterminate public health hazard.

- ATSDR concludes that present and potential future surface water exposure does not pose a public health hazard because: 1) contaminant concentrations are too low to pose a health hazard and/or 2) exposure to the general public is minimal, if it occurs at all.

Discussion

IAAAP property has several streams, rivers, and other surface water bodies. Totaling an area of approximately 13 acres, 30 ponds and small impoundments are located on the installation (JAYCOR, 1996). The average creek width within IAAAP varies from about 50 to 200 feet. The three primary watersheds draining IAAAP are Brush Creek, Long Creek, and Spring Creek.

Brush Creek runs from IAAAP's northern boundary, through the central part of the base, down to the southeastern corner of the property. It runs through the locations where most activity associated with facility operations occurs, draining the majority of industrial operations: Lines 1, 2, 3, 6, 7, 9, 800, the Line 800 Pinkwater Lagoon, the former Line 1 Impoundment, parts of Lines 4A and 5A, the Pesticide Pit, and the Sewage Treatment Plant. Long Creek flows east from IAAAP's western boundary into Mathes Lake, which is located in the central part of the installation. Long Creek surface waters remain uncontaminated. Until 1977, treated surface water from Mathes Lake served as IAAAP's primary drinking water source. Spring Creek flows south along the installation's eastern boundary. RDX is the main contaminant of concern, although other explosives and some metals have been detected in Brush and Spring Creeks.

In the past, Brush Creek "ran pink" from IAAAP explosives contamination. ATSDR found no studies or technical reports quantifying this claim, but several documents said that this community concern about pink water was raised during the World War II era (ACE, 1997b,c). Past employees of IAAAP verified that explosives contamination continued to be dumped into the Pinkwater Lagoon throughout the 1960s and 1970s. One former IAAAP employee

reported that "chunks of TNT and Composition B as large as my fist were in the sump water dumped into the lagoon" (Public Comment Responses, 1999). This same employee indicated that surface water samples may have been drawn from the creeks in the 1960s and 1970s. ATSDR found no record of these sampling efforts, so it is impossible to conclusively know what caused Brush Creek to run pink. In general, however, LAP operations generally produce pink water during the explosive TNT washdown operations when water is used to remove solvents from the product. Pink water is a TNT solution that is approximately 99% water with a TNT concentration of approximately 5 ppm (McCarley, 1998). Because ATSDR could not determine the specific nature and extent of IAAAP past contamination, however, ***ATSDR concludes that past exposures to on- and off-site surface water pose an indeterminate public health hazard.***

Currently, public exposure to contaminated surface waters—defined as surface waters that fail to meet ATSDR's drinking water comparison values and health advisory levels—is extremely limited, if it occurs at all. The primary contaminant in surface water is RDX, with other explosives (including TNT) detected in trace amounts. Contaminant concentrations, especially those detected in Brush Creek, fluctuate and have not been fully characterized, but public exposure to these contaminants is limited due to military security measures, perimeter fencing, and natural dilution factors.

There are several water-related recreational facilities on IAAAP and in the immediate area surrounding the installation, but none of these recreational facilities have been affected by contaminated surface waters. Mathes Lake (also called Long Lake) is located on IAAAP. On the water front area of Mathes Lake, where Long Creek feeds into the Lake, there is a small scout camp site. A boat ramp is located on the east shore of Mathes Lake that is used by fishermen. South of IAAAP is the Skunk River, which has two boat launch access areas and one small park located on its banks, most of which are located in the area known as Augusta. The Skunk River is used for all types of recreation, such as boating, water skiing, swimming, and fishing. Brush Creek is too small to be suitable for typical recreational activities such as

swimming, boating, or fishing, but it may be used for recreational purposes by children. Children only have access to Brush Creek after it leaves IAAAP property.

Based on installation geology and hydrogeololgy, on-site contaminants could be carried off site via surface water, primarily Brush Creek and the small unnamed tributaries of Skunk River in the southwest. Off-site concentrations of explosive contaminants, including RDX, varied widely among different sampling events. Generally, RDX levels detected in Brush Creek surface water near the IAAAP boundary remained below 10 ppb. After a rain event in April 1995, however, these RDX concentrations reportedly reached 22 ppb. The Army does not currently understand the complete extent and role of contributing factors that cause such surface water concentration changes, but on-going Brush Creek studies are investigating these fluctuating concentrations. RDX levels in un-named Skunk River tributaries slightly exceeded 2.0 ppb. Public exposure to surface water in Brush Creek and Skunk River tributaries is likely to occur infrequently and for short durations of time. Incidental ingestion of and/or dermal contact with such low-level contaminated surface water, if it occurred at all, would not be associated with adverse health effects. ***ATSDR concludes that present and potential future exposures to on- and off-site surface water pose no apparent public health hazard.***

3. Concern: Soil and Sediment

Could exposure to soil and sediment contaminants at IAAAP result in adverse health effects for employees, residents, or visitors of the installation?

Conclusions

- Some IAAAP soils and sediments have been contaminated by military practices associated with ammunition LAP operations.
- The major sources of contamination at IAAAP occur in enclosed industrial areas or at installation facilities where there is no permitted public access.
- ATSDR concludes that soil and sediment contamination at IAAAP poses no public health hazards because 1) publicly-accessible areas contain contaminant

concentrations too low to pose health hazards; 2) exposure (past, present, and future) to the general public has been prevented; and/or 3) remedial activities have reduced or will reduce contaminant concentrations to levels that pose no public health threat.

Discussion

Forty-four sites of known or suspected soil contamination have been identified at IAAAP. Thirty-three of these sites required further investigation under the RI and were thoroughly evaluated in this Public Health Assessment (Appendix A). Metals and explosives were the primary contaminants of concern in soils. ATSDR compared on-site metal levels to soil comparison values, IAAAP background samples, and detection limits to define contamination.

Site investigations reported the most significant contamination at Lines 1, 2, 3, and 3A, the Explosive Disposal Area, the Firing Site, and the Fire Training Pit (Engineered Efficiency 1996, 1997). Prior to remediation efforts, two subsites, the Line 1 Impoundment and Line 800 Pinkwater Lagoon, were considered to be the greatest sources of explosives contamination at IAAAP. At other sites investigated, soil and sediment contamination was localized, if detected at all, and generally at low levels (Engineered Efficiency 1996, 1997).

Public access to contaminated sites is restricted and prevented because (in addition to perimeter fencing at IAAAP) secondary fencing and security measures surround almost all industrial areas and installation facilities where soil contamination occurs. Unfenced sites with potentially-contaminated soil/sediment include the Inert Landfill, Construction Debris Landfill, and Demolition Area. Surface soils at these three sites contain contaminant concentrations below levels associated with health effects and/or are undergoing remedial activities to reduce contaminant concentrations to levels protective of human health. Public exposure to on-site contaminated sediments is prevented because the sediments lie underwater, beneath on-site surface water bodies. For some of the year, low surface water flows may allow for the public to walk through the streams, but on-site exposure to sediments appears minimal because on-site visitors are likely to wear shoes or boots and will not regularly be exposed to these sediments.

Deer hunting is permitted on the installation and at areas surrounding IAAAP, so deer hunters may have come in contact in the past to contaminated soils at the unfenced sites, specifically at the Inert Landfill. ATSDR believes that incidental exposure to soil contamination is extremely minimal, if it occurs at all, for two primary reasons: 1) the amount of time deer hunters spend in contact with on-site contaminated soil is likely to be very brief and will not occur on a regular basis, and 2) the hunters will likely stay in forested areas and their margins, rather than venture into the open fields or industrial areas where the soil contamination occurs.

Army-approved groups (e.g., the Boy Scouts of America) and trespassers may access forested and agricultural areas on site, but it is extremely unlikely that they will access contaminated sites. No contaminated areas are located near the scout camp at Mathes Lake and no contaminated areas are located near IAAAP's perimeter. No likely exposures are near the Inert Landfill or other areas of known soil contamination (Appendix A).

The Army has initiated NTC removal actions to address soil contamination at several areas across the IAAAP (O&M, 1998; OHM Remediation Services Corp., 1996). The Army is remediating soil contamination even though there is little, if any, public exposure to contaminated soils, to prevent the potential movement of contaminants to underlying groundwater. Remediation sites include the Inert Landfill, the Pesticide Pit, the former Fire Training Pit, explosives-contaminated sumps, and the Line 1 Impoundment and Line 800 Pinkwater Lagoon subsites. All major sources of contamination at IAAAP either have been or will be remediated (e.g., landfill consolidation, capping, bioventing, or soil vapor extraction) (O&M, 1998) (see Completed Soil Actions of the Public Health Action Plan). ***ATSDR concludes that past, present, and future exposures to on- and off-site soil and sediment do not pose a public health hazard.***

4. Concern: Other Public Health Concerns

Has contamination from IAAAP affected local agricultural products, deer, or cattle populations and potentially harmed those individuals consuming local produce, venison, and beef?

Conclusions

- Plant uptake of RDX varies by species and growing conditions. According to an on-site Army study and off-site environmental investigations, the IAAAP crops eaten by humans (specifically corn and soybean) do not appear to bioaccumulate RDX into their leaf, stalk, grain, or root tissues.

- Available data indicate that environmental RDX, similar to those levels detected at IAAAP, does not bioaccumulate in deer tissue. Because deer and cattle are closely related species, they have similar metabolic processes; therefore, it is equally unlikely for cattle to accumulate explosives in their tissues.

- ATSDR was unable to identify any specific public health hazards associated with the consumption of local biota. RDX concentrations detected in local biota are not bioaccumulating at levels expected to affect human health via the food chain (plant-animal-human).

Discussion

Crops in the vicinity of IAAAP may be irrigated with RDX-contaminated water and grow in soil containing RDX (maximum detected concentration of 1.4 parts per million [ppm]). To better characterize the potential for RDX to accumulate in on-site plants, the Army conducted a study in the summer of 1994 (Center for Environmental Restoration Systems, 1995a). This study found that the potential exists for RDX to enter the food chain via fruit- and nut-bearing trees, as well as in locally-grown grains. RDX was found in the shoots and roots of some plants growing on RDX-contaminated soils at sites surveyed at IAAAP. Plant concentrations of RDX varied greatly by species.

ATSDR examined potential health impacts associated with IAAAP plants consumed by people, specifically corn and soybeans. Only one sampled agricultural area, a small area in one cornfield, contained detectable RDX in the soil. Corn grown in this contaminated soil did not contain detectable RDX concentrations in its corn leaf, stalk, grain, or root samples. Similarly,

corn grown in uncontaminated soil contained no detectable RDX concentrations (Center for Environmental Restoration Systems, 1995a). These findings are consistent with other studies indicating that at relatively low levels of RDX in soil ($\leq$ 0.3 ppm) or in irrigation water ($\leq$ 0.1 ppm), RDX does not bioaccumulate in crops (USAEC, 1996). Soybean crops were not sampled at IAAAP, but other studies indicate that soybean and corn bioaccumulate RDX in similar concentrations (i.e., little or no bioaccumulation at lower soil and water concentrations; bioconcentration factors increase at higher levels of RDX in soil and water) (Checkai and Simini, 1996). Because IAAAP crops are not grown in highly contaminated soil, are not irrigated with highly contaminated water, and the Army study indicates that no RDX is bioaccumulating in corn, ATSDR concludes that local crops are safe for human consumption.

Another community concern addresses the safety of human consumption of venison and beef from animals which feed on the installation. Specifically, community members expressed concern that deer and cattle caught on the installation might be unfit for human consumption because the animals may eat plants containing RDX and/or drink from contaminated surface water. Although no IAAAP studies specifically address this issue, ATSDR identified several deer tissue studies of explosives uptake conducted at other facilities. According to the literature, explosives (including RDX) do not bioaccumulate significantly at the concentrations typically seen in the environment (EPA, 1997; ATSDR, 1996; Whaley and Leach, 1994; Shugart et. al., 1990). At another facility, the Joliet Army Ammunition Plant, with similar contamination issues, a study found that on-site deer tissue did not contain any detectable explosives or explosive residues in either deer muscle or deer liver (Whaley and Leach, 1994). Although ATSDR identified no cattle studies, ATSDR expects that RDX levels in beef would be comparable to those found in venison because both cattle and deer are ruminants (belong to the mammalian suborder *Ruminantia*) that have similar metabolic processes (ATSDR, 1996). From these toxicologic and ecological studies, ATSDR concludes that deer and cattle residing on IAAAP property are unlikely to contain significant levels of RDX, if any.

ATSDR concludes that past, present, and future consumption of local crops, deer, and cattle does not pose a public health hazard.

COMMUNITY HEALTH CONCERNS

ATSDR identified community health concerns by talking with local citizens, meeting with IAAAP employees, and reviewing IAAAP RAB discussions. ATSDR found that the community's greatest health concerns involve issues pertaining to groundwater contamination and radiological contamination.[4] In the past, local citizens expressed concern about potentially developing cancer and/or other health problems from exposure to IAAAP-contaminated groundwater. Local newspapers printed articles about the reported health problems of a family living south of IAAAP. No toxicological studies or health outcome data were ever gathered to verify such public health effects. Based on the concentrations of environmental contaminants in the vicinity of IAAAP and toxicological information, however, it does not appear that installation-related contaminants can be causally related to public health effects. There is only limited exposure, if any, to the environmental contaminants at IAAAP. Adverse public health impacts are not likely from the exposures that would reasonably be expected to occur or would have reasonably been expected to have occurred in the past.

ATSDR CHILD HEALTH INITIATIVE

ATSDR recognizes that infants and children may be more sensitive to exposures than adults in communities with contamination in their water, soil, air, or food. This sensitivity is a result of a number of factors. Children are more likely to be exposed to soil or surface water contamination because they play outdoors and often bring food into contaminated areas. For example, children may come into contact with and ingest soil particles at higher rates than adults do; also, some children with a behavior trait known as "pica" are more likely than others to ingest soil and other nonfood items. Children are shorter than adults, which means they can breath dust, soil, and any vapors close to the ground. Also, they are smaller, resulting in higher doses of chemical exposure per body weight. The developing body systems of children can sustain permanent damage if toxic exposures occur during critical growth stages. Because

[4] Community concerns regarding radiological issues will be addressed by ATSDR when sufficient information regarding potential environmental contamination becomes available.

children depend completely on adults for risk identification and management decisions, ATSDR is committed to evaluating their special interest at sites such as IAAAP, as part of the ATSDR Child Health Initiative. ATSDR has attempted to identify populations of children in the vicinity of IAAAP and any completed exposure pathways to these children.

In the IAAAP area, ATSDR identified several populations of children. Several active schools, day care facilities, and church facilities are all located off site. The closest active school is in Danville, Iowa, which is over 4 miles from IAAAP. Several inactive schools (e.g., the Buena Vista School and Brush College) are located on or near IAAAP, but all these educational facilities are located on uncontaminated soil.

None of the identified child populations have been exposed to contaminant levels associated with adverse health effects in children. There are no child exposures (past, present, or potential future) to on-site RDX-contaminated groundwater, soil, sediment, or surface water. On-site recreational facilities, including the scout camp on Mathes Lake, are not associated with any known contamination. There is no known contamination associated with off-site soil, sediment, or local biota. As outlined in Appendix B, past exposures to RDX in off-site private drinking water wells were at levels below those associated with health effects in children.[5]

Low-level RDX contamination (generally less than 10 ppb) has impacted off-site surface water south and southeast of IAAAP. The maximum detected concentration in off-site surface water is below drinking water levels associated with adverse health effects in children (Appendix B). No one, however, drinks this surface water. Child exposures are limited to dermal contact and/or incidental ingestion when swimming or playing in the creeks. Exposure is further limited by Iowa's climate; according to local community members, children only swim in the creeks

[5] ATSDR's estimated exposure doses are calculated for the general child population in the IAAAP vicinity and may not accurately reflect exposure for the one household that has ignored repeated Army recommendations to abandon their private well. For this household, the exposure period was approximately twice as long. According to ATSDR estimates, doubling the exposure period may be associated with an increased incidence of noncancer effects in children (see Appendix B). ATSDR, however, does not know if any children have lived in the household for this entire 15-year duration.

during Iowa's summer months (ATSDR, 1998). Therefore, surface water exposure does not currently pose a public health hazard for children.

