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DISPOSAL OF CHEMICAL AGENTS AND MUNITIONS STORED AT ANNISTON ARMY DEPOT ANNISTON, ALABAMA, FINAL PHASE I ENVIRONMENTAL REPORT

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ABSTRACT

The Anniston Army Depot (ANAD) is one of eight continental United States (CONUS) Army installations where lethal unitary chemical agents and munitions are stored, and where destruction of agents and munitions is proposed under the Chemical Stockpile Disposal Program (CSDP). In 1988 the U.S. Army issued a Final Programmatic Environmental Impact Statement (FPEIS) for the CSDP that identified on-site disposal of agents and munitions as the environmentally preferred alternative (i.e., the alternative with the least potential to cause significant adverse impacts). In some instances, the FPEIS included generic data and assumptions that were developed to allow a consistent comparison of potential impacts among programmatic alternatives and did not include detailed conditions at each of the eight installations. The environmentally preferred alternative was identified using a method based on five measures of risk directed at potential human health and ecosystem/environmental effects; the adequacy of emergency response also played a key role in the method. In the Record of Decision following the FPEIS, on-site disposal was selected for implementation of the program.

The purpose of this Phase I report is to examine the proposed implementation of on-site disposal at ANAD in light of more detailed and more recent data than those included in the FPEIS. Two principal issues are addressed: (1) whether or not the new data would result in identification of on-site disposal at ANAD as the environmentally preferred alternative (using the same selection method and data analysis tools as in the FPEIS), and (2) whether or not the new data indicate the presence of significant environmental resources that could be affected by on-site disposal at ANAD. In addition, a status report is presented on the maturity of the disposal technology (and how it could affect on-site disposal at ANAD).

Inclusion of these more recent data into the FPEIS decision method resulted in confirmation of on-site disposal for ANAD. No unique resources with the potential to prevent or delay implementation of on-site disposal at ANAD have been identified. A review of the technology status identified four principal technology developments that have occurred since publication of the FPEIS and should be of value in the implementation of on-site disposal at ANAD: the disposal of nonlethal agent at Pine Bluff Arsenal, located near Pine Bluff, Arkansas; construction and testing of facilities for disposal of stored lethal agent at Johnston Atoll, located about 1300 km (800 miles) southwest of Hawaii in the Pacific Ocean; lethal agent disposal tests at the chemical agent pilot plant operations at Tooele Army Depot, located near Salt Lake City, Utah; and equipment advances.

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ABBREVIATIONS AND ACRONYMS

ACAMS	automatic continuous air monitoring system
agl	above ground level
ANAD	Anniston Army Depot
APG	Aberdeen Proving Ground
ATC	Applied Technology Council
CAMDS	Chemical Agent Munitions Disposal System
CDTF	Chemical Demilitarization Training Facility
CEQ	Council on Environmental Quality
CFR	Code of Federal Regulations
CML	conservative most likely
CONUS	continental United States
CSDP	Chemical Stockpile Disposal Program
DATS	Drill and Transfer System
DEM	Department of Environmental Management
DFS	deactivation furnace system
DPEIS	draft programmatic environmental impact statement
D2PC	atmospheric dispersion model computer program
E	east
EIS	environmental impact statement
EMA	Emergency Management Agency
ENE	east-northeast
EOC	emergency operations center
EPA	Environmental Protection Agency
EPGA	effective peak ground acceleration
ERCP	Emergency Response Concept Plan
ESE	east-southeast
FEMA	Federal Emergency Management Agency
FPEIS	final programmatic environmental impact statement
ft	feet
FWS	U.S. Fish and Wildlife Service
GB	chemical nerve agent, also called Sarin
GPSF	General Purpose Support Facility
H	chemical blister agent, also generally called sulfur mustard
ha	hectare
HD	chemical blister agent, also generally called distilled mustard
hr	hour
HT	chemical blister agent consisting of a mixture of HD and an organic compound
JACADS	Johnston Atoll Chemical Agent Destruction System
kg	kilogram
km	kilometer
L	liter
LBAD	Lexington–Blue Grass Army Depot
lb	pounds
LIC	liquid incinerator

m	meter
MDB	Munitions Demilitarization Building
mg	milligram
Mgd	million gallons per day
min	minute
mm	millimeter
mph	mile(s) per hour
MPF	metal parts furnace
MSL	mean sea level
N	north
NE	northeast
NEPA	National Environmental Policy Act of 1969
NF	national forest
NNE	north-northeast
NNW	north-northwest
NRC	Nuclear Regulatory Commission
NW	northwest
NWA	national wilderness area
NWR	national wildlife refuge
ORNL	Oak Ridge National Laboratory
OVT	Operations Verification Test
PBA	Pine Bluff Arsenal
PGA	peak ground acceleration
PMCD	Program Manager for Chemical Demilitarization
PSD	prevention of significant deterioration
Pub. L.	Public Law
Pt.	Part
RMA	Rocky Mountain Arsenal
ROD	Record of Decision
s	second
S	south
SE	southeast
SSE	(1) south-southeast (2) safe-shutdown earthquake
SSW	south-southwest
SW	southwest
TEAD	Tooele Army Depot
TWA	time weighted average
VX	chemical nerve agent
W	west
WC	worst case
WNW	west-northwest
WSW	west-southwest

FOREWORD

As part of the U.S. Army's Chemical Stockpile Disposal Program (CSDP), which is concerned with destruction of agents and munitions stored at eight existing Army installations in the continental United States, the Army proposes to dispose of lethal chemical agents and munitions stored at Anniston Army Depot (ANAD), Anniston, Alabama. In compliance with the National Environmental Policy Act (NEPA), the Army has initiated a site-specific NEPA review of this proposed action at ANAD. The environmental compliance documentation will be prepared in two phases.

In the Phase I process, the overall CSDP decision to dispose of each installation's stockpile on-site is further considered, and its validity at each storage installation is reviewed with more recent and more detailed data than those that provided the basis for the final programmatic environmental impact statement (FPEIS) for the CSDP (completed in January 1988). The Phase II process [the preparation of a site-specific environmental impact statement (EIS)] focuses on the site-specific implementation (plant construction and disposal operations) of on-site disposal (assuming that on-site disposal is upheld after Phase I). It should be emphasized that the Phase I Environmental Report is the starting point for the site-specific decision-making process, and it provides the environmental information by which the impacts of the proposed action are to be assessed in the site-specific EISs.

A final Phase I Environmental Report for ANAD was issued by the Army in July 1989 (*Disposal of Chemical Agents and Munitions Stored at Anniston Army Depot, Anniston, Alabama—Final Phase I Environmental Report*, Office of the Program Manager for Chemical Demilitarization, Aberdeen Proving Ground, Maryland.) The report concluded that the FPEIS environmentally preferred alternative (on-site disposal), which is also the Army's preferred alternative, is indeed valid for ANAD. No new or unique site-specific information was found that would change or contradict the conclusions of the FPEIS with respect to ANAD. The report recommended that preparation of the site-specific EIS should proceed and should focus on implementation of the on-site incineration and should not consider other alternatives for disposing of either the ANAD stockpile or stockpiles from other installations at ANAD.

The Phase I report was independently reviewed by Argonne National Laboratory (ANL) and the review summarized in a report (*Chemical Stockpile Disposal Program: Review and Comment on the Phase I Environmental Report for the Anniston Army Depot, Anniston, Alabama*, ANL/EAIS/TM-5, Argonne, Illinois, December 1989). Additional recommendations for the content of the site specific EIS were included in the ANL review. An addendum to the final Phase I report was issued in February 1990 to summarize the external review of the Phase I report by cooperating agencies and ANL, and to include additional information in the Phase I process, as recommended by the independent review. None of this new information changed the conclusions of the Phase I report.

On April 20, 1990, the findings and conclusions of the Phase I report, the independent review, and the addendum to Phase I were certified to the Congress by Acting Assistant Secretary of the Army, Michael W. Owen.

This Oak Ridge National Laboratory Technical Memorandum consists of the July 1989 Phase I report (Volume 1) and the 1990 Addendum (Volume 2). It was prepared to document the Phase I process for disposal of chemical agents and munitions stored at ANAD.

EXECUTIVE SUMMARY

The Anniston Army Depot (ANAD) is one of eight continental United States (CONUS) Army installations where lethal unitary chemical agents* and munitions are stored, and where destruction of agents and munitions is proposed under the Chemical Stockpile Disposal Program (CSDP). The chemical agent inventory at ANAD consists of approximately 7%, by weight, of the total U.S. stockpile and includes almost all of the munition types. None of the agents or munitions at ANAD has been manufactured since 1968; they are in various stages of deterioration, with a few munitions already leaking. The destruction of the stockpile is necessary to eliminate the risk to the public from continued storage and to dispose of obsolete and leaking munitions.

In 1988 the U.S. Army issued a Final Programmatic Environmental Impact Statement (FPEIS) for the CSDP that identified on-site disposal of agents and munitions as the environmentally preferred alternative (i.e., the alternative with the least potential to cause significant adverse impacts). In some instances, the FPEIS included generic data and assumptions that were developed to allow a consistent comparison of potential impacts among programmatic alternatives and did not include detailed conditions at each of the eight installations. The environmentally preferred alternative was identified using a method based on five measures of risk directed at potential human health and ecosystem/environmental effects; the adequacy of emergency response also played a key role in the method. In the Record of Decision following the FPEIS, on-site disposal was selected for implementation of the program.

The purpose of this Phase I report is to examine the proposed implementation of on-site disposal at ANAD in light of more detailed and more recent data than those included in the FPEIS. Two principal issues are addressed: (1) whether or not the new data would result in identification of on-site disposal at ANAD as the environmentally preferred alternative (using the same selection method and data analysis tools as in the FPEIS), and (2) whether or not the new data indicate the presence of significant environmental resources that could be affected by on-site disposal at ANAD. In addition, status reports are presented on maturity of the disposal technology (and how it could affect on-site disposal at ANAD) and on the tracking of changes in technology to ensure that the overall risk identified in the FPEIS is not exceeded. Confirmation of on-site disposal in Phase I allows the site-specific EIS (addressing on-site disposal) to begin under Phase II.