It is possible that in the past children were exposed to higher concentrations of RDX and other explosive contaminants (e.g., TNT) in surface water. Surface waters were not sampled during the 1950s when off-site creeks ran pink. ATSDR does not believe that it posed any child health risks because it is highly improbable that children would have swam or played in contaminated pink waters when abundant uncontaminated surface waters (e.g., Long Creek) were located in the immediate vicinity. Past child exposures would have been further limited by seasonal swimming due to Iowa's climate. It should also be noted that ATSDR was unable to identify any specific health complaints or symptoms (child or adult) that community members associated with past IAAAP activities. Because, however, this past exposure is not fully characterized and remains unquantifiable, ***ATSDR concludes that past surface water exposure poses an indeterminate health hazard for children. For all other exposure pathways, on- and off-site groundwater (past, present, and future), surface water (present and future), and soil (past, present, and future), ATSDR concludes that these exposures pose no or no apparent public health hazard for children.***

CONCLUSIONS

Based on a thorough evaluation of available environmental information, ATSDR concludes that IAAAP should be assigned to the ***No Apparent Public Health Hazard*** category for the following reasons:

1. *Exposure to on-site groundwater does not pose a past, present, or future public health hazard.* RDX and other contaminants have been detected at levels above ATSDR comparison values in groundwater underlying IAAAP property. No exposures to groundwater contamination have occurred, however, because IAAAP does not use on-site groundwater as its drinking water source. On-site drinking water received from the Burlington Municipal System meets state and federal drinking water standards.

2. *Past exposure to off-site groundwater south of IAAAP poses no apparent public health hazard. There is and will be no present or future exposures, so off-site groundwater does not pose a present or future public health hazard.* In off-site areas where people may have ingested RDX-contaminated groundwater at levels above health-based

guidelines, no public health hazard exists due to the short exposure durations, the low exposure doses, and/or Army remediation efforts. No quantitative measures of potential exposure to contaminated groundwater exists prior to the investigations beginning in 1985 and no evaluation of that interval is given in this assessment. Present and potential future exposures to RDX-contaminated groundwater above health-based guidelines is unlikely, since residences south of IAAAP have been connected to the rural water supply and all off-site drinking water meets state and federal drinking water standards.[6]

3. *Past exposure to on- and off-site surface water poses an indeterminate public health hazard. Present and future exposures to on- and off-site surface water pose no apparent public health hazard.* IAAAP-contaminated surface water has never been used as a source of drinking water. Public exposure to potentially contaminated surface water is minimal, if it occurs at all, through swimming or wading.

4. *Exposure to soil at IAAAP does not pose a past, present, or future public health hazard.* Some IAAAP soil contains contaminants above ATSDR comparison values, but public exposure (past, present, and future) is not likely, largely because access to contaminated sites is limited and contamination occurs primarily in subsurface soils or industrial areas. In the few contaminated areas that the public may potentially access, the Army has or is in the process of remediating surface soil contamination as necessary to reduce contaminant levels.

5. *Exposure to IAAAP crops, venison, and beef does not pose a past, present, or future public health hazard.* Due to local conditions and the nature of explosives, RDX does not appear to bioaccumulate in IAAAP crops, deer, or cattle. Therefore, no public health hazard exists from the consumption of local biota.

PUBLIC HEALTH ACTION PLAN

The Public Health Action Plan (PHAP) for IAAAP contains a description of actions taken and those to be taken, as necessary, by ATSDR, the Army, and EPA at IAAAP and in the vicinity of the installation subsequent to the completion of this public health assessment. The purpose of the PHAP is to ensure that the public health assessment not only identifies public health hazards, but provides a plan of action designated to mitigate and prevent adverse human health effects

[6] This conclusion excludes the one household that has refused to abandon its contaminated private well, even after the Army has connected the residence to the Rathbun Rural Water System and repeatedly informed the residents that their well water does not meet state and federal standards (see Concern: Groundwater section and Appendix B).

resulting from exposure to hazardous substances in the environment. The public health actions that are completed, being implemented, or planned are as follows:

Completed Groundwater Actions

- Over the past 20 years, the Army has thoroughly investigated the nature and extent of groundwater contamination (OU #3). When RDX was discovered in several off-site private wells, the Army immediately supplied all potentially-at-risk residents with alternate drinking water sources and paid for residents to be connected to the Rathbun Rural Water System supply.

- After monitoring and characterizing IAAAP groundwater contamination, the Army concluded that the most effective way to remediate the contamination is to prevent any further movement of contaminants from soil to groundwater.

Completed Surface Water Actions

- The Army monitored and characterized contaminants in on- and off-site surface waters in the IAAAP vicinity.

- Contaminated wastewater from IAAAP is treated (primarily with settling tanks, filtration, and carbon adsorption) and discharged in accordance with National Pollutant Discharge Elimination System permitted outfalls. See Appendix A for site-specific details.

Completed Soil and Sediment Actions

- As described in Appendix A, the Army has initiated remediation actions at IAAAP to remove and treat soils that may impact underlying groundwater. All contaminated soils are being carefully handled to prevent exposure to the general public.

- The northern section of Trench 5 in the Inert Landfill, containing explosive-contaminated wastes, was capped and closed in 1989 in accordance with RCRA Subtitle C guidelines.

- In the spring of 1995, approximately 150 cubic yards of pesticides-contaminated soils were excavated from the former Pesticide Disposal Pit and disposed of at an approved off-site waste disposal facility.

- Also in the spring of 1995, explosives-contaminated soils associated with over 50 abandoned wastewater sumps were excavated. These contaminated soils were temporarily stored in a lined stockpile near the Inert Landfill at IAAAP, and were moved to the on-site soil repository for permanent disposal in the spring of 1997.

- In the fall of 1997, the Army completed construction of a low-permeability cover on the 17-acre Inert Landfill site to prevent infiltration of precipitation in the landfill material and the subsequent transport of contaminants from wastes to groundwater.

- The Line 1 Impoundment and Line 800 Pinkwater Lagoon subsites are considered to be the greatest sources of explosives contamination at IAAAP. As a part of the NTC removal actions for the Line 1 Impoundment and the Line 800 Pinkwater Lagoon, soils have been sampled, analyzed, and segregated according to the risk or contaminant level detected. Depending on the concentration of explosives in the excavated soils, the soils have been placed in one of three areas: in the designated Corrective Action Management Unit (CAMU; also known as Trench 7), in the soil repository, or beneath the cap at the Inert Landfill. Soils with the highest contaminant concentrations were stockpiled in the CAMU for treatment at a later date. Soils with lower levels were disposed of in the soil repository, while soils with the lowest levels were disposed of as random fill beneath the Inert Landfill cap. The excavation and segregation of soils from the Line 1 Impoundment and the Line 800 Lagoon was completed in August 1997.

Ongoing/Planned Groundwater Actions

- The Army will monitor all regions of groundwater contamination and repair or up-grade interim activities (e.g., supplying bottled water to local residents) as needed.

- The Army will continue to collect and analyze groundwater data from the Army's monitoring wells, private wells, and municipal wells.

- ATSDR will review groundwater data as they become available and will reevaluate Public Health Assessment conclusions if and when groundwater quality, use, and/or exposure scenarios change. This review will include potential radionuclide contamination in IAAAP groundwater.

Ongoing/Planned Surface Water Actions

- The Army will continue to monitor and further characterize on- and off-site surface waters in the vicinity of IAAAP.

- ATSDR will review potential radionuclide contamination in IAAAP surface waters.

Ongoing/Planned Soil and Sediment Actions

- The Army is in the process of developing a final remediation action for IAAAP soils (OU #1). The Army plans to treat all contaminated soils stockpiled in the CAMU, including:
  - Approximately 9,000 cubic yards of soil contaminated with explosives.
  - Approximately 600 cubic yards of soil contaminated with explosives plus metals.
  - Approximately 200 cubic yards of soil contaminated with semi-volatile organic compounds (SVOCs).
  - Approximately 300 cubic yards of soil contaminated with radionuclides.
- The Army is planning NTC removal actions to address an estimated 1,000 cubic yards of VOC-contaminated soils at the former Fire Training Pit. The Army recently selected on-site low-temperature thermal desorption as the remediation technology to complete this cleanup.
- ATSDR will review potential radionuclide contamination in IAAAP soils.

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Table 2: Summary of Potential Exposure Pathways at Iowa Army Ammunition Plant (IAAAP)

PATHWAY NAME	POTENTIAL SOURCE OF CONTAMINATION	ENVIRON-MENTAL MEDIUM	POINT OF EXPOSURE	ROUTE OF EXPOSURE	TIME OF EXPOSURE	EXPOSED POPULATION	COMMENTS
Drinking water (Off-site private wells south and southeast of IAAAP)	Hexahydro-1,3,5-trinitro-1,3,5-triazine (RDX)—Iowa Army Ammunition Plant (IAAAP) discharges. Two sub-sites (the former Line 1 Impoundment and the Line 800 Pinkwater Lagoon) appear to be the primary sources of explosives leaching into local water supplies.	Groundwater	Five private off-site wells south and southeast of IAAAP. Most contamination was detected in wells adjacent to Brush Creek, although two wells on a Skunk River Tributary contained RDX.	Ingestion, dermal contact	**Past:** ● RDX was first detected in trace amounts in off-site wells in September 1992. RDX was detected above the U.S. Environmental Protection Agency's health advisory limit (HAL) of 2.0 parts per billion (ppb). The maximum detected concentration of RDX was 27.5 ppb in Well 2. **Present and Future:** ● No contaminants (including RDX) have been detected above Agency for Toxic Substances and Disease Registry (ATSDR) screening values in off-site active production wells in the past 5 years.	**Past:** ● Five families living directly south and southeast of IAAAP. ● One hundred and fifty four residences south and southeast of IAAAP were deemed potentially exposed to RDX-contaminated drinking water. **Present and Future:** ● None[7]	**Past:** ● After RDX was detected above the HAL in drinking water, the Army immediately provided bottled water to all affected residences. The Army then contracted with the Rathbun Water Company to connect over 150 residences in the area to the public water supply at the Army's expense. **Present and Future:** ● Municipal drinking water is filtered and treated, reducing groundwater contaminants to levels below state and federal drinking water standards. ● Army remedial activities and natural attenuation are reducing, and will continue to reduce, RDX concentrations in groundwater. ● Groundwater monitoring will continue on and off site. If contamination of a drinking water well is detected in the future, the use of the affected well will be discontinued or further remediated as necessary. *Past consumption of groundwater from private wells south of IAAAP poses no apparent public health hazards; present and future consumption poses no public health hazards.*

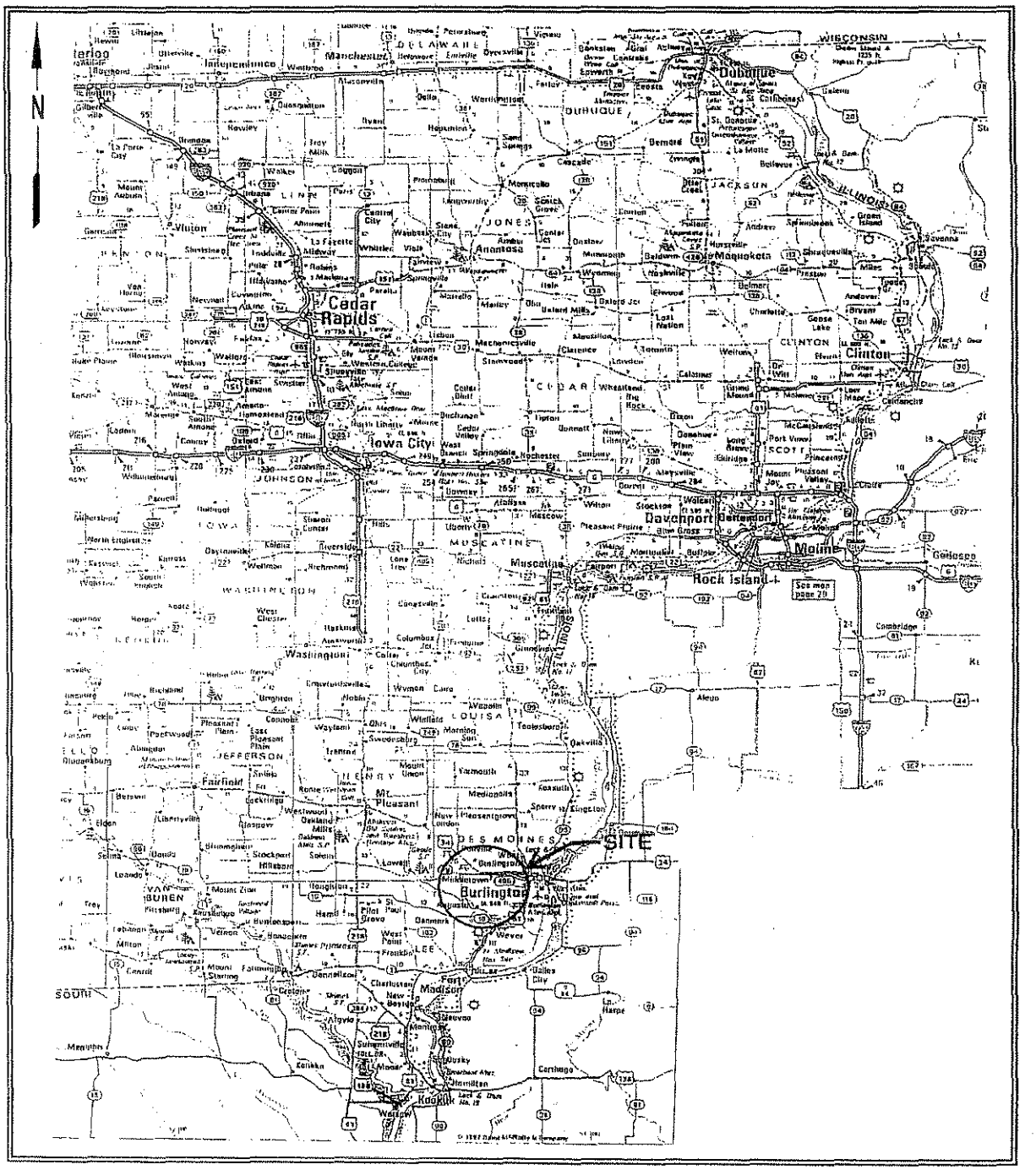
[7] Excluding the one household that has refused to abandon its contaminated private well, even after the Army has connected the residence to the Rathbun Rural Water System and repeatedly informed the household that their well water does not meet state and federal standards (see Concern: Groundwater section and Appendix B).

PATHWAY NAME	POTENTIAL SOURCE OF CONTAMINATION	ENVIRON-MENTAL MEDIUM	POINT OF EXPOSURE	ROUTE OF EXPOSURE	TIME OF EXPOSURE	EXPOSED POPULATION	COMMENTS
Surface water (Brush Creek, Spring Creek, Long Creek, Mathes Lake, and un-named Skunk River tributaries)	TNT, RDX, and other explosives— IAAAP discharges have contaminated most on-site and some off-site surface waters. Two sub-sites (the former Line 1 Impoundment and the Line 800 Pinkwater Lagoon) appear to be the primary sources of explosives.	Surface water	Off-site surface water in Brush Creek and in some un-named Skunk River tributaries	Incidental ingestion, dermal contact	**Past:** ● Prior to the early 1950s, Brush Creek reportedly ran pink due to the presence of explosives, most likely TNT. No quantitative data are available for this period. **Present and Future:** ● Fluctuating RDX concentrations, generally below 10 ppb (maximum detected concentration of 22 ppb), have been detected off-site in Brush Creek surface water near the IAAAP boundary. RDX levels in the un-named Skunk River tributaries slightly exceeded the HAL of 2.0. Spring Creek, Long Creek, and Mathes Lake remain uncontaminated.	**Past, Present, and Future:** ● Local residents have access to Brush Creek and the un-named Skunk River tributaries after they leave IAAAP property. These surface waters are too small to be suitable for typical recreational activities such as swimming, boating, or fishing, but they may be used for recreational purposes by children.	**Past:** ● After IAAAP surface waters became visibly polluted in the 1950s, the Army changed its disposal methods, including treatment and filtration of process waters prior to discharge. ● ATSDR did not identify any exposure pathways for adults via surface water. ● Child exposures are likely to be minimal, if they occurred at all, because the contaminated surface waters are shallow and small. It appears unlikely that children would have spent much time in Brush Creek or the un-named Skunk River tributaries, especially when there are several other, larger (and cleaner) creeks, rivers, and lakes in the immediate vicinity. *Past exposure to IAAAP-area surface waters poses an indeterminate public health hazard.* **Present and Future:** ● ATSDR did not identify any exposure pathways for adults via surface water. ● Child exposures are likely to be minimal, if they occurs at all. The contaminated surface waters are shallow and small. It is unlikely that children will spend much time in Brush Creek or the un-named Skunk River tributaries, especially when there are several larger (and cleaner) creeks, rivers, and lakes in the immediate vicinity. Minimal exposure to the low-levels of contamination detected are not associated with any public health hazard. ● Army remedial activities and natural attenuation are reducing, and will continue to reduce, RDX concentrations in surface water. *Current and future exposures to IAAAP-area surface waters pose no apparent public health hazards.*

PATHWAY NAME	POTENTIAL SOURCE OF CONTAMINATION	ENVIRON-MENTAL MEDIUM	POINT OF EXPOSURE	ROUTE OF EXPOSURE	TIME OF EXPOSURE	EXPOSED POPULATION	COMMENTS
Soil and Sediment (On-site)	Explosives, metals, volatile organic compounds (VOCs), semi-volatile organic compounds (SVOCs), and radionuclides — IAAAP discharges from loading, assembling, and packing ammunition appear to be the primary sources of contamination. The most significant contamination occurred at installation facilities and industrial areas, including Lines 1, 2, 3, 3A, and 800, the Explosive Disposal Area, the Firing Site, and the Fire Training Pit. Two sub-sites, the Line 1 Impoundment and Line 800 Pinkwater Lagoon, are considered to be the greatest sources of explosives contamination at IAAAP.	Soil and sediment	Contact with surface soil and sediment	Dermal contact	**Past, Present, and Future:** ● Contact with surface soil and sediment is extremely limited, if it occurs at all.	**Past, Present, and Future:** ● Local deer hunters, Army-approved groups (e.g., the Boy Scouts of America), and trespassers may access forested and agricultural areas on the installation.	**Past, Present, and Future:** ● IAAAP is surrounded by perimeter fencing to restrict public access. Access to contaminated areas is further restricted by secondary fencing and on-site security measures for 30 of the 33 potentially-contaminated sites. ● ATSDR believes that exposure to soil and sediment contamination at the three un-fenced sites is extremely minimal, if it occurs at all for two primary reasons: 1. The amount of time visitors spend in contact with on-site soil is likely to be very brief and will not occur on a regular basis, and 2. The visitors generally stay in or near forested areas, rather than venturing into open fields or industrial areas where the contamination occurs. ● Public exposure to contaminated sediments is further prevented because the sediments lie underwater, beneath restricted on-site surface water bodies. ● Army remedial activities are reducing, and will continue to reduce, RDX, TNT, metals, VOCs, SVOCs, and radionuclide concentrations in soil and sediment. *Past, current, and future exposures to IAAAP soil and sediment pose no public health hazards.*

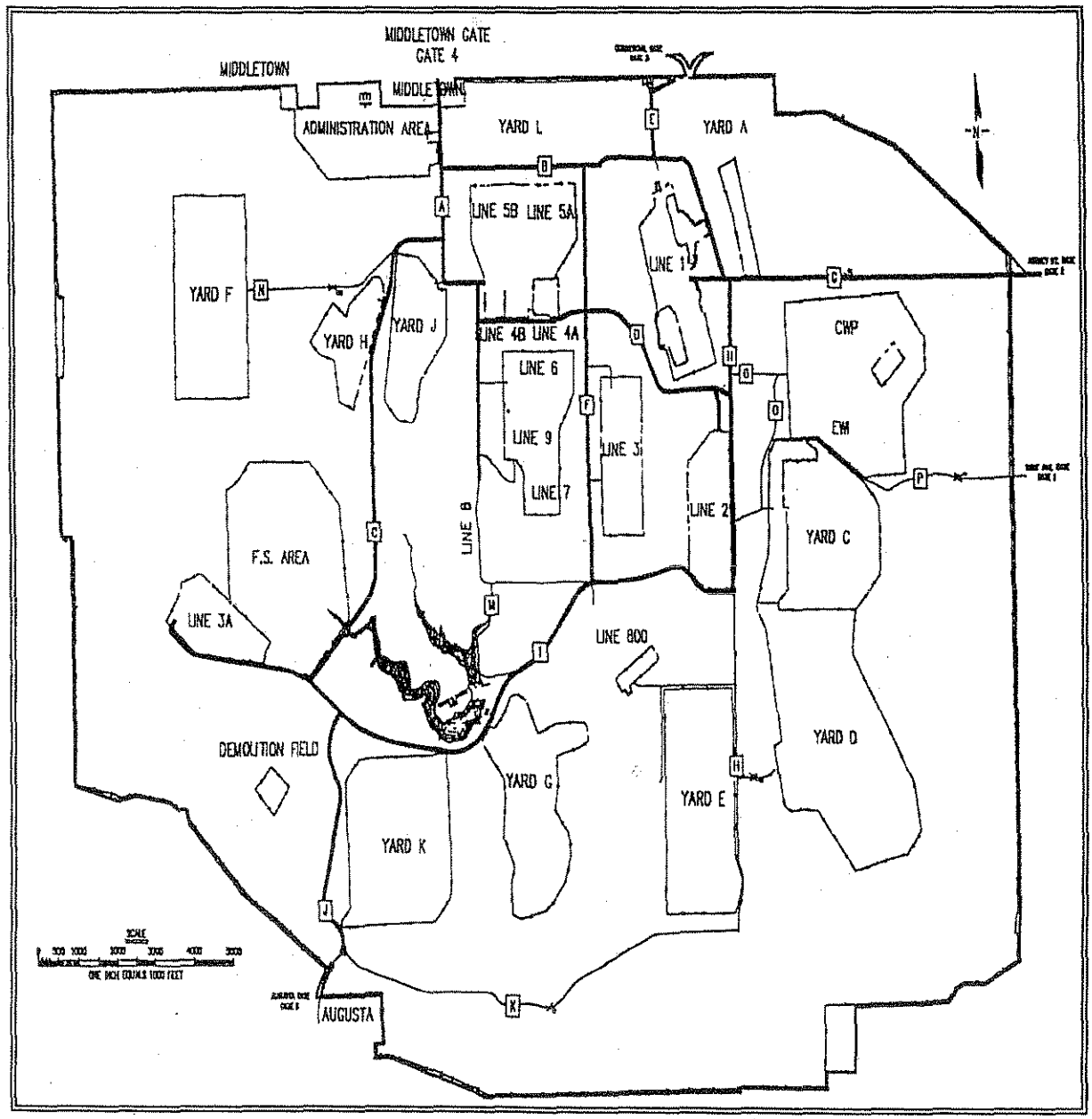
PATHWAY NAME	POTENTIAL SOURCE OF CONTAMINATION	ENVIRON-MENTAL MEDIUM	POINT OF EXPOSURE	ROUTE OF EXPOSURE	TIME OF EXPOSURE	EXPOSED POPULATION	COMMENTS
Local Biota (produce, deer, and cattle from the IAAAP area)	RDX — IAAAP discharges have contaminated on-site soils and surface waters. Plants grow in some contaminated areas and may be irrigated with RDX-contaminated water. Deer and cattle may eat these plants and/or drink contaminated surface water. Two sub-sites (the former Line 1 Impoundment and the Line 800 Pinkwater Lagoon) appear to be the primary sources of explosives leaching into local water supplies.	IAAAP biota	Corn, soy beans, deer, and cattle from the IAAAP area	Ingestion	**Past, Present, and Future:** ● None	**Past, Present, and Future:** ● None	**Past, Present, and Future:** ● Toxicologic and ecological studies indicate that IAAAP crops are not bioaccumulating RDX in their tissue and that they are safe for human consumption. ● Toxicologic and ecological studies indicate that deer and cattle do not tend to bioaccumulate RDX in their tissue and that IAAAP venison and beef is safe for human consumption. *Past, current, and future consumption of local crops, venison, and beef pose no public health hazards.*

Figure 1
Area Map
Middletown, Iowa



Source: Dames and Moore, 1989.

Figure 2
Iowa Army Ammunition Plant, Iowa



Source: USAEC, 1995.

Figure 3

ATSDR's Exposure Evaluation Process

REMEMBER: For a public health threat to exist, the following three conditions must all be met:

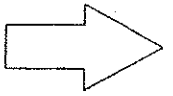
- People must come into contact with areas that have potential contamination
- Contaminants must exist in the environment
- The amount of contamination must be sufficient to affect people's health

Are People Exposed To Areas With Potentially Contaminated Media?

For exposure to occur, contaminants must be in locations where people can contact them.

People may contact contaminants by any of the following three exposure routes:

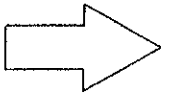
Inhalation
Ingestion
Dermal absorption



Are the Environmental Media Contaminated?

ATSDR considers:

Soil
Ground water
Surface water and sediment
Air
Food sources

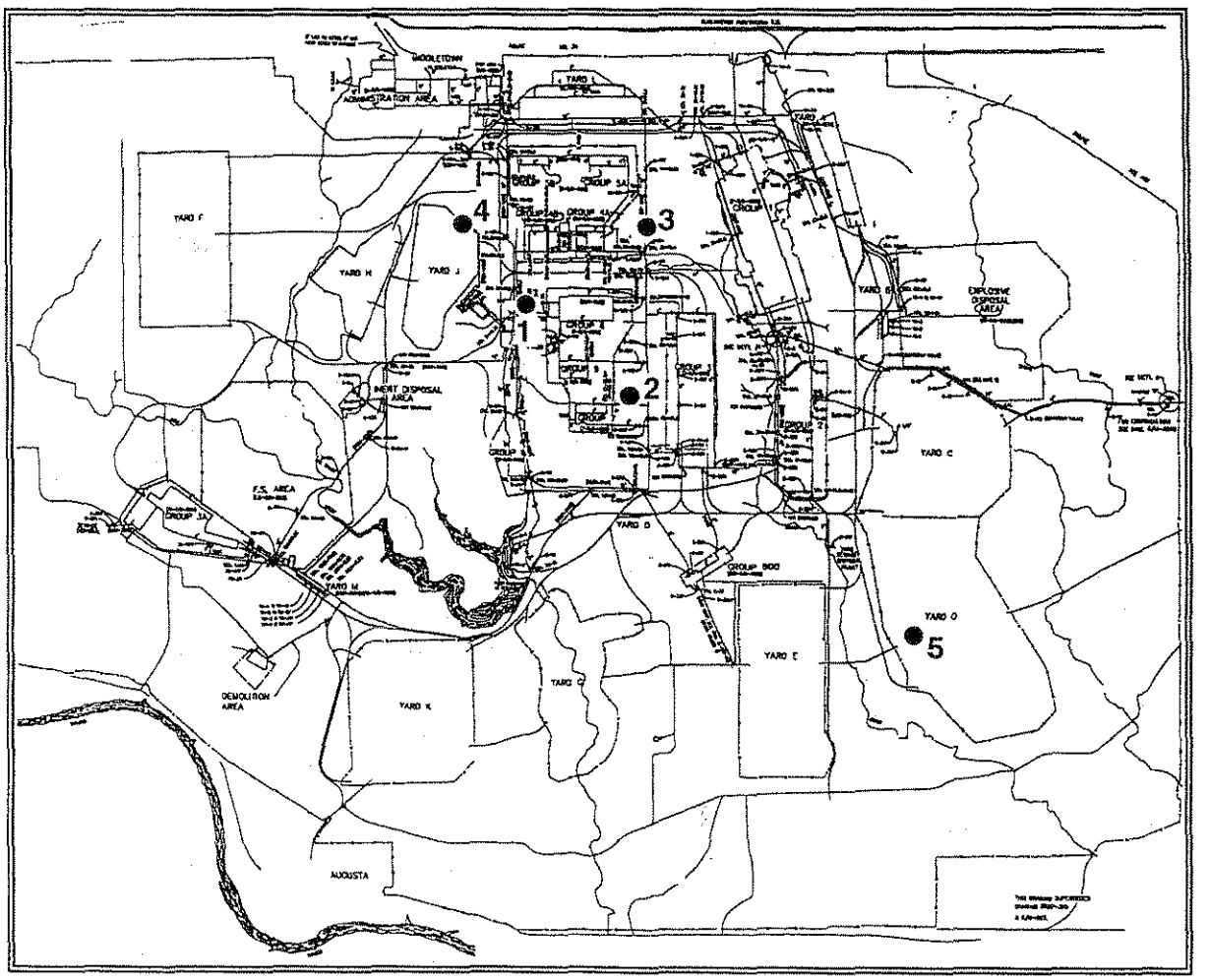


For Each Completed Exposure Pathway, Will the Contamination Affect Public Health?

ATSDR will evaluate existing data on contaminant concentration and exposure duration and frequency.

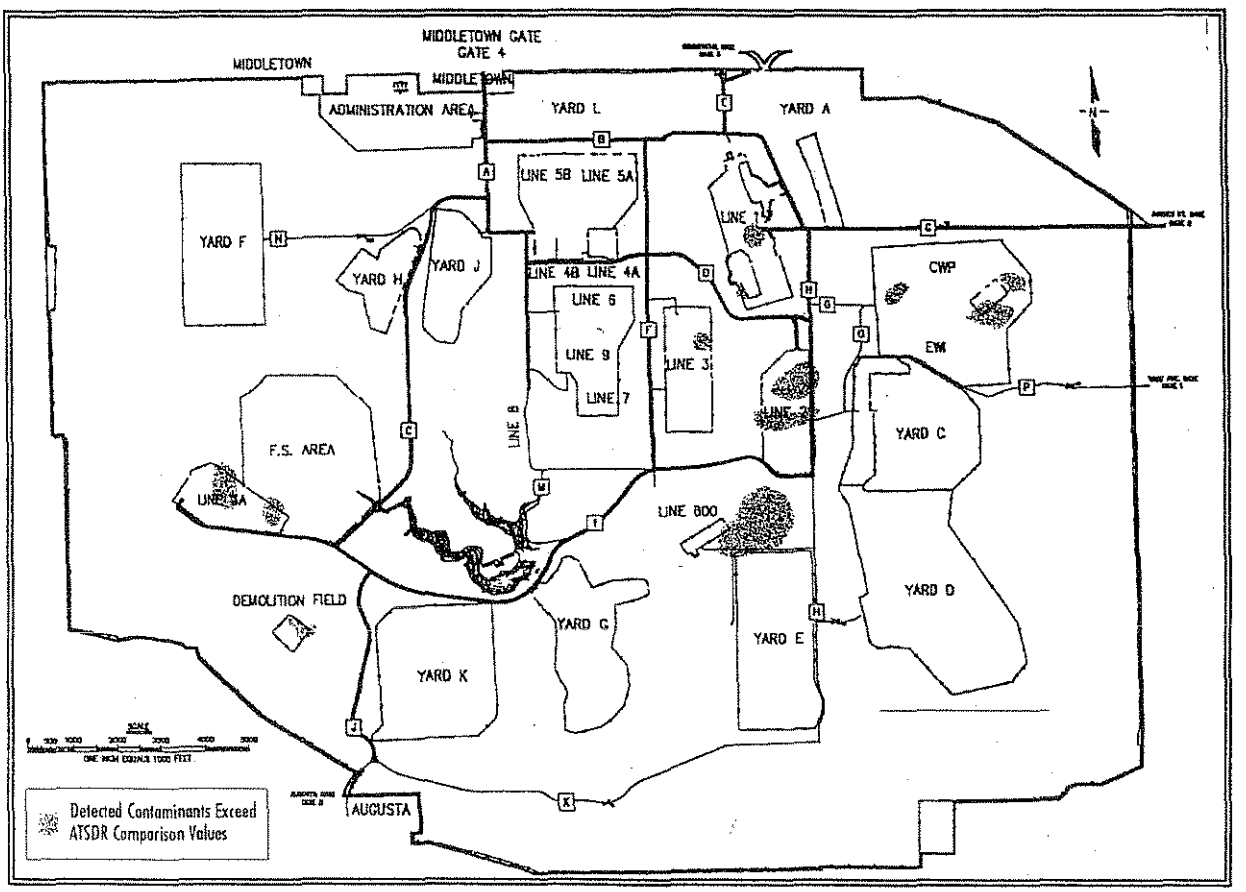
ATSDR will also consider individual characteristics (such as age, gender, and lifestyle) of the exposed population that may influence the public health effects of contamination.