More recent and more detailed site-specific data of the same types used in the FPEIS to identify the environmentally preferred alternative were gathered during the Phase I process. These new data were then examined and compared with the FPEIS data to determine if they have changed enough to warrant recomputation of the five measures of risk used to select the programmatic environmentally preferred alternative. Of all the data types examined, only residential population was identified as having changed enough to warrant recomputation of risk (primarily because of population growth and a change in the location of the residents). For the areas of seismicity, meteorology, and meteorite/tornado frequency, either new data were not identified during the Phase I

*Unitary agents are so named because they alone can produce their desired hazardous effect on human health in their form as stored; they do not require mixing with another component to become hazardous (as is the case with binary chemical agents).

process or, if located, were not sufficiently different from data used on the FPEIS risk assessment to warrant reevaluation of risk. For the areas of on-site transport and aircraft activity, new data were located with potential to change the values of the risk measures, but were judged to offer minimal potential to preferentially affect risk for one or more alternatives.

The new population data were used to compute fatalities using the same computation methods and values for all other parameters as in the FPEIS. The revised fatality estimates were then used to compute the five measures of risk for on-site disposal, continued storage, and on-site activities associated with off-site transport of the ANAD stockpile. Results indicate that continued storage at ANAD can be rejected because one of the measures of risk was greater, by a statistically significant amount, than the values for the other alternatives. The other alternatives are statistically indistinguishable. However, risks from on-site disposal are in all cases equal to or less than risks from other alternatives. The conclusion is that on-site disposal remains valid as the environmentally preferred alternative for ANAD. On-site disposal is at least equivalent to all other alternatives in terms of the potential for human health impacts. If the off-site transportation risks (not addressed in this document because they are beyond the scope) are also included, the on-site alternative is clearly preferable given the opportunity for risk reductions associated with emergency planning and preparedness activities that are under way at ANAD.

During the Phase I process, data on resources that could be affected by on-site disposal at ANAD were gathered to determine if any significant new resources are present that could prevent or delay construction and operation of the on-site disposal facility. The resources that were considered are population, meteorology/air quality, surface and groundwater, land use, ecology, socioeconomics, and aircraft activity. Some of these resources were examined in the FPEIS in assessing potential impacts of the programmatic alternatives, whereas others represent information that was not appropriate for examination on the programmatic level. No assessment of potential impacts was done during the Phase I process with these data. Rather, the data were examined to help identify potential issues to be analyzed under Phase II. No unique resources with the potential to prevent or delay implementation of on-site disposal at ANAD have been identified.

Technology status/maturity and technology risk assurance were also examined during the Phase I process, although neither factor was instrumental in reaching the conclusions for ANAD identified in the previous paragraphs. Four principal technology developments have occurred since publication of the FPEIS and should be of value in the implementation of on-site disposal at ANAD: the ongoing disposal of nonlethal agent at Pine Bluff Arsenal, located near Pine Bluff, Arkansas; construction and testing of facilities for disposal of stored lethal agent at Johnston Atoll, located about 1300 km (800 miles) southwest of Hawaii in the Pacific Ocean; lethal agent disposal tests at the chemical agent pilot plant operations at Tooele Army Depot, located near Salt Lake City, Utah; and equipment advances. Technology risk assurance refers to tracking the disposal facility design changes that have occurred since the FPEIS to provide assurance that the changing design does not exceed the risk ceiling identified in the FPEIS. At this point these activities are concerned with establishing a system for technology risk assurance and with documenting the FPEIS technology factors used to develop the risk ceiling.

PREFACE

The U.S. Department of the Army proposes under the Chemical Stockpile Disposal Program (CSDP) to destroy the nation's total stockpile of lethal unitary chemical agents and munitions. The unitary chemical agents to be destroyed under the CSDP include nerve agents that directly affect the nervous system and blister agents that produce blisters on exposed tissue. Unitary agents are so named because they alone can produce their desired hazardous effect on human health in their form as stored; they do not require mixing with another component to become hazardous (as is the case with binary chemical agents). These agents are stored in munitions (e.g., rockets, land mines, mortars, cartridges, and projectiles) that in addition to agents contain various explosive components (e.g., fuses, propellants, and bursters). Agents not contained in munitions are stored in bulk containers, which include bombs, spray tanks, and steel one-ton containers, none of which contains any explosives.

The proposed action is being carried out in response to a congressional mandate in Title 14, Part B, Section 1412 of Pub. L. 99-145, the Department of Defense Authorization Act of 1986, which directs that the destruction of the agents and munitions be accomplished by September 30, 1994, in conjunction with the acquisition of binary chemical weapons. In March 1988, the Army received an extension from Congress of the 1994 deadline to April 30, 1997, under Pub. L. 100-456. Under emergency conditions or if there is a significant delay in the acquisition of an adequate number of binary chemical weapons to meet the requirements of the Armed Forces, Pub. L. 99-145 allows the Secretary of Defense to defer, beyond April 30, 1997, the destruction of not more than 10% ("useful 10%") of the unitary stockpile.

Congress has directed the Army to accomplish the proposed destruction in a manner that provides: (1) maximum protection of the environment, the general public, and the personnel involved in the destruction process; (2) adequate and safe facilities designed solely for the destruction of the lethal chemical stockpile; and (3) cleanup, dismantling, and disposal of the facilities when the disposal program is complete.

The existing unitary chemical munitions are stored at eight U.S. Army installations located in the continental United States (CONUS): Aberdeen Proving Ground (APG), near Edgewood, Maryland; Anniston Army Depot (ANAD), near Anniston, Alabama; Lexington-Blue Grass Army Depot (LBAD), near Lexington, Kentucky; Newport Army Ammunition Plant, near Newport, Indiana; Pine Bluff Arsenal (PBA), near Pine Bluff, Arkansas; Pueblo Depot Activity, near Pueblo, Colorado; Tooele Army Depot (TEAD), near Tooele, Utah; and Umatilla Depot Activity (UMDA), near Hermiston, Oregon. None of the agents and munitions currently in storage has been manufactured since 1968, and although some of them are "like new," others are in various stages of deterioration, with a few items developing leaks. All items that have been verified as leaking have been either repaired and decontaminated on the spot or containerized and placed in isolated storage.

At each of the eight sites, the Army proposes to remove the agents and munitions from existing storage, transport them to a proposed on-site disposal facility, disassemble them, and incinerate the agents. No stockpiled agents or munitions are proposed to be transported to other storage installations or sites for destruction. Incineration, the selected disposal technology, has been endorsed by the National Research Council as the safest means of destroying these lethal chemical agents. For the purpose of this Phase I report, "on-site disposal facility" refers to the incinerator and all associated structures and equipment for storing, handling, and processing the munitions and agents.

A federal program such as the CSDP requires a National Environmental Policy Act (NEPA) review to ensure that environmental factors are given adequate consideration early in the decision-making process. For the CSDP, a NEPA review strategy has been structured to address two levels of decision making: (1) the programmatic level and (2) the site level.

Implementation of this NEPA review strategy for the CSDP began in January 1986 with initiation of the programmatic Environmental Impact Statement (EIS). In January 1988, the Army issued the final programmatic EIS (FPEIS). The FPEIS discussed five alternatives: four for destroying the stockpile, and no action [required by regulations implementing NEPA (40 CFR Pt. 1500-1508)]. The five alternatives are as follows:

1. continued storage of the stocks at their present locations (the no action alternative);
2. on-site disposal of the stocks at their present storage locations;
3. relocation of the stocks to regional disposal centers at ANAD and TEAD for destruction;
4. relocation of the stocks to a national disposal center at TEAD for destruction; and
5. relocation of the inventories at some sites to alternate sites, with the remainder destroyed at their present storage locations (this alternative includes air movement of the APG and LBAD inventories to TEAD for destruction).

The FPEIS identified on-site disposal as the environmentally preferred alternative (i.e., the alternative with the least potential for significant adverse impacts). In addition, the Army's Record of Decision (ROD) for the FPEIS selected on-site disposal for implementation. The ROD stated that environmental impacts, including the hazards and risk analyses presented in the FPEIS, were a contributing but not the determining factor in the decision. Other factors considered included the feasibility and effectiveness of emergency response measures, vulnerability to terrorism and sabotage, and logistical complexity.

On-site disposal, having been selected for implementation, will require that the Army prepare eight site-specific NEPA-compliance documents for each installation to assist with the site-level decision making. The programmatic ROD stated that the site-specific NEPA documents would focus on the implementation of the programmatic decision at a given site and on specific issues and concerns related to implementation at a given site.

1. INTRODUCTION

1.1 BACKGROUND

This Phase I Environmental Report has been prepared by the U.S. Department of the Army to assist in the development of site-specific National Environmental Policy Act of 1969 (NEPA) (Pub. L. 91-190) compliance documentation for disposal of the lethal unitary chemical agents and munitions stored at the Anniston Army Depot (ANAD) located near Anniston, Alabama. ANAD is one of the eight U.S. Army installations where on-site disposal of agents and munitions is proposed under the Chemical Stockpile Disposal Program (CSDP). Following the issuance of the Record of Decision (U.S. Army 1988a) for the CSDP Final Programmatic Environmental Impact Statement (FPEIS) in February 1988 (U.S. Army 1988b), the Army began site-specific NEPA reviews for the installations involved in the CSDP. The U.S. Department of the Army proposes under the CSDP to destroy the nation's stockpile of lethal unitary chemical agents (nerve and blister) and munitions.

The Army has developed a two-phase process for conducting the site-specific NEPA studies. In Phase I, the programmatic decision of on-site disposal is to be given further consideration by a review of its validity at each storage installation using more detailed and more recent data than those used in the FPEIS. Phase II (the preparation of an EIS) is to address potential impacts from site-specific implementation (plant construction and operation) of on-site disposal.

The site-specific NEPA reviews for the CSDP began with Tooele Army Depot (TEAD) and continue with this report for ANAD. This Phase I Environmental Report is the starting point for the site-specific decision-making process at ANAD and it provides the environmental information by which the site-specific impacts of the proposed action are to be assessed in Phase II.