Figure 4
Locations of Production and Monitoring Wells
Iowa Army Ammunition Plant, Iowa



Source: Hicks, 1999; Mason and Hanger Corporation, 1997.

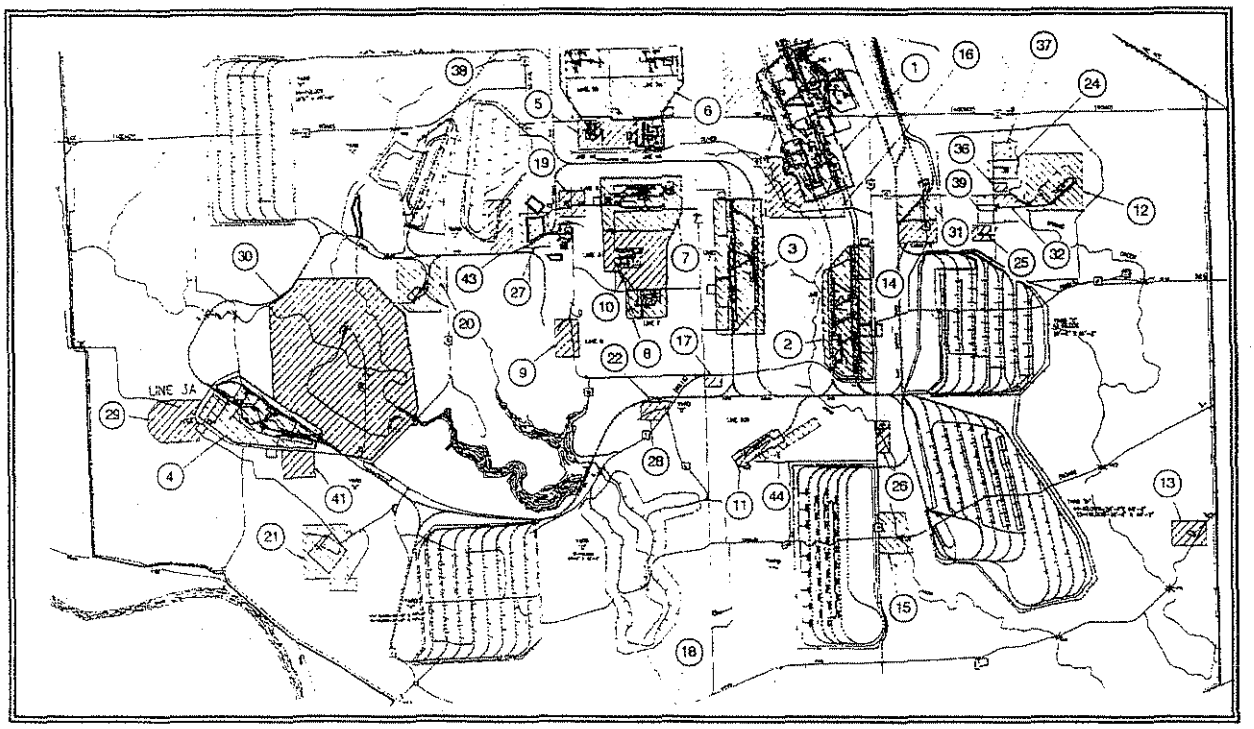
Figure 5
Locations of Suspected Groundwater Plumes
Iowa Army Ammunition Plant, Iowa



Source: Adapted from ACE, 1997b.

Note: Suspected contaminant plumes are not drawn to scale.

Figure 6
Locations of the 44 PA/SI Sites
Iowa Army Ammunition Plant, Iowa



Source: JAYCOR, 1996; Mason and Hanger Corporation, 1997.

APPENDIX A:

Evaluation of Potential Public Health Hazards Associated With the 33 RI/FS Sites at Iowa Army Ammunition Plant

Appendix A: Evaluation of Potential Public Health Hazards Associated with 33 RI/FS Sites at Iowa Army Ammunition Plant.

Site	Site Description/ Waste Disposal History	Investigation Results/ Environmental Monitoring Results	Corrective Activities and/or Current Status	Evaluation of Public Health Hazards
Facilities in Brush Creek Watershed				
Line 1	Line 1 is a fenced, 190-acre parcel with 22 buildings. Since 1941, cartridges, missiles, warheads, and grenades have been loaded and packed on Line 1. From 1941 to 1975, the U.S. Atomic Energy Commission (AEC) modified and operated parts of this site. In the past, untreated wastewater from the Line 1 operations were disposed in the Former Line 1 Impoundment. Line 1 drainage ways currently receive treated wastewater discharge through National Pollutant Discharge Elimination System (NPDES) permitted outfalls. The primary contaminants of concern include explosives, metals, and volatile organic compounds (VOCs).	**Groundwater:** Contained elevated (above ATSDR comparison values) levels of explosives, metals, VOCs, and semi-volatile organic compounds (SVOCs). **Surface Water:** Contained elevated levels of explosives and metals. **Soil and Sediment:** Contained explosives in near-surface soils with HMX, RDX, 2,4,6-TNT as high as 1,600, 3,700, and 9,200 parts per million (ppm), respectively. Metals contamination was more widespread than explosives contamination. Lead was generally the metal reported at highest concentration (as high as 1,530 ppm) and mercury (as high as 2,000 ppm) was highest at some Line 1 locations. Radionuclide contamination was not detected. VOCs (maximum concentration of 18,037 parts per billion [ppb]) were detected in soil gas samples taken from subsurface soils near one building.	**Corrective Activities:** • All Line 1 wastewater is treated by carbon adsorption and discharged to drainage ditches to NPDES permitted outfall (#12). • In the spring of 1995, sumps and associated contaminated soils were excavated and moved to the on-site soil repository, adjacent to the Inert Landfill. • By August 1997, Line 1 soils were sampled, analyzed, and segregated according to the risk or contaminant level detected. Depending on the concentration of explosives in the excavated soils, the soils have been placed in one of three on-site areas: the designated Corrective Action Management Unit (CAMU), constructed adjacent to the IAAAP Inert Landfill, in the soil repository, or beneath the cap at the Inert Landfill as random fill to achieve final grade. Soils with contaminant concentrations posing the highest risks were stockpiled in the CAMU for treatment at a later date. Soils with an intermediate level of risk were disposed of in the soil repository, while soils with the lowest risk levels were disposed of beneath the Inert Landfill cap. **Current Status:** • RI/FS complete. • The Army will continue monitoring and remediation activities.	No public health hazards are associated with this site. **Groundwater:** No active production wells lie in the vicinity of Line 1. **Surface Water:** There is no public exposure to Line 1 surface water. **Soil and Sediment:** Because land use at this site is industrial/commercial and contaminants were primarily detected in the subsurface soils, public exposure (past, present, and future) is highly unlikely. Remedial activities have reduced contaminant levels to those protective of human health. On-site workers will not contact site soil or sediment without adequate health and safety precautions as required by the Occupational Safety and Health Administration (OSHA).

Appendix A: Evaluation of Potential Public Health Hazards Associated with 33 RI/FS Sites at Iowa Army Ammunition Plant.

Site	Site Description/ Waste Disposal History	Investigation Results/ Environmental Monitoring Results	Corrective Activities and/or Current Status	Evaluation of Public Health Hazards
Former Line 1 Impoundment	The Former Line 1 Impoundment was formed by damming a portion of the upper reaches of Brush Creek. The primary function of the impoundment was to allow settlement of particles from explosives-contaminated wastewater prior to discharge downstream. The impoundment is an estimated 3.6 acres in size and, during periods of high flow, covers an estimated 7.5 acres (1,300 feet to 2,400 feet long). It received large volumes of discharge from 1948 to 1975. The explosives wastes primarily included 2,4,6-TNT and its degradation products. Other wastes included minor amounts of coal from a nearby coal pile and condensate from a coal-fired power plant. No known water treatment process was employed other than intermittent addition of fly ash to adsorb explosives components and reduce color. The actual volume or quantity of discharges to the Former Line 1 Impoundment was not recorded and is not known. The Former Line 1 Impoundment operated until 1975, when its embankment was breached by Brush Creek and the area was allowed to re-vegetate naturally.	**Groundwater:** Contained elevated levels of RDX (up to 445 ppb) and HMX (up to 80 ppb). Metals were not elevated. This groundwater moves southward along Brush Creek. **Surface Water:** RDX was detected from less than detection limit up to 185 ppb. Metals were not elevated. **Soil and Sediment**: The dominant explosives detected were RDX (up to 400 ppb) and HMX (up to 61 ppb), with trace amounts of tetryl; 1,3-DNB; 2,4-DNT; 2,6-DNT; 1,3,5-TNB, and 2,4,6-TNT detected. Excluding barium (up to 903 ppm), metals were not present in soil samples at elevated concentrations.	**Corrective Activities**: • In 1997, approximately 8,270 cubic yards of explosives-contaminated soils were excavated from the Former Line 1 Impoundment. These soils contained more than 3,900 pounds of explosives. These soils were sampled, analyzed, and segregated according to the risk or contaminant level detected. Depending on the concentration of explosives in the excavated soils, the soils have been placed in one of three on-site areas: the designated Corrective Action Management Unit (CAMU), constructed adjacent to the IAAAP Inert Landfill, in the soil repository, or beneath the cap at the Inert Landfill as random fill to achieve final grade. Soils with contaminant concentrations posing the highest risks were stockpiled in the CAMU for treatment at a later date. Soils with an intermediate level of risk were disposed of in the soil repository, while soils with the lowest risk levels were disposed of beneath the Inert Landfill cap. • The Former Line 1 Impoundment has been converted into a wetlands. Remediation efforts are establishing native plants that contain an enzyme (nitroreductase) needed to pyhtoremediate the surface and groundwater contaminated with residual levels of explosives. **Current Status:** • RI/FS complete. • The Army will continue monitoring and remediation activities.	No public health hazards are associated with this site. **Groundwater**: No active production wells lie in the vicinity of the Former Line 1 Impoundment. **Surface Water:** There is no public exposure to surface water at this site. **Soil and Sediment**: There is no public exposure to soil and sediment at this site. Remedial activities have reduced contaminant levels to those protective of human health. On-site workers will not contact site soils without adequate health and safety precautions as required by OSHA.

Appendix A: Evaluation of Potential Public Health Hazards Associated with 33 RI/FS Sites at Iowa Army Ammunition Plant.

Site	Site Description/ Waste Disposal History	Investigation Results/ Environmental Monitoring Results	Corrective Activities and/or Current Status	Evaluation of Public Health Hazards
Line 2	Line 2 is a fenced, 140-acre parcel with 70 buildings. It operated from the early 1940s to 1947 and from 1949 to present. Line 2 was primarily used to load, assemble, and pack ammunition. Contaminants of concern include explosives, metals, VOCs, and SVOCs.	**Groundwater**: Contained elevated levels of explosives, metals, and VOCs. **Surface Water**: Contained elevated levels of explosives and metals. **Soil and Sediment**: Explosives were identified in surficial soils near foundations of munitions processing building and loading/unloading areas. Contamination was also detected in loess and fill material surrounding former wastewater sumps, wastewater discharge locations, and drainage ways. VOCs were detected (up to 1,950 ppb) in the subsurface soils of two discontinuous areas.	**Corrective Activities**: • All Line 2 wastewater is treated by carbon adsorption in adjacent filter houses and discharged to NPDES permitted outfalls (#21, #22). • In the spring of 1995, sumps and associated contaminated soils were excavated and moved to the on-site soil repository. **Current Status:** • RI/FS complete. • The Army will continue monitoring and remediation activities.	No public health hazards are associated with this site. **Groundwater**: No active production wells lie in the vicinity of Line 2. **Surface Water:** There is no public exposure to Line 2 surface water. **Soil and Sediment**: Access to all production lines is restricted to operations personnel. The production line areas are completely fenced and access is controlled by security guards. Because land use at this site is industrial/commercial and contaminants were primarily detected in the subsurface soils, public exposure (past, present, and future) is highly unlikely. Remedial activities have reduced contaminant levels to those protective of human health. On-site workers will not contact site soils without adequate health and safety precautions as required by OSHA.

Appendix A: Evaluation of Potential Public Health Hazards Associated with 33 RI/FS Sites at Iowa Army Ammunition Plant.

Site	Site Description/ Waste Disposal History	Investigation Results/ Environmental Monitoring Results	Corrective Activities and/or Current Status	Evaluation of Public Health Hazards
Line 3	Line 3 is a fenced, 149-acre parcel with 56 buildings. It supported cleaning metal operations from 1941 to 1945 and from 1949 to present. Explosives, metals, and VOCs are the primary contaminants of concern at Line 3.	**Groundwater:** Contained elevated levels of explosives, metals, and VOCs. **Surface Water:** Contained elevated levels of explosives and metals. **Soil and Sediment**: The Remedial Investigation (RI) indicated that 38 of 135 soil samples contained explosives. Soils with the highest concentrations of explosives were located at wastewater sumps, the foundations of buildings where wastewater is generated, and loading docks. Swales and ditches tended to channelize concentrations in near-surface soils. Metals contamination (particularly lead and, to a lesser degree, chromium) was also widespread, especially within 10 to 20 feet of historical sources at Line 3. VOCs were detected up to 1,462 ppb in the subsurface soils of one area.	**Corrective Activities**: • All Line 3 wastewater is treated with settling tanks, filtration, and carbon adsorption. It is discharged by drainage ditches to NPDES permitted outfalls (#32, #33). • In the spring of 1995, sumps and associated contaminated soils were excavated and moved to the on-site soil repository. **Current Status:** • RI/FS complete. • The Army will continue monitoring and remediation activities.	No public health hazards are associated with this site. **Groundwater**: No active production wells lie in the vicinity of Line 3. **Surface Water:** There is no public exposure to Line 3 surface water. **Soil and Sediment**: Because land use at this site is industrial/commercial and contaminants were primarily detected in the subsurface soils, public exposure (past, present, and future) is highly unlikely. Remedial activities have reduced contaminant levels to those protective of human health. On-site workers will not contact site soils without adequate health and safety precautions as required by OSHA.
Line 4A	Line 4A is a fenced, 21-acre parcel with 12 buildings. It supported detonator production and assembly from 1941 to 1945 and from 1982 to present. Explosives and metals are the primary contaminants of concern.	**Groundwater:** Contained elevated levels of metals. **Surface Water:** Contained elevated levels of explosives and metals. **Soil and Sediment**: Explosive contamination was below ATSDR comparison values. All 69 samples from the RI reported arsenic, barium, and lead at levels up to 11, 526, and 1,160 ppm, respectively. Chromium was detected in 64 samples at levels up to 39.8 ppm and mercury was detected in 12 samples at levels up to 0.184 ppm. Surficial metals contamination existed primarily around one sump and along the surface water drainage pathway leading east of the site.	**Corrective Activities**: • All Line 4A wastewater enters treatment tanks, with sludge of settled metals shipped off-site. There are also treatment sumps for RDX-contaminated wastewater. In the past, treated wastewater was discharged to a NPDES permitted outfall (#41), but no wastewater is presently discharging. • In the spring of 1995, 14 in-ground sumps (treatment tanks) and associated contaminated soils were excavated and moved to the on-site soil repository. **Current Status:** • RI/FS complete. • The Army will continue monitoring and remediation activities.	No public health hazards are associated with this site. **Groundwater**: No active production wells lie in the vicinity of Line 4A. **Surface**: There is no public exposure to Line 4A surface water. **Soil and Sediment**: There is no public exposure to soil and sediment at this site. Remedial activities have reduced contaminant levels to those protective of human health. On-site workers will not contact site soils without adequate health and safety precautions as required by OSHA.

Appendix A: Evaluation of Potential Public Health Hazards Associated with 33 RI/FS Sites at Iowa Army Ammunition Plant.

Site	Site Description/ Waste Disposal History	Investigation Results/ Environmental Monitoring Results	Corrective Activities and/or Current Status	Evaluation of Public Health Hazards
Line 5A	Line 5A is a fenced, 33-acre parcel with 17 buildings. It operated from 1942 to 1945 and from 1949 to 1998, although it is currently inactive. Line 5A contained explosive assembly operations and component lines for pelletizing. Explosives are the primary contaminants of concern.	**Groundwater:** Contained elevated levels of metals. **Surface Water:** Contained elevated levels of explosives. **Soil and Sediment:** Explosives contamination was detected above ATSDR comparison values in surface soil immediately adjacent to sumps.	**Corrective Activities:** • All Line 5A wastewater was discharged to intermittent drainage ditches to a NPDES permitted outfall (#51). It is presently not discharging. • In the spring of 1995, sumps and associated contaminated soils were excavated and moved to the on-site soil repository. **Current Status:** • RI/FS complete. • The Army will continue monitoring and remediation activities.	No public health hazards are associated with this site. **Groundwater:** No active production wells lie in the vicinity of Line 5A. **Surface Water:** There is no public exposure to Line 5A surface water. **Soil and Sediment:** There is no public exposure to soil and sediment at this site. Remedial activities have reduced contaminant levels to those protective of human health. On-site workers will not contact site soils without adequate health and safety precautions as required by OSHA.
Line 6	Line 6 is a fenced, 30-acre parcel with 34 buildings. It was in use from 1941 until 1981 for the production, storage, and shipping of detonators, relays, and hand-grenade fusers. Contaminants of concern at Line 6 include explosives and metals.	**Groundwater:** Contained elevated levels of metals. **Surface Water:** Contained elevated levels of explosives and metals. **Soil and Sediment:** Explosives detected during the RI were below ATSDR comparison values. Metal concentrations were elevated in surficial soils of sumps, ditches, and drainage swales. Maximum detected concentrations for lead, silver, and mercury were 13,000, 500, and 1,900 ppm, respectively.	**Corrective Activities:** • In the past, Line 6 wastewater percolated into the ground, overflowed to a tributary of Brush Creek, or was placed in treatment tanks and neutralized in Building 6-68. Treated wastewater was pumped from the treatment tanks to gravel filterbeds. Generated wastewater treatment sludge was shipped off-site. • In the spring of 1995, Building 6-68 underwent RCRA closure. Also at this time, the gravel filterbeds, sumps, and associated contaminated soils were excavated and moved to the on-site soil repository. **Current Status:** • RI/FS complete. • The Army will continue monitoring and remediation activities.	No public health hazards are associated with this site. **Groundwater:** No active production wells lie in the vicinity of Line 6. **Surface Water:** There is no public exposure to Line 6 surface water. **Soil and Sediment:** There is no public exposure to soil and sediment at this site. Remedial activities have reduced contaminant levels to those protective of human health. On-site workers will not contact site soils without adequate health and safety precautions as required by OSHA.

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Site	Site Description/ Waste Disposal History	Investigation Results/ Environmental Monitoring Results	Corrective Activities and/or Current Status	Evaluation of Public Health Hazards
Line 7	Line 7 is a fenced, 9-acre parcel in the center of Iowa Army Ammunition Plant (IAAAP) property. From 1941 to 1970, Line 7 operated as a fuse and blank loading facility and a loading, assembly, and packing (LAP) facility. In the past, building washdown waste was discharged to gravel-lined sumps. Sumps were pumped and removed water taken to carbon filter units.	**Groundwater:** No contaminants were elevated in Line 7 groundwater. **Surface Water:** Contained elevated levels of explosives and metals. **Soil and Sediment:** Explosive and metal contamination in soils and sediment did not exceed ATSDR comparison values.	**Corrective Activities:** • In the spring of 1995, sumps and associated contaminated soils were excavated and moved to the on-site soil repository. **Current Status:** • RI/FS complete. • The Army will continue monitoring and remediation activities.	No public health hazards are associated with this site. **Groundwater:** No active production wells lie in the vicinity of Line 7. **Surface Water:** There is no public exposure to Line 7 surface water. **Soil and Sediment:** There is no public exposure to soil and sediment at this site. Contaminant concentrations are at levels that do not pose health hazards. On-site workers will not contact site soils without adequate health and safety precautions as required by OSHA.
Line 9	Line 9 is a fenced, 9-acre parcel with 15 buildings in the center of IAAAP property. It began operations in 1942 and continues to serve in "Lay-Away" status as a component production and LAP facility. Explosives, metals, and VOCs are the contaminants of concern.	**Groundwater:** Contained elevated levels of VOCs and SVOCs. **Surface Water:** Contained elevated levels of explosives and metals. **Soil and Sediment:** Surficial soil surrounding sumps and drainage pathways contained slightly elevated explosives and metals contamination (specifically antimony, lead, and copper). VOCs and 1,1,2-trichlorofluoroethane (Freon) were detected subsurface soils, primarily between 23- to 33-foot depths.	**Corrective Activities:** • Most Line 9 waste solvents are stored for 9 months, although a 90-day solvent accumulation area temporarily existed. • In the spring of 1995, sumps and associated contaminated soils were excavated and moved to the on-site soil repository. **Current Status:** • RI/FS complete. • The Army will continue monitoring and remediation activities.	No public health hazards are associated with this site. **Groundwater:** No active production wells lie in the vicinity of Line 9. **Surface Water:** There is no public exposure to Line 9 surface water. **Soil and Sediment:** There is no public exposure to soil and sediment at this site. Contaminants were primarily detected in the subsurface soils and are inaccessible. Remedial activities have reduced contaminant levels to those protective of human health. On-site workers will not contact site soils without adequate health and safety precautions as required by OSHA.

Appendix A: Evaluation of Potential Public Health Hazards Associated with 33 RI/FS Sites at Iowa Army Ammunition Plant.

Site	Site Description/ Waste Disposal History	Investigation Results/ Environmental Monitoring Results	Corrective Activities and/or Current Status	Evaluation of Public Health Hazards
Line 800 (Line 800 Pinkwater Lagoon)	Line 800 is a fenced, 17.5-acre parcel with 18 buildings in the center of IAAAP property. It began operations in 1941 for ammunition renovation and fuse demilitarization. Line 800 is currently inactive even though it is still considered operational. Wastes were generated by metal cleaning operations. Most Line 800 wastewater was disposed of in the Line 800 Pinkwater Lagoon, which measures 5 acres and is 4-feet deep. A limited amount of wastewater drained directly into adjacent ditches and Brush Creek. In 1979 and 1980, waste sludge from the Line 800 metal cleaning bath was disposed of at the former Blue Sludge Lagoon at the Inert Disposal Area. Explosives and metals are the primary contaminates of concern.	**Groundwater:** Contained elevated levels of explosives, metals, VOCs, and SVOCs. **Surface Water:** Contained elevated levels of explosives and metals. **Soil and Sediment**: Surficial soil contamination occurred mostly adjacent to sumps and drainage ways. Specifically, two areas contained explosives RDX (7.7 to 130 ppm), HMX (4.3 to 56 ppm), 2,4,6-TNT (2.3 to 36 ppm). All 60 samples collected during the RI contained barium and lead with maximum values of 651 and 1,650 ppm, respectively. Chromium was detected in 59 samples with a maximum value of 161 ppm, arsenic was detected in 56 samples with a maximum value of 18 ppm, mercury was detected in 20 samples with a maximum value of 7.8 ppm, and cadmium was detected in 10 samples with a maximum value of 757 ppm.	**Corrective Activities**: • All Line 800 wastewater is treated in a closed loop metals wastestream. Metals are collected from this wastestream and sold as scrap. The wastestream effluent runs into the Line 800 Pinkwater Lagoon. In the lagoon, a settling/carbon filter system further treats the generated process water. Treated water is discharged to a NPDES permitted outfall (#82). • In the spring of 1995, sumps and associated contaminated soils were excavated and moved to the on-site soil repository. • Waste sludge disposed of at the former Blue Sludge Lagoon at the Inert Disposal Area was deposited into Trench 6 at the Inert Disposal Area in January 1997. **Current Status:** • Line 800 is currently not discharging any wastewaters. • RI/FS complete. • The Army will continue monitoring and remediation activities.	No public health hazards are associated with this site. **Groundwater**: No active production wells lie in the vicinity of Line 800. **Surface Water:** There is no public exposure to Line 800 surface water. **Soil and Sediment**: There is no public exposure to soil and sediment at this site. Remedial activities have reduced contaminant levels to those protective of human health. On-site workers will not contact site soil and sediment without adequate health and safety precautions as required by OSHA.

Appendix A: Evaluation of Potential Public Health Hazards Associated with 33 RI/FS Sites at Iowa Army Ammunition Plant.

Site	Site Description/ Waste Disposal History	Investigation Results/ Environmental Monitoring Results	Corrective Activities and/or Current Status	Evaluation of Public Health Hazards
Pesticide Pit	The Pesticide Pit is an 8-square foot area located in the center of IAAAP, north of Line 800. It was a lined pit used from 1968 to 1974 for the disposal of small amounts of pesticides, herbicides, and rinsate. Pesticides and SVOCs are the contaminants of concern at this site.	**Groundwater:** Contained elevated levels of metals, SVOCs, and pesticides. **Surface Water:** There is no surface water at this site. **Soil:** Pesticides were detected in 13 of 18 samples during the RI. 4,4'-DDE concentrations were greatest and ranged from 0.013 to 21,000 ppm. Surficial contamination extended slightly southeast of the pit. 2-methylnaphthalene was the SVOC detected at the highest concentration (200 ppm).	**Corrective Activities:** • The Pesticide Pit and all its contents were excavated, containerized, and transported to an off-site Inert Landfill in 1995. **Current Status:** • RI/FS complete. • The Army will continue monitoring and remediation activities.	No public health hazards are associated with this site. **Groundwater:** No active production wells lie in the vicinity of the Pesticide Pit. **Surface Water:** No surface water exists at this site. **Soil:** Past public exposure to the Pesticide Pit is extremely minimal, if it occurred at all. Remedial activities have reduced contaminant levels to those protective of human health. On-site workers will not contact site soils without adequate health and safety precautions as required by OSHA.
Sewage Treatment Plant	The Sewage Treatment Plant occupies approximately 1 acre. It is the main treatment plant for IAAAP. Metals are the primary contaminant of concern at this site.	**Groundwater:** No contaminants were elevated in groundwater underlying the Sewage Treatment Plant. **Surface Water:** Contained elevated levels of metals. **Sludge:** Metals were reported in sludge at the expected levels.	**Corrective Activities:** • All Sewage Treatment Plant wastewater is treated. It runs through an Imhoff tank, a trickling filter, a secondary clarifier, and sludge drying beds before being discharged to a NPDES permitted outfall (#13). **Current Status:** • RI/FS complete. • The Army will continue monitoring and remediation activities.	No public health hazards are associated with this site. **Groundwater:** No active production wells lie in the vicinity of the Sewage Treatment Plant. **Surface Water:** There is no public exposure to Sewage Treatment Plant surface water. **Sludge:** The public is not exposed to Sewage Treatment Plant sludge.

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Site	Site Description/ Waste Disposal History	Investigation Results/ Environmental Monitoring Results	Corrective Activities and/or Current Status	Evaluation of Public Health Hazards
Facilities in Long Creek Watershed				
Line 3A	Line 3A lies on the western side of IAAAP property. It is a fenced 119-acre parcel with 17 buildings. From 1943 to 1945 and from 1949 to 1989, Line 3A functioned as an explosives-related processing and LAP area. In the early 1980s, it was re-opened for the production of anti-tank mines. Treated wastewater from the site is discharged to an intermittent creek that flows for one mile and then joins Long Creek. The contaminants of concern are primarily explosives, metals, and polychlorinated biphenyl (PCBs).	**Groundwater:** Contained elevated levels of explosives, metals, VOCs, and SVOCs. **Surface Water:** Contained elevated levels of explosives and metals. VOCs were detected in trace amounts. **Soil and Sediment:** 2,4,6-TNT and RDX were detected in soils near Line 3A at levels up to 19,000 and 11,000 ppm, respectively. HMX was detected at levels up to 1,700 ppm. 1,3,5-TNB, 2,4-DNT, 1,3-DNB, 2,6-DNT, and nitrobenzene were detected at low concentrations. Most explosive contamination was detected around one building, sumps, and loading areas. Metals were also present, with barium and lead detected at the highest concentrations (341 and 1,710 ppm, respectively). PCBs were detected in one sample collected at the NPDES discharge point at levels less than 10 ppm.	**Corrective Activities:** • All Line 3A wastewater is processed through a carbon filter and discharged to creeks through NPDES permitted outfalls (#34, #35). • In the spring of 1995, sumps and associated contaminated soils were excavated and moved to the on-site soil repository. **Current Status:** • RI/FS complete. • The Army will continue monitoring and remediation activities.	No public health hazards are associated with this site. **Groundwater:** No active production wells lie in the vicinity of Line 3A. **Surface Water:** There is no public exposure to Line 3A surface water. **Soil and Sediment:** There is no public exposure to soil and sediment at this site. Remedial activities have reduced contaminant levels to those protective of human health. On-site workers will not contact site soils without adequate health and safety precautions as required by OSHA.
Line 4B	Line 4B is a fenced, 16-acre parcel in the northern part of IAAAP. It operated from 1941 to 1945 and from 1962 to date, but it is currently inactive. Components, missiles, and fuses were assembled at this site.	**Groundwater:** Contained elevated levels of SVOCs. **Surface Water:** Surface water contained the SVOC bis(2)ethylhexylphthalate slightly above detection limits, but below ATSDR comparison values. **Soil and Sediment:** No contaminants were detected above ATSDR comparison values or background levels.	**Corrective Activities:** • All Line 4B wastewater was stored in either in-ground or above-ground tanks, and transported to carbon filter facilities for on-site treatment. **Current Status:** • RI/FS complete. • The Army will continue monitoring and remediation activities.	No public health hazards are associated with this site. **Groundwater:** No active production wells lie in the vicinity of Line 4B. **Surface Water:** There is no public exposure to Line 4B surface water. **Soil and Sediment:** There is no public exposure to soil and sediment at this site. Contaminant concentrations are at levels that do not pose health hazards.