1.2 ANNISTON ARMY DEPOT

ANAD is located in Calhoun County in northeastern Alabama, about 80 km (50 miles) east of Birmingham, Alabama (Fig. 1). ANAD covers 7,300 ha (18,000 acres) of land (including the Coosa River Storage Annex located to the south of the main depot), with more than 5,700 ha (14,000 acres) of woodlands, about 16 ha (40 acres) of lakes and streams, and about 800 ha (2,100 acres) of improved grounds (all totals include the Coosa River Storage Annex). There are almost 2,000 buildings and structures with about 790,000 m^2 (8.5 million $feet^2$) of floor space, approximately 400 km (250 miles) of roads and streets, and 75 km (46 miles) of railroad tracks. Principal missions at ANAD are rebuilding and maintaining tanks and other heavy equipment, performing missile maintenance, repairing and rebuilding small arms and artillery, supplying materiel and services worldwide to the U.S. Army, and storing ammunition. Industrialized operations are located in the eastern portion of the depot, and supply and administration are located in the western section. Ammunition storage and rebuilding activities occur in the central, controlled-access area of the depot.

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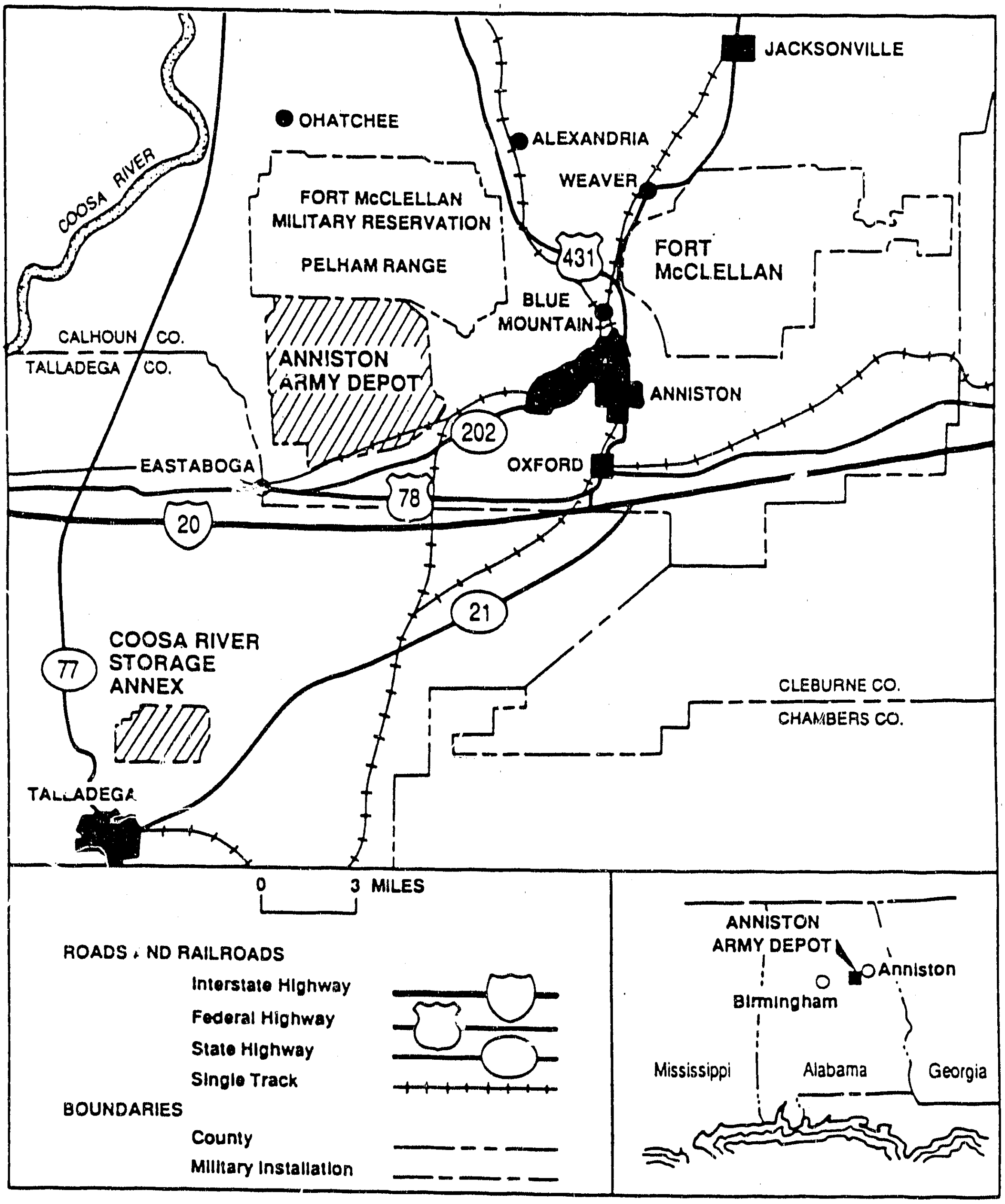

Fig. 1. Regional location of Anniston Army Depot.

Part of ANAD's mission is storage of lethal unitary chemical agent; the storage area is located in the north central part of the depot, as shown in Fig. 2. Approximately 7% of the total U.S. stockpile of lethal unitary chemical agents is stored at ANAD in two forms: mustard agents (designated as H, HD, or HT) and nerve agents (designated as GB and VX). The chemical agent inventory at ANAD consists of almost all munition types and bulk containers (except spray tanks) found in the U.S. stockpile. The facility proposed for disposal of chemical agents and munitions is planned to be located about 0.6 km (0.4 mile) south of the northern ANAD border (see Fig. 2). The geographic coordinates of the site of the proposed disposal facility are 33.68 N latitude and 85.96 W longitude.

In the FPEIS, shipment of ANAD's stockpile off-site for disposal was addressed under the alternative of national disposal at TEAD. Thus, in the FPEIS, the only disposal alternative considered that did not involve agent disposal on-site at ANAD was national disposal.

1.3 OBJECTIVES AND SCOPE

To reasonably and objectively compare the various programmatic alternatives, the FPEIS employed some generic assumptions and inputs such as process and handling descriptions, on-site transport characteristics (such as transport distances and road conditions), and certain meteorological data. Other assumptions and inputs were more site-specific, as appropriate, to allow a reasonable comparison of alternatives.

The purpose of this report is to examine the proposed implementation of on-site disposal at ANAD in light of more recent and more detailed data than those on which the FPEIS is based. Two principal issues are addressed: (1) whether or not the new data would result in the rejection of on-site disposal at ANAD as the environmentally preferred alternative (using the same methods and data analysis tools as in the FPEIS) and (2) whether or not the new data indicate the presence of significant environmental resources that could be affected by implementation of on-site disposal at ANAD. For the first issue, the data are confined to those used to identify the environmentally preferred alternative. To address the second issue, existing data on all potential environmental resources that could be affected by on-site disposal at ANAD are examined and summarized. In addition, status reports are also presented on the maturity of the disposal technology (and how it could affect on-site disposal at ANAD) and on the tracking of changes in technology to ensure that the overall risk presented in the FPEIS for ANAD is not exceeded.

This Phase I Environmental Report is not intended to validate the Army's programmatic ROD for the CSDP; it can only confirm or reject the environmentally preferred alternative (on-site disposal) as identified in the FPEIS for ANAD. Data gathered during Phase I include (1) any new information that was not available for use in the FPEIS, (2) more detailed information than was required for the programmatic purpose of comparing alternatives in the FPEIS, and (3) any information that may have been overlooked in the FPEIS.

In light of the first issue to be addressed in Phase I, the scope of this Phase I Environmental Report is limited to reexamining the FPEIS environmentally preferred alternative (i.e., on-site disposal) in light of more recent and detailed data. To allow consistent comparisons among alternatives using new data and to allow comparisons with the FPEIS findings, only the input data change for the FPEIS method used to identify the environmentally preferred alternative. The scope of the reexamination is limited to

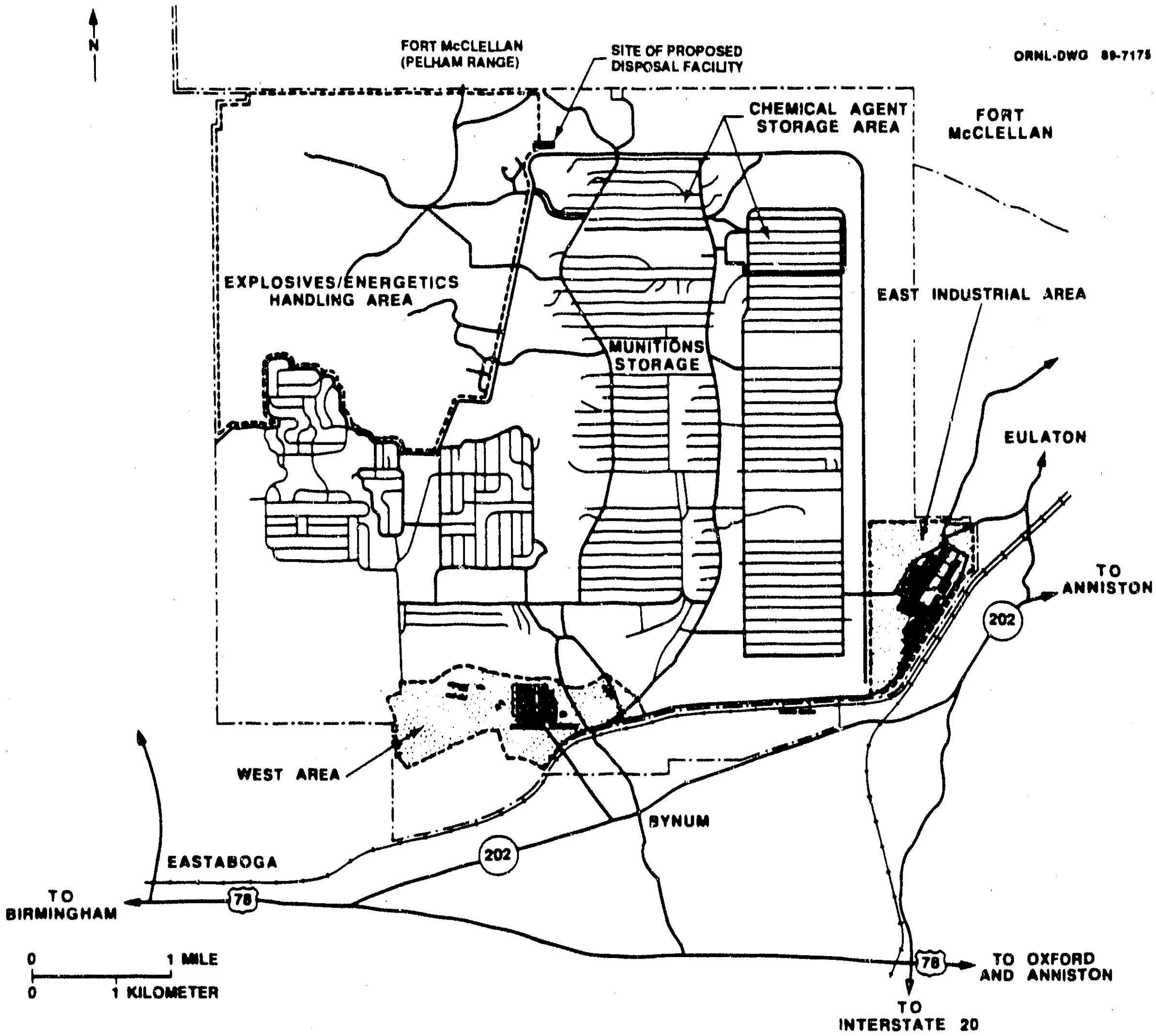

Fig. 2. General layout of the Anniston Army Depot showing the site of the proposed disposal facility.