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Site	Site Description/ Waste Disposal History	Investigation Results/ Environmental Monitoring Results	Corrective Activities and/or Current Status	Evaluation of Public Health Hazards
Line 5B	Line 5B is a fenced, 41-acre parcel with 18 buildings. It operated from 1942 to 1945 and from 1949 to the present, but it is currently inactive. It primarily supported pelletizing and assembling of adaptor boosting tetryl. Explosives and metals are the contaminants of concern.	**Groundwater:** Contained elevated levels of metals. **Surface Water:** Contained elevated levels of explosives and metals. **Soil and Sediment:** Most explosive contamination was low-level and occurred in areas adjacent to sumps. However, two of eight sampling locations around one building contained RDX above 1,000 ppm. Two samples also reported tetryl and HMX at levels between 100 and 500 ppm. Lead was detected near sumps at levels between 100 and 500 ppm.	**Corrective Activities:** • All Line 5B wastewater is processed through carbon filter columns and discharged to a NPDES permitted outfall (#052). • In the spring of 1995, sumps and associated contaminated soils were excavated and moved to the on-site soil repository. **Current Status:** • RI/FS complete. • The Army will continue monitoring and remediation activities.	No public health hazards are associated with this site. **Groundwater:** No active production wells lie in the vicinity of Line 5B. **Surface Water:** There is no public exposure to Line 5B surface water. **Soil and Sediment:** There is no public exposure to soil and sediment at this site. Remedial activities have reduced contaminant levels to those protective of human health. On-site workers will not contact site soils without adequate health and safety precautions as required by OSHA.
Line 8	Line 8 is a 69-acre parcel in the center of IAAAP property. It was constructed and used during World War II for Amatol (ammonium nitrate) production, fertilizer production, and fuse and rocket igniter LAP operations. Line 8 production activities closed in 1950. Ammunition inspection activities took place from 1976 to 1993. Metals are the contaminants of concern.	**Groundwater:** Groundwater at Line 8 was not sampled. **Surface Water:** Contained elevated levels of metals. **Soil and Sediment:** No explosives were detected in soil and sediment samples. Low metal concentrations in soils were detected, all below ATSDR comparison values. No metals were detected in associated drainage pathways, indicating that metals are not migrating from Line 8.	**Current Status:** • RI/FS complete. • The Army will continue monitoring and remediation activities.	No public health hazards are associated with this site. **Groundwater:** No active production wells lie in the vicinity of Line 8. **Surface Water:** There is no public exposure to Line 8 surface water. **Soil and Sediment:** There is no public exposure to soil and sediment at this site. Contaminant concentrations are at levels that do not pose health hazards.

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Site	Site Description/ Waste Disposal History	Investigation Results/ Environmental Monitoring Results	Corrective Activities and/or Current Status	Evaluation of Public Health Hazards
Line 800	A small portion of Line 800 drains southwest in an intermittent stream to Long Creek. Explosives and metals are the contaminants of concern (see "Facilities in Brush Creek Watershed" section of this table for more details).	**Groundwater:** Contained elevated levels of explosives, metals, and VOCs. **Surface Water:** Contained elevated levels of explosives and metals. VOCs were detected in trace amounts. **Soil and Sediment**: See "Facilities in Brush Creek Watershed" section of this table for more details.	**Corrective Activities**: • See "Facilities in Brush Creek Watershed" section of this table for more details. **Current Status:** • See "Facilities in Brush Creek Watershed" section of this table for more details.	No public health hazards are associated with this site. **Groundwater**: No active production wells lie in the vicinity of Line 800. **Surface Water:** There is no public exposure to Line 800 surface water. **Soil and Sediment**: There is no public exposure to soil and sediment at this site. Remedial activities have reduced contaminant levels to those protective of human health.
Building 600-86	Building 600-86 served as IAAAP's Central Chemical Laboratory from 1941 to 1953. Presently, it serves as a permitted RCRA hazardous waste storage facility.	**Groundwater:** Contained elevated levels of metals. **Surface Water:** Contained elevated levels of metals. **Soil and Sediment**: No contaminants were detected above ATSDR comparison values or background levels.	**Current Status:** • RI/FS complete.	No public health hazards are associated with this site. **Groundwater**: No active production wells lie in the vicinity of the Building 600-86. **Surface Water:** There is no public exposure to Building 600-86 surface water. **Soil and Sediment**: There is no public exposure to soil and sediment at this site. Contaminant concentrations are at levels that do not pose health hazards.

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Site	Site Description/ Waste Disposal History	Investigation Results/ Environmental Monitoring Results	Corrective Activities and/or Current Status	Evaluation of Public Health Hazards
Construction Debris Landfill	The Construction Debris Landfill is a 3-acre area where debris is stored on surface soil. The Construction Debris Landfill began operations in 1940 and debris is present today. Explosives, metals, pesticides, and PCBs were the contaminants of concern prior to RI investigations, but contamination levels proved than expected.	**Groundwater:** Contained elevated levels of metals. **Surface Water:** Contained elevated levels of metals. **Soil and Sediment:** No contaminants were detected above ATSDR comparison values or background levels.	**Current Status:** • RI/FS complete.	No public health hazards are associated with this site. **Groundwater:** No active production wells lie in the vicinity of the Construction Debris Landfill. **Surface Water:** There is no public exposure to the Construction Debris Landfill surface water. **Soil and Sediment:** Past public exposure to the Construction Debris Landfill is extremely minimal, if it occurred at all. Contaminant concentrations are at levels that do not pose health hazards.
Firing Site	The Firing Site is a fenced, 459-acre parcel in the west-central portion of IAAAP. Three acres with firing pads are used for static testing of warheads. Other areas are used for the destructive testing of 701 shots of D-38s and high explosives. Radionuclides were the primary contaminants of concern at the Firing Site.	**Groundwater:** Contained elevated levels of metals and radionuclides. **Surface Water:** Contained elevated levels of metals and radionuclides. Radionuclides detected were (maximum detected concentration): potassium 40 (250pCi/L), alpha gross (24.8 pCi/L), and beta gross (16.2 pCi/L). **Soil and Sediment:** Radionuclides were above detection limits, with the highest level at the North Test Site.	**Corrective Activities:** • Prior to AEC phase out in 1975, radioactive soils were removed and transported off-site to Sheffield, Illinois for landfilling. • Radioactive soils were removed and stored in the on-site CAMU, adjacent to the Inert Landfill. **Current Status:** • RI/FS complete. • The Army will continue monitoring and remediation activities.	No public health hazards are associated with this site. **Groundwater:** No active production wells lie in the vicinity of the Firing Site. **Surface Water:** There is no public exposure to Firing Site surface water. **Soil and Sediment:** There is no public exposure to soil and sediment at this site. Remedial activities have reduced contaminant levels to those protective of human health. On-site workers will not contact site soils without adequate health and safety precautions as required by OSHA.

Appendix A: Evaluation of Potential Public Health Hazards Associated with 33 RI/FS Sites at Iowa Army Ammunition Plant.

Site	Site Description/ Waste Disposal History	Investigation Results/ Environmental Monitoring Results	Corrective Activities and/or Current Status	Evaluation of Public Health Hazards
Fly Ash Landfill	The Fly Ash Landfill is a 9.5 acre area that accepts fly ash from a coal-fired heating plant. It has been in operation since 1985. No hazardous waste has been disposed at this site. Contaminants of concern include metals and sulfates.	**Groundwater:** Contained elevated levels of metals, explosives, and sulfates. **Surface Water:** Contained elevated levels of metals. **Soil and Sediment**: No contaminants were detected above ATSDR comparison values or background levels.	**Current Status:** • RI/FS complete.	No public health hazards are associated with this site. **Groundwater**: No active production wells lie in the vicinity of the Fly Ash Landfill. **Surface Water:** There is no public exposure to the Fly Ash Landfill surface water. **Soil and Sediment**: There is no public exposure to soil and sediment at this site. Contaminant concentrations are at levels that do not pose health hazards.
Fly Ash Disposal Area	The Fly Ash Disposal Area is a 5-acre parcel that contains fly ash, residual coal, and other residue from IAAAP's coal-fired plant. Metals and sulfates are the contaminants of concern.	**Groundwater:** Contained elevated levels of metals. **Surface Water:** Contained elevated levels of metals and sulfates. **Soil and Sediment**: No contaminants were detected above ATSDR comparison values or background levels.	**Current Status:** • RI/FS complete.	No public health hazards are associated with this site. **Groundwater**: No active production wells lie in the vicinity of the Fly Ash Disposal Area. **Surface Water:** There is no public exposure to Fly Ash Disposal Area surface water. **Soil and Sediment**: There is no public exposure to soil and sediment at this site. Contaminant concentrations are at levels that do not pose health hazards.

Appendix A: Evaluation of Potential Public Health Hazards Associated with 33 RI/FS Sites at Iowa Army Ammunition Plant.

Site	Site Description/ Waste Disposal History	Investigation Results/ Environmental Monitoring Results	Corrective Activities and/or Current Status	Evaluation of Public Health Hazards
Inert Disposal Area (Inert Landfill)	The Inert Landfill covers approximately 14 acres in the west-central portion of IAAAP. From 1941 to 1984, the Inert Landfill functioned as a sanitary landfill, burning field, metal salvage operation, sludge drying bed, and clay-lined holding area. It received such materials as residential and cafeteria refuse and garbage, plastic, tin cans, scrap lumber, empty drums (crushed), unsalvageable paper and cardboard, and asbestos insulation (in double plastic bags). For several years in the early 1980s, a small portion of the Inert Landfill (Trench 5) received other wastes, such as ash from the open burning of explosives and explosive-contaminated waste, the contaminated waste processor, and the explosive waste incinerator. Surface run-off from the area reaches Long Creek only during heavy rain or melting ice and snow. Contaminants of concern include metals, VOCs, and SVOCs.	**Groundwater:** Contained elevated levels of metals and VOCs. **Surface Water:** Contained elevated levels of metals. VOCs were detected in trace amounts. **Soil and Sediment**: Elevated metals were detected, including (maximum concentration detected): barium (1,240 ppm), chromium (502 ppm), lead (51,000 ppm), arsenic (117 ppm), mercury (1.1 ppm), cadmium (31.2), silver (14 ppm), and selenium (100 ppm). Asbestos was not detected.	**Corrective Activities**: • The Inert Landfill was closed in 1984. • In 1989, Trench 5 was capped and closed in accordance with the Resource Conservation Recovery Act (RCRA) Subtitle C guidelines. • Contaminated soils were removed and stored in the on-site CAMU and soil repository. • In the fall of 1997, the Army completed construction of a low permeability cover, consisting of a geonet drainage layer and a low permeability geomembrane with appropriate vegetative cover. The cover prevents infiltration of precipitation into the landfill material and the subsequent transport of contaminants from wastes to groundwater. **Current Status:** • In RI/FS process. The Army is currently evaluating treatment methods to cap the Inert Landfill and to treat soils in the CAMU and soil repository. All trenches within the Inert Landfill (including the CAMU and soil repository) will be capped in accordance with RCRA Subtitle C guidelines. • The Army will continue monitoring and remediation activities.	No public health hazards are associated with this site. **Groundwater**: No active production wells lie in the vicinity of the Inert Landfill. **Surface Water:** There is no public exposure to Inert Landfill surface water. **Soil and Sediment**: Past public exposure to the Inert Landfill is extremely minimal, if it occurred at all. Remedial activities have reduced contaminant levels to those protective of human health. On-site workers will not contact site soils without adequate health and safety precautions as required by OSHA.

Appendix A: Evaluation of Potential Public Health Hazards Associated with 33 RI/FS Sites at Iowa Army Ammunition Plant.

Site	Site Description/ Waste Disposal History	Investigation Results/ Environmental Monitoring Results	Corrective Activities and/or Current Status	Evaluation of Public Health Hazards
Facilities in Spring Creek Watershed				
Ammunition Box Chipper Disposal Pit (ABC Disposal Pit)	ABC Disposal Pit is a small site measuring 120 by 40 by 8 feet. It was used for approximately 3 months from 1972 to 1975. Shredded wooden ammunition boxes, primarily 90-millimeter cartridge boxes, were reportedly buried at this site. Explosives are the primary contaminants of concern.	**Groundwater:** Contained elevated levels of metals. **Surface Water:** Contained elevated levels of explosives. **Soil and Sediment**: ABC Disposal Pit soil and sediment contamination levels were below ATSDR comparison values.	**Current Status:** • RI/FS complete.	No public health hazards are associated with this site. **Groundwater**: No active production wells lie in the vicinity of the ABC Disposal Pit. **Surface Water:** There is no public exposure to ABC Disposal Pit surface water. **Soil and Sediment**: There is no public exposure to soil and sediment at this site. Contaminant concentrations are at levels that do not pose health hazards.
Contaminated Waste Processor (CWP)	Housed in building BG-199-2 in the Explosive Disposal Area, the CWP has been in operation since 1982. The CWP flashes or burns materials that have come in contact with explosives or other energetic substances, including equipment, pipe, steel, empty cartridge cases and projectiles, and lumber. Ash from the CWP is drummed and placed in a RCRA accumulation area pending toxicity testing results. CWP-generated wash water is collected in floor trenches and pumped into a 1,200-gallon sump on the south side of the building and transported to Line 2 for treatment. Explosives are the contaminants of concern.	**Groundwater:** No contaminants were elevated in groundwater underlying the CWP. **Surface Water:** Contained elevated levels of explosives. **Soil and Sediment**: CWP soil and sediment contamination levels were below ATSDR comparison values.	**Corrective Activities**: • All CWP wastewater is treated in Line 2 filter houses and discharged to a NPDES permitted outfall (#21). **Current Status:** • RI/FS complete.	No public health hazards are associated with this site. **Groundwater**: No active production wells lie in the vicinity of the CWP. **Surface Water:** There is no public exposure to CWP surface water. **Soil and Sediment**: There is no public exposure to soil and sediment at this site. Contaminant concentrations are at levels that do not pose health hazards.

Appendix A: Evaluation of Potential Public Health Hazards Associated with 33 RI/FS Sites at Iowa Army Ammunition Plant.

Site	Site Description/ Waste Disposal History	Investigation Results/ Environmental Monitoring Results	Corrective Activities and/or Current Status	Evaluation of Public Health Hazards
Explosive Waste Incinerator (EWI)	The EWI is housed within building BG-199-1 in the Explosive Disposal Area. The EWI operated from 1981 to 1990, as a permitted RCRA facility. The EWI incinerated sump scrap and waste explosives that could not be reused or resold off site. Wastewater was pumped into a sump and transported to Line 2 for treatment. The EWI was permanently closed in 1998.	**Groundwater:** No groundwater samples were collected from the EWI. **Surface Water:** Contained elevated levels of explosives. **Soil and Sediment**: EWI soil and sediment contamination levels were below ATSDR comparison values.	**Corrective Activities:** • In the past, incinerated EWI residue and ash were drummed, labeled, and transferred to the RCRA accumulation area of the CWP and managed as hazardous waste. • All EWI wastewater was treated in Line 2 filter houses and discharged to a NPDES permitted outfall (#21). • The EWI went through the RCRA closure process in September 1998. **Current Status:** • RI/FS complete.	No public health hazards are associated with this site. **Groundwater**: No active production wells lie in the vicinity of the EWI. **Surface Water:** There is no public exposure to EWI surface water. **Soil and Sediment**: There is no public exposure to soil and sediment at this site. Contaminant concentrations are at levels that do not pose health hazards.
Explosive Disposal Area	The Explosive Disposal Area is a fenced, 12-acre parcel in the north-east corner of IAAAP. Until 1982, debris was openly burned at this site. Debris contained explosives-contaminated metals, propellants, explosives, and pyrotechnic-contaminated materials. Surface runoff from the site's western portion goes directly to Spring Creek. The site's eastern portion runoff feeds a Spring Creek tributary. The primary contaminants of concern are explosives, metals, and SVOCs.	**Groundwater:** Contained elevated levels of metals, explosives, VOCs, and SVOCs. **Surface Water:** Contained elevated levels of explosives. **Soil and Sediment**: Explosive contamination occurs in surface soil, primarily at the site's pad centers, areas near culverts, and areas where pools of surface water develop in the drainage ditches. Metals were detected mostly at low levels, with the highest lead levels between 100 ppm and 500 ppm. Surficial soil in the drainage ditches near the 8 burn pads contained elevated levels of SVOCs.	**Corrective Activities:** • Contaminated soils were removed and stored in the on-site CAMU and soil repository. **Current Status:** • RI/FS complete. • The Army will continue monitoring and remediation activities.	No public health hazards are associated with this site. **Groundwater**: No active production wells lie in the vicinity of the Explosive Disposal Area. **Surface Water:** There is no public exposure to Explosive Disposal Area surface water. **Soil and Sediment**: There is no public exposure to soil and sediment at this site. Remedial activities have reduced contaminant levels to those protective of human health. On-site workers will not contact site soils without adequate health and safety precautions as required by OSHA.

Appendix A: Evaluation of Potential Public Health Hazards Associated with 33 RI/FS Sites at Iowa Army Ammunition Plant.

Site	Site Description/ Waste Disposal History	Investigation Results/ Environmental Monitoring Results	Corrective Activities and/or Current Status	Evaluation of Public Health Hazards
Fire Training Pit	The Fire Training Pit is a 40-by-60-by-2-foot area that was used by firefighters from 1982 to 1987. Fifty-five gallons drums of solvents or fuels were placed in the Fire Training Pit and set ablaze. Contaminants of concern include metals, VOCs, and SVOCs.	**Groundwater:** Contained elevated levels of metals, VOCs, and SVOCs. **Surface Water:** Contained elevated levels of explosives. **Soil and Sediment**: Metals contamination was highest (greater than 1,000 ppm) in the center of the pit. VOCs (up to 200 ppm) and SVOCs (up to 12 ppm) were detected in subsurface soils. Surface soils contained SVOCs with a maximum detected concentration of 60 ppm.	**Corrective Activities**: • Contaminated soils were removed and stored in the on-site CAMU and soil repository. **Current Status:** • RI/FS complete. • The Army will continue monitoring and remediation activities.	No public health hazards are associated with this site. **Groundwater**: No active production wells lie in the vicinity of the Fire Training Pit. **Surface Water:** There is no public exposure to Fire Training Pit surface water. **Soil and Sediment**: There is no public exposure to soil and sediment at this site. Remedial activities have reduced contaminant levels to those protective of human health. On-site workers will not contact site soils without adequate health and safety precautions as required by OSHA.
North Burn Pads	The North Burn Pads site contains two pads, each measuring 20 by 50 feet. It is in a fenced area. From 1968 to 1972, lead azide and gun powder were burned at this site. Surface run-off flows southeast toward an unnamed tributary of Spring Creek. Metals are the primary contaminant of concern.	**Groundwater:** Contained elevated levels of metals and explosives. **Surface Water:** Contained elevated levels of explosives. **Soil and Sediment**: Extensive metals contaminated surficial soils. Metals decreased with soil depth, but even at 3 feet, there were elevated levels of antimony (122 ppm), barium (645 ppm), cadmium (1.49 ppm), chromium (74.2 ppm), copper (11,500 ppm), lead (5,930 ppm), nickel (278 ppm), silver (1.66 ppm), sodium (356 ppm), and zinc (8,040 ppm).	**Corrective Activities**: • Contaminated soils were removed and stored in the on-site CAMU and soil repository. **Current Status:** • RI/FS complete. • The Army will continue monitoring and remediation activities.	No public health hazards are associated with this site. **Groundwater**: No active production wells lie in the vicinity of the North Burn Pads. **Surface Water:** There is no public exposure to North Burn Pads surface water. **Soil and Sediment**: There is no public exposure to soil and sediment at this site. Remedial activities have reduced contaminant levels to those protective of human health. On-site workers will not contact site soils without adequate health and safety precautions as required by OSHA.

Appendix A: Evaluation of Potential Public Health Hazards Associated with 33 RI/FS Sites at Iowa Army Ammunition Plant.

Site	Site Description/ Waste Disposal History	Investigation Results/ Environmental Monitoring Results	Corrective Activities and/or Current Status	Evaluation of Public Health Hazards
North Burn Pads Landfill	The North Burn Pads Landfill is a 3/4-acre landfill used prior to 1980. It is located within a fenced area. This site stored residue from the North Burn Pads, primarily flashed or burned cans and containers. Explosives and metals are the primary contaminants of concern.	**Groundwater:** Contained elevated levels of metals, explosives, and VOCs. **Surface Water:** Contained elevated levels of explosives. **Soil and Sediment**: North Burn Pads Landfill soil and sediment contamination levels were below ATSDR comparison values.	**Corrective Activities**: • Some contents of the North Burn Pads Landfill were removed in 1980 and taken to the Inert Landfill. • In 1998, more soils and debris were removed and placed in the Inert Landfill, primarily to minimize any further groundwater contamination. **Current Status:** • RI/FS complete.	No public health hazards are associated with this site. **Groundwater**: No active production wells lie in the vicinity of the North Burn Pads Landfill. **Surface Water:** There is no public exposure to North Burn Pads Landfill surface water. **Soil and Sediment**: There is no public exposure to soil and sediment at this site. Contaminant concentrations are at levels that do not pose health hazards.
PCB Roundhouse Transformer Storage Area (PCB-RTSA)	The PCB-RTSA is a large, flat-graded, fenced area in the northeastern portion of IAAAP. It stores unused transformers. In 1980, all transformers with >500 ppm PCBs were moved inside an on-site warehouse, in 1987, all transformers with >50 ppm PCBs were moved outside. The outside transformers lie in the yard on ground surface. PCBs are the primary contaminants of concern.	**Groundwater:** No groundwater samples were collected underlying the PCB-RTSA. **Surface Water:** Contained elevated levels of explosives. **Soil and Sediment**: Low-levels (generally less than 2 ppm) PCBs were detected in surface soils over much of the yard and in some samples to the west and south of the yard.	**Current Status:** • RI/FS complete.	No public health hazards are associated with this site. **Groundwater**: No active production wells lie in the vicinity of the PCB-RTSA. **Surface Water:** There is no public exposure to PCB-RTSA surface water. **Soil and Sediment**: There is no public exposure to soil and sediment at this site. Contaminant concentrations are at levels that do not pose health hazards.

Appendix A: Evaluation of Potential Public Health Hazards Associated with 33 RI/FS Sites at Iowa Army Ammunition Plant.

Site	Site Description/ Waste Disposal History	Investigation Results/ Environmental Monitoring Results	Corrective Activities and/or Current Status	Evaluation of Public Health Hazards
West Burn Pads (Contains the West Burn Pads Landfill and the Burn Cage Ash Disposal Landfill)	The West Burn Pads site is in a fenced area. It contains two burn pads (50 by 15 feet), two landfills (200 by 300 feet), and three cages (30 by 60 feet). The pad cages and the Burn Cage Ash Disposal Landfill operated from 1949 to 1975. The West Burn Pads Landfill received wastes from 1950 to 1875. This site is adjacent to Spring Creek in a fenced-off area in the northeast corner of IAAAP. At the pads, explosives-contaminated metal parts were flashed and disposed or sold as scrap. Salvageable metal parts were stored at this site. The cages were used to incinerate inert and explosive-contaminated packaging. The West Burn Pads Landfill received residue from pads and various types of solid waste. The Burn Cage Ash Disposal Landfill received residual ash from burn cages. Discarded materials were put on the ground and covered with earth at both landfills. Contaminants of concern include explosives, metals, VOCs, and SVOCs.	**Groundwater:** Contained elevated levels of metals, explosives, and VOCs. **Surface Water:** Contained elevated levels of explosives. **Soil and Sediment**: The RI indicated the widespread presence of explosives in surficial soils and drainage ways. The highest detections were HMX at 27,000 ppm and RDX at 140 ppm in surface samples. Metal contamination (arsenic, barium, chromium, mercury, silver, and cadmium) was fairly widespread throughout the area. Low levels of VOCs and SVOCs were detected.	**Corrective Activities:** • Burn cages were removed when the site became inactive. • Some debris and contaminated soils were removed and stored in the on-site CAMU and soil repository. **Current Status:** • RI/FS complete. • The Army will continue monitoring and remediation activities.	No public health hazards are associated with this site. **Groundwater**: No active production wells lie in the vicinity of the West Burn Pads. **Surface Water:** There is no public exposure to West Burn Pads surface water. **Soil and Sediment**: There is no public exposure to soil and sediment at this site. Remedial activities have reduced contaminant levels to those protective of human health. On-site workers will not contact site soils without adequate health and safety precautions as required by OSHA.

Appendix A: Evaluation of Potential Public Health Hazards Associated with 33 RI/FS Sites at Iowa Army Ammunition Plant.

Site	Site Description/ Waste Disposal History	Investigation Results/ Environmental Monitoring Results	Corrective Activities and/or Current Status	Evaluation of Public Health Hazards
Facilities in Skunk River Watershed				
Line 3A	Some explosives-contaminated wastewater from Line 3A drains into a tributary of the Skunk River (see "Facilities in Long Creek Watershed" section of this table for more details).	**Groundwater:** Contained elevated levels of explosives, metals, and VOCs. **Surface Water:** Contained elevated levels of explosives and metals. **Soil and Sediment**: See "Facilities in Long Creek Watershed" section of this table for more details.	**Corrective Activities**: • Line 3A wastewater is processed through a closed-loop carbon filter and discharged, as necessary, via NPDES #34 to a tributary of the Skunk River. **Current Status:** • See "Facilities in Long Creek Watershed" section of this table for more details.	No public health hazards are associated with this site. **Groundwater**: No active production wells lie in the vicinity of Line 3A. **Surface Water:** There is no public exposure to Line 3A surface water. **Soil and Sediment**: There is no public exposure to soil and sediment at this site. Remedial activities have reduced contaminant levels to those protective of human health. On-site workers will not contact site soils without adequate health and safety precautions as required by OSHA.
Line 3A Pond	The Line 3A Pond is a 60-by-30-by-8-foot pond in a fenced area of western IAAAP. Between 1956 and 1958 or 1959, approximately 15,000 gallons of spent sulfuric and hydrochloric acid were disposed in the pond and neutralized with sodium hydroxide. The waste was the result of a metal-cleaning operation. Metals are the primary contaminants of concern.	**Groundwater:** No groundwater samples were collected underlying the Line 3A Pond. **Surface Water:** Contained elevated levels of metals. **Soil and Sediment**: Line 3A Sewage Treatment Plant soil and sediment contamination levels were below ATSDR comparison values.	**Corrective Activities**: • Line 3A Pond was excavated and its soils and sediment were disposed in the Inert Landfill. **Current Status:** • RI/FS complete.	No public health hazards are associated with this site. **Groundwater**: No active production wells lie in the vicinity of the Line 3A Pond. **Surface Water:** There is no public exposure to Line 3A Pond surface water. **Soil and Sediment**: There is no public exposure to soil and sediment at this site. Contaminant concentrations are at levels that do not pose health hazards.

Appendix A: Evaluation of Potential Public Health Hazards Associated with 33 RI/FS Sites at Iowa Army Ammunition Plant.

Site	Site Description/ Waste Disposal History	Investigation Results/ Environmental Monitoring Results	Corrective Activities and/or Current Status	Evaluation of Public Health Hazards
Line 3A Sewage Treatment Plant	The Line 3A Sewage Treatment Plant occupies half an acre in a fenced area of western IAAAP. It has operated from 1943 to 1945, from 1949 to the late 1980s, and at present. It treats domestic waste and blowdown water from the IAAAP steam-generating plant at Line 3A. The primary contaminants of concern are explosives and metals.	**Groundwater:** No groundwater samples were collected underlying the Line 3A Sewage Treatment Plant. **Surface Water:** Contained elevated levels of explosives and metals. **Soil and Sediment**: Line 3A Sewage Treatment Plant soil and sediment contamination levels were below ATSDR comparison values.	**Corrective Activities:** • Effluent from the Line 3A Sewage Treatment Plant flows into an intermittent stream west of the site via a NPDES outfall (#014) which eventually drains into the Skunk River. **Current Status:** • RI/FS complete.	No public health hazards are associated with this site. **Groundwater**: No active production wells lie in the vicinity of the Line 3A Sewage Treatment Plant. **Surface Water:** There is no public exposure to Line 3A Sewage Treatment Plant surface water. **Soil and Sediment**: There is no public exposure to soil and sediment at this site. Remedial activities have reduced contaminant levels to those protective of human health.
Demolition Area/Deactivation Furnace (DA/DF)	DA/DF is a fenced, 10-acre parcel in the southwest corner of IAAAP. The DA was used from the early 1940s to present, the DF operated from 1971 to 1980 and from 1983 to present. The DA was used for the open detonation of reject ammunition, and the DF was used for the destruction of small explosive-loaded components. Explosives and metals are the primary contaminants of concern.	**Groundwater:** Contained elevated levels of metals and explosives. **Surface Water:** Contained elevated levels of explosives. **Soil and Sediment**: Low levels of explosives were found in 1 of 10 samples during the RI. Of 21 soil samples, all had detectable levels of arsenic, barium, chromium, and lead with maximum values of 13, 5,100, 613, and 6,400 ppm, respectively. Lower levels of mercury, cadmium, and selenium were reported in some samples.	**Corrective Activities:** • After detonation, metal and collectable residue were collected and flashed by fire in the on-site CWP to allow for sale of salvageable material. • Unsalvageable metal and ash were treated in the DF and containerized in steel dumpsters and stored as hazardous waste. The DF underwent RCRA closure and is not in a temporary inactive status. **Current Status:** • RI/FS complete. • The Army will continue monitoring and remediation activities.	No public health hazards are associated with this site. **Groundwater**: No active production wells lie in the vicinity of the DA/DF. **Surface Water:** There is no public exposure to DA/DF surface water. **Soil and Sediment**: There is no public exposure to soil and sediment at this site. Remedial activities have reduced contaminant levels to those protective of human health. On-site workers will not contact site soils without adequate health and safety precautions as required by OSHA.

Sources: CDM, 1997; ACE, 1998c; IAAAP, 1999.

APPENDIX B

Estimates of Human Exposure Dose and Determination of Health Effects from Past Consumption of RDX-Contaminated Groundwater

APPENDIX B: Estimates of Human Exposure Dose and Determination of Health Effects from Past Consumption of RDX-Contaminated Groundwater

Derivation of ATSDR's Estimated Exposure Doses[8]

To determine whether adverse health effects are a concern for this pathway, ATSDR estimated adult and child exposure doses for past ingestion of RDX-contaminated groundwater in the vicinity of IAAAP. In deriving human exposure doses, ATSDR incorporated information about the frequency and duration of potential contaminant exposure. ATSDR assumed that a typical adult drank 2 liters of water each day and weighed 70 kg and that a child drank 1 liter of water each day and weighed 10 kg. ATSDR used an exposure period of 7 years for adults and children to consider for the years between sampling periods when RDX was not detected (1985) and when RDX was detected (1992) in off-site private wells. ATSDR also assumed that the drinking water pumped to residential taps contained the maximum RDX concentration (27.5 ppb) detected in an active well. Furthermore, ATSDR assumed that 100% of the water used for drinking came from the groundwater contaminated by IAAAP activities.

ATSDR used the following equation to estimate potential exposure doses for past ingestion of groundwater from private wells that may have been affected by RDX:

$$\textit{Estimated exposure dose} = \frac{\text{Conc.} \times \text{IR} \times \text{EF} \times \text{ED}}{\text{BW} \times \text{AT}}$$

where:

Conc.	=	Maximum detected contaminant concentration in an active production well: 0.0275 parts per million (ppm)
IR	=	Ingestion rate (liters/day): 2 liters/day for adults; 1 liter/day for children
EF	=	Exposure frequency or number of exposure events per year of exposure: 1 event/day x 7 days/week x 52 weeks/year or approximately 365 events/year
ED	=	Exposure duration or the duration over which exposure occurs: 7 years (coincides with the approximate time span that RDX was not detected in private wells to when RDX was first detected in private wells [1985 to 1992])
BW	=	Body weight (kg): 70 kg for adult; 10 kg for children
AT	=	Averaging time or the time period over which cumulative exposures are averaged (7 years x 365 days/year for noncancer effects; 70 years x 365 days per year for cancer).