on-site activities associated with the ANAD stockpile: continued storage, on-site disposal, or any packaging, on-site movement, and temporary storage associated with off-site disposal. This report does not address potential risks or impacts from possible actions taken outside the installation boundary (e.g., transportation from one installation to another, unloading at the receiving installation, etc.). However, on-site activities associated with the national disposal alternative are considered in the reexamination and comparison of risks among alternatives at ANAD. Technological and procedural characteristics used to reexamine the environmentally preferred alternative in the Phase I Report are assumed to be the same as those given in the FPEIS (Sect. 2 and Appendices A, C, and G) and in support studies referenced in the FPEIS. In terms of the second major issue to be addressed in Phase I, the scope is limited to potential resources that could be affected by on-site disposal at ANAD.

As mentioned in the preface, Pub. L. 99-145 allows the Army to defer destruction of the "useful 10%" of the total stockpile to a later date. ANAD is one of four installations at which the 10% would be maintained; thus, if the 10% is evenly distributed over the four installations, ANAD would be storing about 2.5% of the total stockpile, or about one third of the current stockpile in storage at ANAD at present. Deferring destruction would shorten the time frame for on-site disposal operations and thus would reduce the risk from on-site disposal. On the other hand, risk associated with continued storage would continue at ANAD, although at a reduced level due to the smaller stockpile. The decision of maintaining the "useful 10%" of the stockpile is dependent upon the production of binary agents and munitions, which is a separate action outside the scope of the CSDP. Such a decision would be made by the Secretary of Defense at a future date with full consideration of environmental factors as required by NEPA. This Phase I Report and the site specific EIS will address complete disposal of the ANAD stockpile.

The potential impact region addressed by this document is limited to the area within 100 km (62 miles) of the site of the proposed disposal facility at ANAD (Fig. 3). This area [which is also referred to as the 100-km (62-mile) zone] is the largest zone of potential human health impacts as identified in the FPEIS. At ANAD, the continued storage alternative was postulated in the FPEIS to result in potential human fatalities to a distance of 100 km (62 miles); all other alternatives (i.e., on-site disposal, regional disposal, and national disposal) considered in the FPEIS for ANAD were estimated to result in potential human fatalities to a distance of 50 km (31 miles). Thus, different impact zones are applicable to different alternatives. Also, in the FPEIS, information on some of the resources was collected for zones of different sizes [e.g., socioeconomic information was collected for the 10-km (6.2-mile) zone]. This Phase I report addresses resource information to the minimum distance applicable for the alternatives under consideration. Some resources are described for larger regions as appropriate (e.g., ecological impacts do not necessarily coincide with the zone for human fatalities; economic impacts are more appropriately described on a multi-county or regional basis).

Section 2 describes the approach taken to reassess the programmatic data for ANAD. It defines and outlines the framework under which the reexamination of FPEIS data is to be performed. The section also provides an overview of the method employed in the FPEIS to identify the environmentally preferred alternative (more detail is given in Appendix A).

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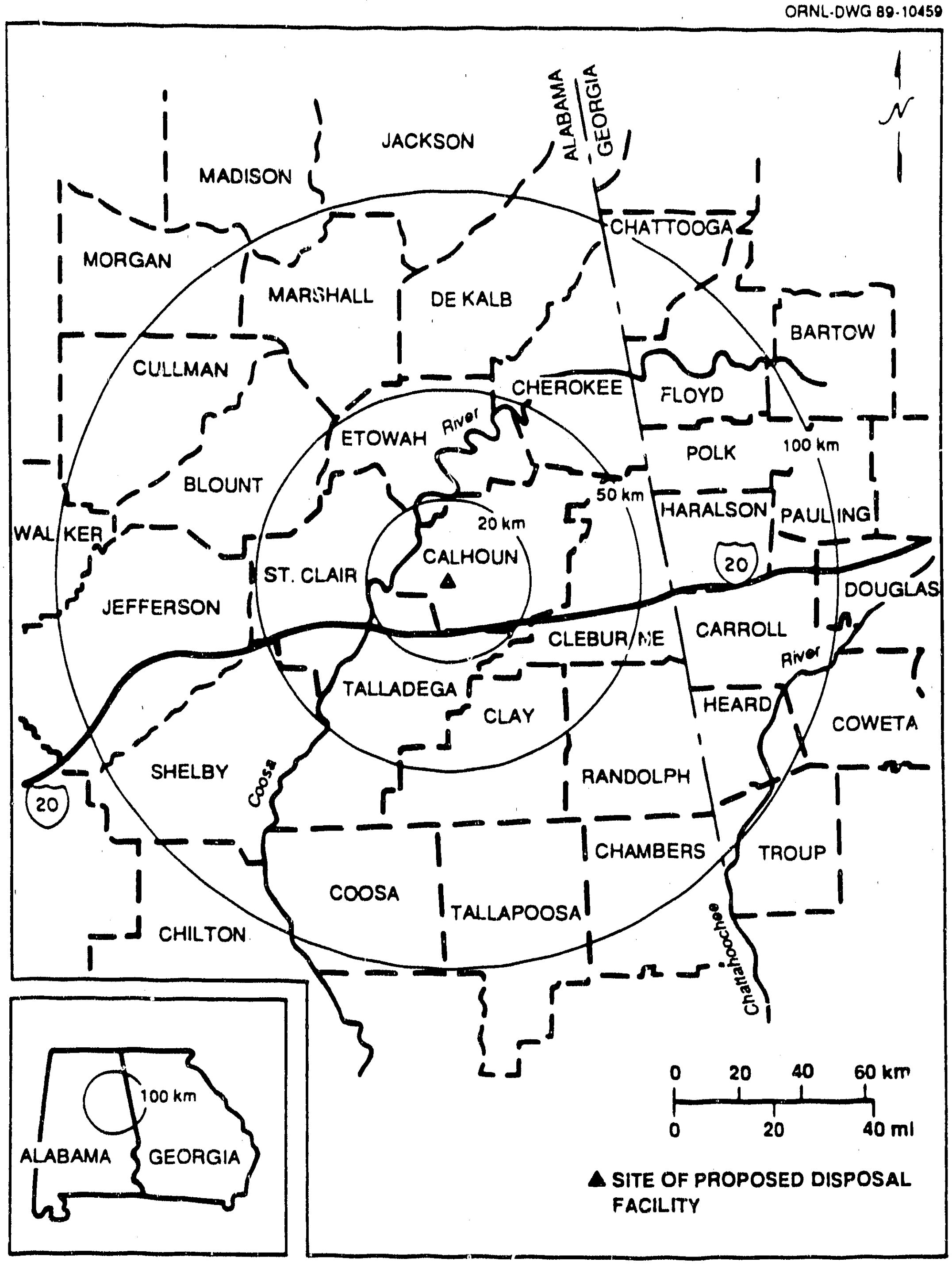

Fig. 3. Location of site of proposed disposal facility at Anniston Army Depot with respect to 20-km (12.4-miles), 50-km (31-miles), and 100-km (62-miles) zones.

Section 3 presents and compares the newly collected site-specific information and data for ANAD. Data are organized according to those affecting the process for identifying the environmentally preferred alternative (Sect. 3.1) and those relevant to site-specific implementation (Sect. 3.2). Section 3.3 addresses technological considerations such as the maturity and status of the disposal process, and Sect. 3.4 discusses technology risk assurance.

A summary of Phase I findings is given in Sect. 4, along with conclusions regarding preparation of the site-specific EIS for ANAD.

1.4 REFERENCES

U.S. Army 1988a. *Record of Decision for the Chemical Stockpile Disposal Program*, Office of the Under Secretary of the Army, February 23, 1988.

U.S. Army 1988b. *Chemical Stockpile Disposal Program Final Programmatic Environmental Impact Statement*, Vols. 1, 2, and 3, Program Executive Officer—Program Manager for Chemical Demilitarization, Aberdeen Proving Ground, Md., January.

2. APPROACH

This section of the report provides a general discussion of the process used to identify the environmentally preferred programmatic alternative in the FPEIS (U.S. Army 1988), and the types of data, assumptions, and information that were used. This then provides a basis for a conceptual overview of the Phase I Environmental Report. The approach used to gather data and information during the Phase I process for ANAD is also discussed.

2.1 IDENTIFYING THE PROGRAMMATIC ENVIRONMENTALLY PREFERRED ALTERNATIVE

During preparation of the FPEIS, a method was developed to systematically compare programmatic alternatives to identify an environmentally preferred alternative. Alternatives are compared with respect to potential impacts from implementing the alternatives under normal operations and accident scenarios.

The FPEIS concluded that potential impacts from incident-free operations would be minimal and mitigable and would not be significant in distinguishing among program alternatives. Consequently, potential effects from accident scenarios figured prominently in identifying the environmentally preferred alternative. The method consists of sequential examination and comparison of factors reflecting the programmatic goals of no fatalities and minimal environmental insult. The comparison involved three consecutive tiers of examination for each programmatic alternative: (1) human health impacts, (2) ecosystem and environmental impacts, and (3) feasibility and potential effectiveness of emergency planning and preparedness. Appendix A presents details on how the method was developed and used in the FPEIS. Figure 4 provides an overview of how the method was used to identify on-site disposal as the programmatic environmentally preferred alternative (i.e., the alternative with the least potential for causing significant adverse impacts).