[8] For the one household that has repeatedly ignored Army recommendations and knowingly continues to drink from a contaminated private well, ATSDR used an exposure period of 15 years instead of 7 years. This extended exposure period does not appear to result in any health threats for adults because the estimated adult exposure dose (0.001 mg/kg/day) remains below EPA's oral reference dose (RfD) of 0.003 mg/kg/day. Therefore, ATSDR concludes that there are no apparent noncancer effects associated with adults ingesting the households' private well water in the past. The prolonged 15-year exposure, however, increased the estimated child exposure dose (0.006 mg/kg/day) above EPA's oral reference dose (RfD) of 0.003 mg/kg/day. Therefore, ATSDR concludes that there may be noncancer health effects for children. ATSDR does not know if any children have lived in the household for this entire 15-year duration.

The estimated exposure doses calculated are conservative estimates and may overestimate actual doses received by this population. Actual doses associated with exposure to water in the private wells is expected to be less than estimates presented above, based on the following reasons:

- The maximum detected RDX concentration used to estimate exposure doses for all residents in the IAAAP vicinity was detected in a private well serving only one family. All other RDX detections in active drinking water wells were lower, and all but one other detection only slightly exceeded the 2.0 ppb health advisory limit.

- The exposure frequency is extremely conservative because it assumes that residents were drinking all their water from contaminated wells for 365 days a year. In all probability, the affected residents also consumed other water sources (e.g., water supplied at work, bottled water, restaurant water, water from various travel locations, etc.).

- Similarly, the exposure duration is extremely conservative. The exposure duration used to estimate the exposure dose was 7 years for adults and children (the length of time from when wells were known to be contaminant-free to when they were first discovered to contain RDX). This estimate probably overestimates exposure because not all wells were contaminated or in use for the full 7 years.

Evaluation of ATSDR's Estimated Exposure Dose

When evaluating *noncancer* effects, ATSDR uses standard health guidelines, such as EPA's oral reference dose (RfD), to determine whether adverse effects will occur. An RfD is defined as an estimate of daily oral human exposure to a chemical that is likely to be without an appreciable risk of deleterious effects (noncancer) over a specified duration of exposure. Estimated exposure doses for both adults (0.0008 mg/kg/day) and children (0.0028 mg/kg/day) were below EPA's oral reference dose (RfD) of 0.003 mg/kg/day. Therefore, ATSDR concludes that past ingestion of RDX-contaminated groundwater in the IAAAP vicinity is not associated with any noncancer effects.

Cancer effects

Although there are no studies establishing a direct link between oral exposure to RDX and cancer in humans, laboratory experiments with animals have resulted in a classification of RDX as a Possible Human Carcinogen.

For screening purposes, ATSDR used a previously derived cancer potency factors (CPF) for RDX of 0.11 $(mg/kg/day)^{-1}$. CPFs, developed using data from animal or human studies, define the relationship between exposure doses and the likelihood of an increased risk of developing cancer over a lifetime. The derivation of CPFs often requires extrapolation from high exposure doses administered in animal studies to lower exposure levels typical of human exposure to environmental contaminants. Because CPFs represent the upper-bound estimate of the

probability of developing cancer at a defined level of exposure, they tend to be very conservative (i.e., overestimate the actual risk) in order to account for a number of uncertainties in the data used in extrapolation. Therefore, this approach provides a conservative evaluation of the likelihood of cancer effects being associated with the levels of RDX detected in drinking water in the vicinity of IAAAP.

ATSDR estimated the potential for cancer to occur using the following equation:

Lifetime Cancer Risk = Estimated exposure dose (mg/kg/day) x CPF $(mg/kg/day)^{-1}$

For the IAAAP, ATSDR derived a lifetime (70 year) cancer estimate from RDX-contaminated drinking water of 8×10^{-6} (or an increased likelihood of 8 in one million). Although no risk of cancer is considered acceptable, because a zero cancer risk is not possible to achieve, ATSDR often uses a range of 10^{-4} to 10^{-6} estimated lifetime cancer risk (or 1 new case in 10,000 to 1,000,000 exposed persons) to determine whether there is a concern for cancer effects. The IAAAP cancer estimate is within ATSDR's range of 10^{-4} to 10^{-6}. Therefore, ATSDR does not consider an increased risk of cancer from RDX-contaminated drinking water to be a concern for residents living south of IAAAP.

Conclusions

In summary, **no apparent public health hazards** are associated with past consumption of RDX-contaminated groundwater from off-site wells in the vicinity of IAAAP.

APPENDIX C

Comparison Values

APPENDIX C: Comparison Values

The conclusion that a contaminant exceeds the comparison value does not mean that it will cause adverse health effects. Comparison values represent media-specific contaminant concentrations that are used to select contaminants for further evaluation to determine the possibility of adverse public health effects.

Cancer Potency Factor (CPF)

Usually derived from dose-response models and expressed in mg/kg/day, *CPFs* describe the inherent potency of carcinogens and estimate an upper limit on the likelihood that lifetime exposure to a particular chemical could lead to excess cancer deaths.

Cancer Risk Evaluation Guide (CREG)

Estimated contaminant concentrations that would be expected to cause no more than one excess cancer in a million (10^{-6}) persons exposed over a 70-year life span. ATSDR's CREGs are calculated from EPA's cancer potency factors.

EPA Region III Risk-Based Concentration

EPA combines reference doses and carcinogenic potency slopes with "standard" exposure scenarios to calculate risk-based concentrations, which are chemical concentrations corresponding to fixed levels of risk (i.e., a hazard quotient of 1, or lifetime cancer risk of 10^{-6}, whichever occurs at a lower concentration) in water, air, fish tissue, and soil.

Health Advisory Limit (HAL)

The concentration of a chemical in drinking water that is not expected to cause any adverse noncarcinogenic effects over a lifetime of exposure, with a margin of safety.

Lowest Observed Adverse Effect Level (LOAEL)

The lowest dose of a chemical that produced an adverse-effect when it was administered to animals in a toxicity study.

Maximum Contaminant Level (MCL)

The *MCL* is the drinking water stand established by EPA and enforced by the California Department of Environmental Protection. It is the maximum permissible level of a contaminant in water that is delivered to the free-flowing outlet. *MCLs* are considered protective of human health over a lifetime (70 years) for individuals consuming 2 liters of water per day.

Minimal Risk Levels (MRL)

MRLs are estimates of daily human exposure to a chemical (i.e., doses expressed in mg/kg/day) that are unlikely to be associated with any appreciable risk of deleterious noncancer effects over a specified duration of exposure. MRLs are calculated using data from human and animal studies and are reported for acute ($\leq$ 14 days), intermediate (15-364 days), and chronic ($\geq$ 365 days) exposures. MRLs are published in ATSDR Toxicological Profiles for specific chemicals.

APPENDIX D

Glossary

APPENDIX D: Glossary

Background Level

A typical or average level of a chemical in the environment. *Background* often refers to naturally occurring or uncontaminated levels.

Carcinogen

Any substance that may produce cancer.

Comparison Values

Estimated contaminant concentrations in specific media that are not likely to cause adverse health effects, given a standard daily ingestion rate and standard body weight. The *comparison values* are calculated from the scientific literature available on exposure and health effects.

Concentration

The amount of one substance dissolved or contained in a given amount of another. For example, sea water contains a higher concentration of salt than fresh water.

Contaminant

Any substance or material that enters a system where it is not normally found or found in greater concentrations than background levels.

Dose

The amount of substance to which a person is exposed. *Dose* often takes body weight into account.

Environmental contamination

The presence of hazardous substances in the environment. From the public health perspective, *environmental contamination* is addressed when it potentially affects the health and quality of life of people living and working near the contamination.

Exposure

Contact with a chemical by swallowing, by breathing, or by direct contact (such as through the skin or eyes). *Exposure* may be short term (acute) or long term (chronic).

Hazard

A source of risk that does not necessarily imply potential for occurrence. A hazard produces risk only if an exposure pathway exists, and if exposures create the possibility of adverse consequences.

Ingestion

Swallowing (such as eating or drinking). Chemicals can get in or on food, drink, utensils, cigarettes, or hands where they can be ingested. After *ingestion*, chemicals can be absorbed into the blood and distributed throughout the body.

Maximum Contaminant Levels (MCLs)

MCLs represent contaminant concentrations in drinking water that EPA deems protective of public health (considering the availability and economics of water treatment technology) over a lifetime (70 years) at an exposure rate of 2 liters of water per day.

Media

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

Minimal Risk Level (MRL)

An *MRL* is defined as an estimate of daily human exposure to a substance that is likely to be without an appreciable risk of adverse effects (noncancer) over a specified duration of exposure. *MRLs* are derived when reliable and sufficient data exist to identify the target organ(s) of effect or the most sensitive health effect(s) for a specific duration via a given route of exposure. *MRLs* are based on noncancer health effects only. *MRLs* can be derived for acute, intermediate and chronic duration exposures by the inhalation and oral routes.

National Priorities List (NPL)

EPA's listing of sites that have undergone preliminary assessment and site inspection to determine which locations pose an immediate
threat to persons living or working near the release. These sites are most in need of cleanup.

Potentially Exposed

The condition where valid information, usually analytical environmental data, indicates the presence of contaminant(s) of a public health concern in one or more environmental media contacting humans (e.g., air, drinking water, soil, food chain, surface water), and there is evidence that some of those persons may have an identified route(s) of exposure (e.g., drinking contaminated water, breathing contaminated air, having contact with contaminated soil, or eating contaminated food).

Public Health Assessment

The evaluation of data and information on the release of hazardous substances into the environment in order to assess any current or future impact on public health, develop health advisories or other recommendations, and identify studies or actions needed to evaluate and mitigate or prevent human health effects; also, the document resulting from that evaluation.

Public Health Hazard

Sites that pose a public health hazard as the result of long-term exposures to hazardous substances.

Route of Exposure

The path in which a person may contact a chemical substance. For example, drinking (ingestion) and bathing (skin contact) are two different *routes of exposure* to contaminants that may be found in water.

Volatile organic compound (VOC)

Substance containing carbon and different proportions of other elements such as hydrogen, oxygen, fluorine, chlorine, bromine, sulfur, or nitrogen; these substances easily become vapors or gases. A significant number of the VOCs are commonly used as solvents (e.g., paint thinners, lacquer thinner, degreasers, dry cleaning fluids).

APPENDIX E

Responses to Public Comments

APPENDIX E: Responses to Public Comments

The Agency for Toxic Substances and Disease Registry (ATSDR) received the following comments/questions during the public comment period (June 22, 1999 to October 31, 1999) for the Iowa Army Ammunition Plant (IAAAP) Public Health Assessment (PHA). For comments that questioned the validity of statements made in the PHA, ATSDR verified or corrected such statements. The list of comments does not include editorial comments concerning such things as word spelling or sentence syntax.

1. **Comment:** Page 1, Paragraph 4. The validity of the statement "no one has ever used on-site groundwater as a source of drinking water" was questioned. Specific references were made to well pumps located on the installation, visible inside of some fenced areas. It was also pointed out that one on-site well historically provided emergency water to the main reserve of IAAAP's water treatment facility.

   Response: ATSDR did not change the original text because no reference documents could be found to verify that on-site wells were used for drinking water. On the contrary, cited sources identified 5 wells located on the installation, but none of these wells were ever used for drinking water purposes (Hicks, 1999). As explained in the *Groundwater Use* section, one on-site well served as an alternate (i.e., emergency) water source for the water treatment facility, but this well was never needed or used for this purpose (Hicks, 1999). ATSDR sources indicate that IAAAP drinking water was obtained from (treated) Mathes Lake surface water prior to 1977, after which IAAAP used the Burlington Municipal System as its drinking water source. ATSDR does not dispute that on-site wells are visible at the installation.

2. **Comment:** Page 2, Paragraph 1. The validity of the statement "no available data exist to quantify past TNT or RDX contamination level" was questioned. It was suggested that historical surface water contamination data may have been recorded and/or presented at IAAAP meetings during the late 1960s or early 1970s.

   Response: The author of this comment did not provide a reference citation and ATSDR was unable to locate any such quantitative contamination data. IAAAP personnel confirmed that the installation has no record of such sampling events (Allison, 1999c). The closest such study that ATSDR found was a reference to a 1962 study that evaluated surface water contaminant levels as "very strong," "strong," "not as strong," "discernable," or "weak." This 1962 study, however, did not provide quantitative detail about historical surface water contamination (although it does seem to support ATSDR's assumption that the levels of surface water explosives were probably in the ppm range [i.e., pink water]). Therefore, the original text was not changed.

3. **Comment:** Page 3, Paragraph 2. The phrase "components of these munitions, including primers, detonators, fuses, and boosters have also been handled at the facility" should be revised to indicate that these items were manufactured at IAAAP during the 1960s and 1970s on lines 5a, 5b, 6, and 7.

   Response: ATSDR clarified it's statement by adding "primarily in the 1960s and 1970s" to the text.

4. **Comment:** Modify the PHA to indicate that, from 1941 until 1977, Long Lake was the primary source for all IAAAP water (including drinking water, not just an emergency supply).

   Response: ATSDR changed the text to accurately reflect that Mathes Lake surface water (after treatment in an on-site water treatment facility) was the source for all IAAAP drinking water prior to 1977.

5. **Comment:** Past IAAAP employees and local residents commented that they personally observed untreated, contaminated water dumped into the Pink Lagoon and/or they personally witnessed pink water running off site via Brush Creek. One individual commented that "chunks of TNT and Composition B as large as my fist were in the sump water dumped into the lagoon." Therefore, remove the word "allegedly" when referring to pink water in the IAAAP vicinity in the 1960s and 1970s.

   Response: ATSDR contacted current and past IAAAP employees and unequivocally verified that local surface waters historically ran pink. The original text was revised to incorporate the personal observations and to confirm the existence of past surface water contamination. ATSDR removed the word "allegedly" from all surface water discussions.

6. **Comment:** Concern was expressed regarding one family that previously resided on IAAAP's south boundary with Long Creek running through their property. Verify that this family's health problems and their concerns were addressed, even though the family was not specifically mentioned in the PHA.

   Response: To protect individual privacy, ATSDR does not mention family or individual names in PHAs. The health of all families living in the IAAAP vicinity, particularly those living south (downgradient) of IAAAP, were accounted for when developing this document. To ensure, however, that community concerns were clearly addressed, ATSDR added a *Community Health Concerns* section to the PHA.

7. **Comment:** During the 1970s, Long Lake and other local surface waters were contaminated and endured a "major fish kill," allegedly by farm chemicals and pesticides used for "no-till" farming. The U.S. Department of Fisheries regularly performed fish studies at IAAAP. Include this information in the PHA.

   Response: ATSDR PHAs focus on human health issues and generally do not address ecological health or ecological risk issues, unless there is a completed exposure pathway to a human receptor population (there is none in this instance). Moreover, this PHA specifically addresses health issues associated with IAAAP activities (not local farming practices). The original text was not changed.

8. **Comment:** Several commenters were concerned that ATSDR used "pink" water instead of "red" water and "RDX" instead of "TNT."

   Response: Pink water and red water conditions both originate from TNT contaminants, but they indicate varying levels of TNT concentrations. No quantitative data are available, however, to know whether or not historical IAAAP surface water conditions are more accurately described by pink water (approximately 5 ppm) or red water (greater TNT concentrations). The majority of documents obtained by ATSDR used "pink" water to describe historical conditions, although some did use "red" water. All documents referred to the "Pinkwater Lagoon." To be consistent with most reference documents, ATSDR described historical conditions as having "pink" waters. At unknown times in the past, however, ATSDR acknowledges that IAAAP surface waters may have run red. The text, however, was not changed.

   Documents obtained by ATSDR indicate that RDX is currently the primary contaminant of concern, although historically TNT may have been more prevalent (as described in this PHA). Some on-site soil areas currently contain TNT contaminant concentrations above health-based guidelines (see Appendix A for details), but there is no public exposure to these soils. Without exposure, no public health hazards exist, so TNT is not addressed as a primary contaminant of concern. The text was not changed.