For the first two tiers, five measures of risk were developed to compare alternatives:

1. Probability of one or more fatalities is the sum of probabilities for only those credible accidents (probability of occurrence $>10^{-8}$) that result in one or more fatalities under conservative most likely meteorological conditions (see Appendix A for description of these conditions).
2. Maximum number of fatalities is the largest number of fatalities and occurs under worst-case meteorological conditions (see Appendix A for description). It is the consequence of that single credible accident having the greatest lethal downwind distance and one in which the wind is directed toward the area of maximum population.
3. Expected fatalities are computed as the sum of the products of probabilities and consequences (fatalities) for all credible accidents under conservative most likely meteorological conditions.
4. Person-years at risk are computed as the product of the number of people near a site at risk from that credible accident with the greatest downwind distance for a given programmatic alternative and the length of time during which that accident could occur.

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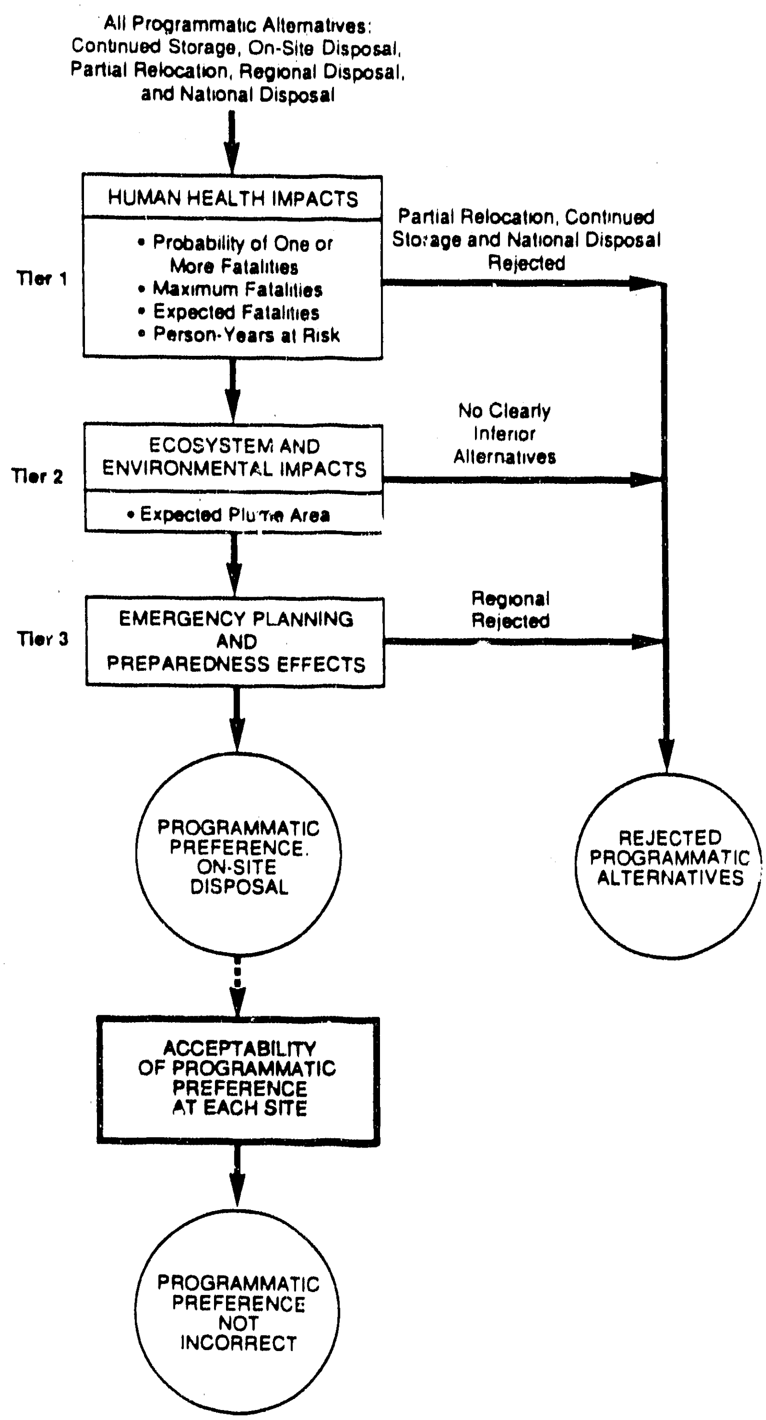

Fig. 4. Flowchart illustrating identification of the Chemical Stockpile Disposal Program programmatic environmentally preferred alternative.

5. Expected plume area is computed as the sum of the products of plume areas and associated probabilities for all credible accidents under conservative most likely meteorological conditions.

Figure 5 presents a simplified generalization of the types of data used to formulate the five measures of risk. The risk measures can be thought of as being comprised of two types of data: residential population and accident probabilities/agent release quantities (the risk measure "expected plume area" is the only one of the five that does not reflect population estimates and is represented solely by the accident database). Within the population data category, the number of people and their location are of primary interest. Within the accident database category, two types of data are of interest: internal and external. Internal data are the technology factors affecting the accident probabilities and agent release quantities: the types of equipment in the technology, the procedures by which the technology is used, and the transportation of the agents and munitions on-site. These are termed "internal" data because they are internal to the Army—that is, the Army can control these through design changes, procedure changes, or changes in the location of the proposed disposal facility (or loading facility in the case of national disposal) or in road conditions to the facility. External data, those over which the Army has little (if any) control, are meteorological factors; the amount of aircraft activity (which can be controlled over an installation through the use of prohibited airspace but which cannot be controlled outside this airspace); the frequency and intensity of earthquakes (seismicity); and the frequency of meteorite strikes on an installation. The assumptions and information used for the external data are described in more detail in Appendix A, as are the mathematical processes used to analyze the data for the computation of measures of risk.

Risk measures (1) through (4) were used for the health effects tier, and the fifth risk measure was used for the ecosystem/environment tier. No risk measures were deemed necessary for the third tier, which dealt primarily with the adequacy of emergency planning and preparedness. The FPEIS method thus consisted of comparing a particular risk measure for a given alternative with the same risk measures for the other alternatives. To avoid presenting classified data on the stockpile, the exact numbers calculated for these risk measures were not used on a site-by-site basis.
Site-specific numbers were translated into shading patterns in the form of pictograms (Appendix A). Accepting or rejecting alternatives at a given tier was done by assuming that a difference between risk measures of a factor of 100 or greater in the pictogram represented a statistically significant difference (the risk measure of maximum number of fatalities, however, did not depend on probabilities and therefore has no expressed uncertainty).

As shown in Fig. 4, all five programmatic alternatives were examined at the first tier (human health) of the process using the first four measures of risk. Partial relocation, continued storage, and national disposal were rejected based on these risk measures, leaving regional disposal and on-site disposal for the next tier. Examining the regional and on-site disposal alternatives in light of ecosystem and environmental impacts did not distinguish between alternatives.

In the third tier (emergency planning and preparedness), regional disposal was rejected because of the greater difficulties in providing adequate emergency response along transportation corridors vs. on site. On-site disposal thus survived the three tiers to become the preferred alternative.

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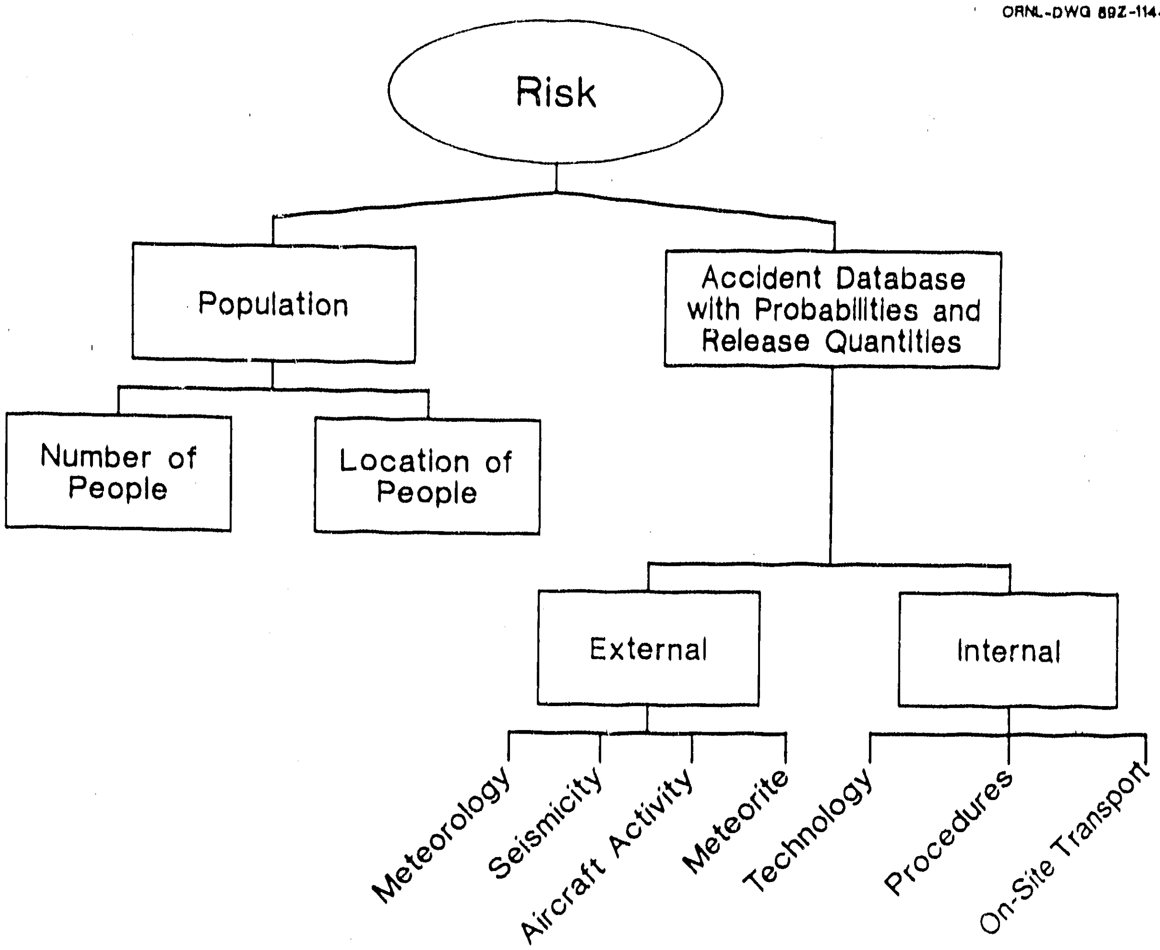

Fig. 5. Conceptual overview of data types used in selecting the programmatic environmentally preferred alternative.

The FPEIS went one step further and examined the preferred alternative, using the above process and programmatic-level data for each site, to show that the risks from on-site disposal were no greater than the risks from the other alternatives considered. Note that the method for identifying the environmentally preferred alternative was never used to identify on-site disposal at a given installation. Rather it was used to identify a programmatic alternative and was then used to show that the alternative identified was not incorrect for any given installation. This completed the impact analysis that served as input into the decision process for identifying on-site disposal as the programmatic environmentally preferred alternative.

2.2 PHASE I CONCEPTUAL FRAMEWORK

Figure 6 presents an overview of the Phase I process. The figure is directed at the use of the Phase I to reexamine the environmentally preferred alternative. The second function of Phase I—examining site-specific resources—is not unique to the

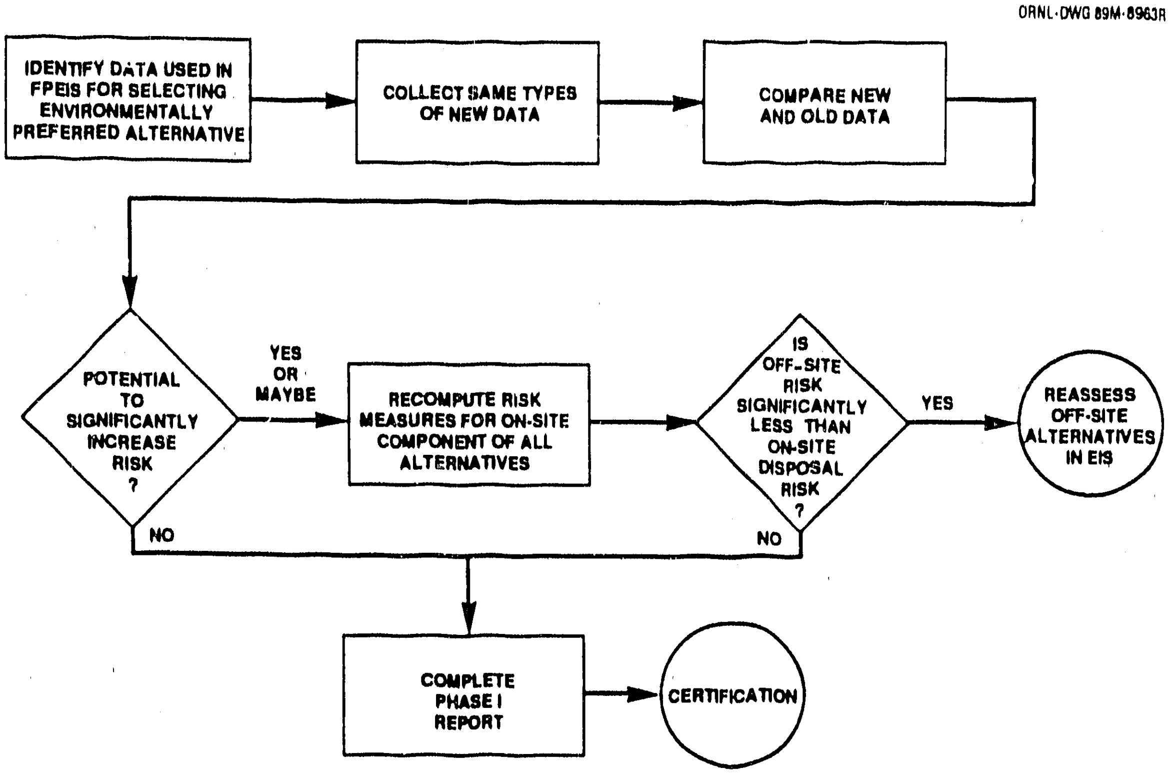

Fig. 6. Flowchart illustrating the Phase I concept.

Phase I/Phase II process and thus is not highlighted in the figure. In the first step, the data, information, and assumptions used to identify the environmentally preferred alternative are identified (see Sect. 2.1). More recent and site-specific data in these areas are then gathered (from scoping meetings, installation visits, contacts with agencies, and other sources) and examined to determine if any changes have occurred that warrant repeating the process for identifying the environmentally preferred alternative. This type of screening function is done to avoid the complex task of recomputing measures of risk "from the ground up" using every piece of new information. The changes in data that show no potential to significantly change risk for one alternative over another are merely mentioned in the Phase I report. For example, if a given risk measure significantly increases for on-site disposal without increasing the same for the other alternatives, then the programmatic results (that risks from on-site disposal are no greater than those for other alternatives considered) could be changed, thereby triggering reevaluation of off-site alternatives with more recent and detailed data. Thus, major changes in the data are not the sole criterion for recomputing risk measures; the data must also demonstrate a potential to affect one alternative more than the others.

New data that are judged to have significant potential to increase risk or that are judged to have an uncertain effect on risk are fed into the risk computation. The new data are used to compute the five measures of risk for each applicable alternative (continued storage, on-site disposal, and on-site activities associated with off-site disposal).

Those risks are incorporated into the FPEIS method for identifying the environmentally preferred alternative. The results are examined to determine if risk from off-site disposal is significantly less than risk from on-site disposal. If the answer is no, the Phase I report is completed and the Phase I process is certified (thereby allowing preparation of the site-specific EIS). If the answer is yes, then an EIS with a different scope is begun—one that addresses continued storage, on-site disposal and off-site transportation and disposal at another installation as alternatives. For ANAD, this would involve disposal of the ANAD stockpile at TEAD.

The use of the FPEIS method is expected to differ slightly in the Phase I report from that in the FPEIS. In the FPEIS, emergency planning and preparedness played an important role in identifying the environmentally preferred alternative, as shown in Fig. 4. For the scope of this Phase I Report, which is directed at distinguishing among disposal alternatives with respect to the population near ANAD, emergency planning will not be an important factor because the Army has begun enhancements of emergency planning and preparedness for ANAD and vicinity (as well as for the other seven installations), and each of the Phase I alternatives will benefit equally from the enhancements. Thus, even though the FPEIS method is used here, emergency planning has limited, if any, potential to affect the identification of the environmentally preferred alternative. For these reasons, the reexamination of the environmentally preferred alternative in this Phase I Report is based primarily on the five measures of risk and the first two tiers of the selection method.

As discussed in Sect. 2.1, the risk measures can be thought of as being comprised of two principal types of data: internal and external. The internal data in the accident database can change as the Army revises procedures and modifies the technology. However, the Army has made a public commitment that the programmatic risk given in the FPEIS represents a ceiling that will not be exceeded as the final design and operating procedures are developed. A risk assurance study is underway (see Sect. 3.4) that examines the ramifications of design changes on risk and makes modifications if the FPEIS risk ceiling is expected to be exceeded. Thus the risk assurance study is performing the function of Phase I with a slightly different approach—instead of assessing the risk ramifications of changes it is ensuring that changes resulting in risk above a ceiling do not occur. Thus, data on technology and procedures are not examined in this Phase I Report. The Phase I approach can thus be considered as conservative in that allowances are not made for technology changes that have been made to enhance public safety. On-site transport is examined in this Phase I Environmental Report because it is concerned with factors that can change due to the characteristics of each installation and its associated stockpile (even though they are still factors over which the Army has control). Primary factors associated with on-site transport are the conditions of the roads and the distances over which agents and munitions would be transported.

External data represent factors largely beyond Army control that could affect risk and, therefore, identification of the environmentally preferred alternative. Each of these data types is examined in this Phase I report to determine if FPEIS data are representative of actual conditions at a given installation. For example, the extent to which meteorological conditions (mixing height, atmospheric stability, and wind speed) at an installation are representative of the values generically assumed in the FPEIS analyses is evaluated. Recent and more detailed data on earthquake, tornado, and meteorite frequencies are examined to see if they reflect the values given in the FPEIS. Data on levels of aircraft activity, including the presence of restricted areas, the type of aircraft, the type of airspace use, and flight frequencies are also evaluated.

2.3 DATA COLLECTION AND AGENCIES CONTACTED

This document is supported by data collected by the authors during site visits in October, November, and December 1988 to the Anniston, Alabama, area. A scoping meeting was also held at the Anniston Army Depot on December 15, 1988, to solicit public input to the NEPA process and to determine the significant issues relating to the proposed action. There were no written comments received at or after that meeting. Verbal comments (approximately five) were given at the scoping meeting, and dealt primarily with re-use of the CSDP disposal equipment after the stockpile is destroyed and with emergency response at the local level.

Written comments on the FPEIS, received since its publication, have also been reviewed. None have dealt specifically with the proposed action at ANAD.

Input was also solicited from the cooperating agencies, which include the U.S. Department of Health and Human Services; the Environmental Protection Agency; the Federal Emergency Management Agency; and many agencies of the state of Alabama. Information obtained from these agencies was considered in conducting this analysis.

In addition to the documents referenced throughout this report, the following agencies were contacted during the collection of data during the Phase I process:

Alabama Department of Agriculture and Industries, Montgomery, Alabama (A. McDonald, Commissioner).

Alabama Department of Conservation and Natural Resources (specifically, Division of Game and Fish), Montgomery, Alabama (C. Kelley, Director).

Alabama Department of Environmental Management, Air Division, Montgomery, Alabama.

Anniston Public Schools, Anniston, Alabama (P. McCartney, Secretary to the Director for Curriculum).

Archives and Historical Collection, Anniston Public Library, Anniston, Alabama (J. Ernest).

Archives and Genealogy, Anniston Public Library, Anniston, Alabama (D. Stewart).

Calhoun County Board of Education, Anniston, Alabama (H. Hobbs, Administrative Assistant)

Calhoun County Chamber of Commerce, Inc., Anniston, Alabama (E. Wheatly).

Calhoun County Chamber of Commerce, Inc., Anniston, Alabama (W. Simpson).

Calhoun County Emergency Planning and Management, Anniston, Alabama (S. Slone).

Calhoun County Health Center, Anniston, Alabama (J. Munroe).

Calhoun County Mental Health Association, Anniston, Alabama (D. Harvey).

Calhoun County Soil Conservation Service, Calhoun County, Alabama (R. Berry).

Geological Survey of Alabama, Water Resources Division, Tuscaloosa, Alabama (W. Mooty).

Georgia Department of Agriculture, Atlanta, Georgia (T. Irvin, Commissioner).

Georgia Department of Natural Resources, Atlanta, Georgia (J. Ledbetter, Commissioner).

Jackson State University, Jacksonville, Alabama (H. Holstein, Archaeologist, Department of Anthropology).

Mental Health and Social Services, Anniston Army Depot, Anniston, Alabama (J. Webb).

Public Affairs Office, Anniston Army Depot, Anniston, Alabama (J. Gustafson).

Talladega County Emergency Planning and Management, Talladega, Alabama (G. Holcomb).
Talladega County Industrial Development, Inc., Talladega, Alabama (S. Smithwick).
Talladega County Public Schools, Talladega, Alabama (B. Smith).
U.S. Army Corps of Engineers, Huntsville, Alabama (A. Dohrman).
U.S. Fish and Wildlife Service, Atlanta, Georgia.
Wildlife Management, Anniston Army Depot, Anniston, Alabama (B. Byrnes).

2.4 REFERENCES

U.S. Department of the Army 1988. *Chemical Stockpile Disposal Program Final Programmatic Environmental Impact Statement*, Vols. 1, 2, and 3, Program Executive Officer-Program Manager for Chemical Demilitarization, Aberdeen Proving Ground, Md., January.

3. COMPARISON OF SITE-SPECIFIC AND PROGRAMMATIC DATA

The two major parts of this section deal with (1) reexamining the identification of the environmentally preferred alternative using recent and more detailed data than those in the FPEIS and (2) describing recent and detailed data on environmental resources that could be affected by on-site disposal. Section 3.1 uses data collected during Phase I with the FPEIS method for identifying the environmentally preferred alternative to reexamine the five FPEIS measures of risk. Section 3.1 is thus an extension of Sect. 2.6.3.3.2 in the FPEIS, which used programmatic data to examine on-site disposal at ANAD using human health impacts, ecosystem/environmental impacts, and emergency planning and preparedness effects. Section 3.2 presents data collected during Phase I for site-specific resources that could be affected by construction and operation of a disposal facility at ANAD. Potential effects on these resources will be addressed in the site-specific EIS for ANAD. Section 3.3 addresses status and maturity of the disposal technology, and Sect. 3.4 discusses technology risk assurance.

Only highlights concerning the newly collected data are given in this section. For some of the resource areas, a more complete presentation of detailed, site-specific information is contained in appendices to this report.

3.1 REEXAMINING THE IDENTIFICATION OF THE ENVIRONMENTALLY PREFERRED ALTERNATIVE

Identification of the environmentally preferred alternative was based on a risk analysis for accident conditions. As discussed in Sect. 2, the two types of data germane to the selection process are population and the accident database. Population data are concerned with the number and location of people. The accident data are concerned with the probabilities and agent release quantities of various accidents associated with each alternative; the probabilities and release quantities can in turn be thought of as being affected by external factors (e.g., meteorology, earthquakes, meteorites, etc.) and internal factors (technology, procedures, facility location). This section examines population and accident database information collected during Phase I for its potential to affect the programmatic environmentally preferred alternative at ANAD. Using those data that have appreciable potential to preferentially affect a given risk measure for a given alternative, this section then reevaluates the risk measures with the new data for the three alternatives applicable to Phase I. Last, the new risk measures are used in the FPEIS method for identifying the environmentally preferred alternative to determine if off-site disposal risk is significantly less than on-site disposal risk.

3.1.1 New Values for Programmatic Data and Assumptions and Their Significance

3.1.1.1 Accident database

As discussed in Sect. 2, of the two major types of data that affect the accident database (internal and external), most of the interest is directed toward the external data because they represent factors over which the Army has little or no control. Internal data, however, reflect factors over which the Army does have control and, thus, can limit changes to technology and procedures so that programmatic risk as presented in the FPEIS is not exceeded. This section therefore focuses on factors that could change: on-site transportation (road conditions and haul distances), meteorological factors, earthquakes (seismicity), aircraft activity, and meteorite strikes, as discussed below.

On-Site Transportation

As discussed in the FPEIS, on-site transport of agents and munitions is related to risk due to potential impacts that could occur from accidents during movement of agents and munitions within a given installation. The potential risk from a transportation accident is dependent upon a number of factors, including road conditions, vehicle speed on the roads, travel distance, the types and numbers of agents and munitions to be transported, and whether or not the on-site transportation is associated with on-site or off-site disposal. For this ANAD Phase I report, on-site transportation is relevant to the on-site disposal and national disposal alternatives; potential risks from continued storage would be unaffected by any changes in parameters affecting transportation risk.

The FPEIS assumed that all on-site transport (for on-site and off-site disposal) at all sites involved a distance of 1.6 km (1 mile), on road conditions similar to the average U.S. public roadway, at a maximum speed limit of 32 km/h (20 mph), during daylight hours and under suitable weather conditions (Sect. 2.3.2.2.1 of the FPEIS).
Factors other than road conditions and travel distance can be controlled, are incorporated into the standard operating procedures for on-site movement of agents and munitions, and thus won't be addressed further in this report. Key factors of interest with respect to transportation risk at ANAD are the road conditions and transport distances.

Road conditions and transport distances are each dependent on the actual roads to be used in moving agents and munitions during on-site disposal and during on-site activities associated with disposal off site (i.e., national disposal at TEAD). As shown in Fig. 2, the site of the proposed disposal facility is located about 0.6 km (0.4 mile) to the south of the northern ANAD border with Pelham Range (Fort McClellan). The actual road distance from the storage area to the site of the proposed storage facility ranges from 1.4 to 5.2 km (0.9 to 3.3 miles), based upon the locations of the storage igloos located the closest and the farthest from the site. The average road distance using these two values is 3.3 km (2.1 miles). In the event of off-site disposal, the chemical agents and munitions would be unloaded from storage and transported to a central loading area where they would be prepared for transport. The site of such an area for ANAD has not been identified. However, many of the siting criteria used to locate the proposed disposal facility would also be used to locate the central loading area. Consequently, it is assumed that if off-site disposal were selected for the ANAD stockpile, the central loading facility would be located either at the site of the proposed disposal facility or at a location whose distance from the storage area would not appreciably differ from the storage area--disposal facility distance.

The majority of the roads within the ANAD chemical storage area are single lane roads, unpaved but treated with dust suppressants. Upgrades are planned to widen some of the roads for two lane traffic, to allow better vehicle circulation during the CSDP, as well as to support traffic with high vehicle gross weights. There are no plans to regrade steep sections of road, which in some cases change height at slopes approaching twenty degrees. On the majority of the roads, there are narrow shoulders with deep ditches and/or steep slopes on either side, which in extreme cases are drops exceeding 15 m (50 ft).

Vehicles must be transported across these roads to move munitions to a central loading facility or to an on-site disposal facility. A change in actual road conditions from those assumed in the FPEIS risk analysis will affect the risk of the on-site and national disposal alternatives; to determine the potential effects on the risk measures for the alternatives, the accident database was examined. Risk from on-site transport under the two alternatives would not be directly proportional to haul distance because of the use of different containers for off-site vs on-site transport, different loadings of agents and munitions on vehicles, and other factors.

Differences in on-site haul distance and in road conditions from those assumed in the FPEIS could affect risk by changing the probabilities of accidents. If a given measure of risk is preferentially affected for an alternative by a change in probability, then the relative rankings of the environmental acceptability of the alternatives could change. This could influence the outcome of the method for identifying the environmentally preferred alternative.

As discussed in Sect. 2, only three of the five measures of risk (expected fatalities, probability of one or more fatalities, and expected plume area) used to identify the environmentally preferred alternative depend upon probability. Therefore, one of the key items of interest is the contribution of on-site transportation to the values of each of these measures of risk for each alternative.

A review of the accident database indicates that for the risk measure of expected fatalities, on-site transportation risks represent 62.5% of the total risk for the ANAD national disposal alternative, and 41% of the total risk for the ANAD on-site disposal alternative. The risk from continued storage has no transportation component. Any increases in on-site transportation risk values (such as from increased probability of accidents) would increase expected fatalities more for national disposal than on-site disposal at ANAD, and could not change the relative rankings of these two alternatives for ANAD as given in the FPEIS (Appendix A). It is extremely unlikely that an increase in the risk value for expected fatalities would change the relative ranking of on-site disposal with respect to continued storage, given that the risk value for on-site disposal would need to increase by more than three orders of magnitude for this to occur. Even if consideration of actual on-site haul distance and road conditions increased the probability of a transportation accident by a factor of five (a reasonable upper bound to the maximum observed change in actual vs assumed haul distance for ANAD) over that in the FPEIS, the resultant risk value would not be large enough to change the relative rankings of on-site vs continued storage for the risk measure of expected fatalities.

As indicated in Appendix A, for the other two probability-related risk measures, risk values for on-site disposal are at least equal to the values for national disposal and continued storage at ANAD in the FPEIS pictogram. A change in risk values of at least two orders of magnitude would be needed to affect the relative ranking of the alternatives with respect to these risk measures. Even a five-fold increase in probability of transportation accidents would be insufficient to produce a statistically significant difference in the relative ranking of the alternatives for these two measures of risk. Given the contribution of transportation to total risk values for each of the three measures of risk affected by probabilities of transportation accidents, and given the relative ranking of alternatives at ANAD with respect to the risk values, the changes in on-site haul distance and road conditions from those values assumed in the FPEIS would not result in significant differences in identifying the environmentally preferred alternative, and thus are not examined further in this document. The potential impacts of on-site transport characteristics will be addressed in the site specific EIS for ANAD.

Meteorology

The principal type of meteorological data of interest to the selection of the environmentally preferred alternative is the applicability of meteorological conditions assumed in the FPEIS: wind speed, atmospheric stability, and mixing height. Tornados are discussed in a separate section in conjunction with meteorites.

Meteorological data for ANAD were examined to evaluate the appropriateness of the conservative most likely (CML) and worst case (WC) meteorological conditions that were used in the FPEIS. The CML scenario represents a frequently occurring meteorological condition that results in relatively large doses compared with other frequently occurring conditions. Specifically, neutral atmospheric stability (Class D) with a wind speed of 3 m/s (6.6 mph) was selected for the CML condition. The WC scenario represents a credible condition that results in near maximum doses. Specifically, a stable atmosphere (Class E) with a wind speed of 1 m/s (2.2 mph) was chosen for the worst case condition.

Accurate measurements of wind speed and derivations of stabilities are needed to evaluate the appropriateness of the two conditions for ANAD. Quality control procedures were performed to determine the accuracy of the wind data collected at three towers located at ANAD. Although the quality of the wind data appears reasonable, and the data should be quite representative of conditions at the site of the proposed disposal facility, the atmospheric stabilities computed from data collected at ANAD are suspect. Stabilities were derived from ANAD data using methods based on the standard deviation in horizontal wind direction (sigma theta method) and based on the rate of temperature change with height (dT/dZ method). The distribution of stabilities obtained using the former method was biased in the direction of being too unstable. This finding was confirmed via actual experience of ANAD personnel in using stabilities derived from "sigma theta" (M. E. Williams, ANAD Chemical Demilitarization Officer, personal communication with R. L. Miller, ORNL, Mar. 14, 1989). The distribution of stabilities obtained using the latter method was biased in the direction of being too stable, with the vast majority of stabilities indicated as being very stable.

As a consequence of the problems in deriving atmospheric stabilities from ANAD data, other data were sought to determine the representativeness of the conditions at ANAD. Data collected at the Anniston Airport were judged to be biased with respect to wind direction (Sect. 3.2.1), and thus were not considered further for the derivation of stabilities. The nearest quality data that were located are those collected at Birmingham, Alabama, located 72 km (45 miles) west of ANAD (Fig. 1). Stabilities were successfully computed by Turner's 1964 method using ANAD wind speed data with Birmingham cloud cover and ceiling height data, for August 1985 through July 1986, as recommended by EPA (1986). The distribution of resulting stabilities appears reasonable, both by time of day and for the overall period of record.

Following the derivation of reasonable stabilities, the joint frequency distribution of stabilities and wind speed classes was constructed to determine the applicability to ANAD of the CML and WC meteorological conditions (Table 1.). The distribution indicated that neutral atmospheric stability (Class D) occurs more often (greater than 41% of the time) than any of the other classes, and D stability with winds between 2.1 and 3.6 m/s (4.7 and 8.1 mph) occurs about 15% of the time, more than any other wind speed class with

Table 1. Joint frequency distribution (in percent) of stability and wind speed for the Anniston Army Depot Drill and Transfer station, 32 m (105 ft)

Stability class	Wind speed (m/s)[a] 0–2.1	2.1–3.6	3.6–5.7	5.7–8.7	8.7–10.8	>10.8	Total
A	0.1	0.3	0.0	0.0	0.0	0.0	0.5
B	1.7	2.4	0.8	0.0	0.0	0.0	4.9
C	4.3	6.2	3.5	0.5	0.0	0.0	14.5
D	11.6	14.6	11.7	3.5	0.1	0.0	41.5
E	5.6	6.1	2.0	0.2	0.0	0.0	13.8
F	15.0	8.4	1.4	0.0	0.0	0.0	24.8
Total	38.3	37.9	19.4	4.2	0.1	0.0	100.0

[a]Multiply by 2.237 to convert to miles per hour.

D stability. Class D stability with higher wind speeds also occurs frequently, but results in less conservative predictions (lower estimated doses). Although maximum predicted doses result from Class F stability with low wind speeds, and although F stability occurs almost 25% of the time at ANAD, F stability intentionally was not used for the WC scenario because predicted doses are greater than doses realistically expected in a credible scenario. During F stability, a puff or plume meanders along a "snake-like" path rather than moving downwind in a line; therefore, actual maximum doses at given locations would be reduced compared with predicted doses that assume continuous exposure along a centerline downwind axis. Class E stability with low wind speeds produces the next highest predicted doses, and meandering is not as pronounced for E stability. For these reasons, E stability with low wind speeds was selected as the WC scenario. Class E stability with winds less than 2.1 m/s (4.7 mph) occurs approximately 6% of the time. Based on these results, it is concluded that the conservative most likely and worst case meteorological conditions used in the FPEIS are appropriate for ANAD.

The height of the mixed layer is another important meteorological factor affecting predictions of dispersion. Lowering this value would tend to decrease the volume of the atmosphere available for dispersion of agent and potentially increase predicted concentrations of agent in the atmosphere. Data on the height of the mixed layer at ANAD are not available (M. E. Williams, ANAD Chemical Demilitarization Officer, personal communication with R. L. Miller, ORNL, March 2, 1989). The best available estimates for this parameter are calculated using a combination of surface data from Birmingham and upper-air data collected at Centreville, Alabama, 136 km (85 miles) southwest of ANAD, the nearest station with upper-air data. Because the height of the mixed layer usually is very similar throughout central Alabama at any given time, these estimates of the height are representative of ANAD. The FPEIS used a value of 750 m (2461 ft) for accidental-release scenarios. An examination of morning and afternoon mixing heights by season (Holzworth 1972) for Montgomery, Alabama (the nearest station with upper-air data during the referenced study) reveals that mean morning mixing heights range from 323 m (1060 ft) in the autumn to 484 m (1588 ft) in the winter and mean afternoon mixing heights range from 1060 m (3478 ft) in the winter to 1801 m (5909 ft) in the summer. It should be noted that the mean morning mixing heights are lowered considerably by ground-level inversions during stable conditions and usually would be higher for the CML scenario of neutral atmospheric stability. For the WC scenario, the height of the mixed layer is not of concern because it is unlikely that more intense stable conditions would occur above the surface inversion that causes the stable conditions. Therefore, based on mean values reported by Holzworth, the selection of a height of 750 m (2461 ft) is appropriate for ANAD.

Seismicity

Seismic data collected during Phase I supplement those in the FPEIS in two important respects. First, foundation conditions (an uncertainty discussed in general terms in the FPEIS) are now known in greater detail. Second, corroborating evidence has been compiled that is consistent with the FPEIS assertion that faults in the ANAD region are inactive. Table 2 summarizes this information.

Data collected during Phase I (U.S. Army undated) show that the proposed disposal facilities will not be damaged by earthquake-generated soil liquefaction. The site for the proposed facilities is located on high ground where the water table is at least 18 m (60 ft)

Table 2. Summary of site-specific and programmatic earthquake parameters and site-specific earthquake design parameters at Anniston Army Depot

Earthquake parameters	Programmatic EIS	Site-specific data	Site-specific design parameters[f]
EPGA 10% probability of exceedance in 50 years	Seismic Zone 1 EPGA = 0.05 g[a] EPGA = 0.09 g[g]	Seismic Zone 2 EPGA = 0.10 g[b] Seismic Zone 2	GPSF: Seismic Zone 2, EPGA = 0.10 g MDB: Seismic Zone 3, PGA = 0.21 g
Maximum expected/ worst-case earthquake	Not provided	Giles Co., Virginia earthquake of 1897. Intensity = VIII Body-wave magnitude = 6[b,c]	
PGA for worst-case earthquake	PGA not provided	PGA = 0.28 g[b] PGA = 0.25 g[c]	Toxic cubicle, inside MDB: PGA = 0.81 g
Potential for liquefaction	None (Professional judgment)	None (Drill logs, standard penetrometer tests)	
Potential for ground motion magnification	Uncertain, foundation conditions not well known	Still uncertain but slight magnification may be anticipated (Drill logs, geology)	Appropriate response spectra for design PGA and duration of shaking
Potential for surface rupture (capable faults)	None (Professional judgment)	Unlikely[d,e]	

Note: EPGA is effective peak ground acceleration; PGA is peak ground acceleration; GPSF is General Purpose Support Facility; MDB is Munitions Demilitarization Building.

[a]ATC (Applied Technology Council), *Tentative Provisions for the Development of Seismic Regulations for Buildings*, Applied Technology Council/National Bureau of Standards Special Publication 510, U.S. Dept. of Commerce, Washington, D.C., 1978.

[b]Jacobs Engineering Group, Inc. and URS/John A. Blume and Associates, *Geological-Seismological Investigation of Earthquake Hazards for a Chemical Stockpile Disposal Facility at the Anniston Army Depot, Alabama*, Office of the Program Manager for Chemical Demilitarization, Aberdeen Proving Ground, Md., 1987.

[c]NRC (U.S. Nuclear Regulatory Commission), *Safety Evaluation Report Related to the Construction of the Clinch River Breeder Reactor Plant*, docket no. 50-537, NUREG-0968, U.S. Nuclear Regulatory Commission, Office of Nuclear Reactor Regulation, Washington, D.C., 1983.

[d]NRC (U.S. Nuclear Regulatory Commission), *Safety Evaluation Report Related to the Construction of Tennessee Valley Authority's Bellefonte Nuclear Power Plant*, docket no. 438, U.S. Nuclear Regulatory Commission, Office of Nuclear Reactor Regulation, Washington, D.C., 1974.

[e]NRC (U.S. Nuclear Regulatory Commission), *Safety Evaluation Report Related to the Operation of Tennessee Valley Authority's Sequoyah Nuclear Power Plant*, docket no. 50-327, U.S. Nuclear Regulatory Commission, Office of Nuclear Reactor Regulation, Washington, D.C., 1980.

[f]Personal communication between B. Ross, structural engineer at U.S. Army Corps of Engineers, Huntsville District and W. P. Staub, geotechnical engineer, Oak Ridge National Laboratory, June 21, 1989.

[g]Algermissen, S. T., Perkins, D. M., Thenhaus, P. C., Hanson, S. L., and Bender, B. L., 1982, Probabilistic estimates of maximum acceleration and velocity in rock in the contiguous United States: U.S. Geological Survey Open-File Report 82-1033, 107 p.

[h]U.S. Army 1982. Seismic design for buildings, TM 5-809-10, U.S. Army Corps of Engineers, Washington, D.C.

deep as indicated by several test wells. Furthermore, foundation materials are composed of cohesive clayey silts of high relative density as determined by lithologic drill logs and standard penetrometer tests, respectively. Therefore, site foundation soils under the proposed disposal facility at ANAD are not sensitive to liquefaction.

Information collected during Phase I confirms the FPEIS assertion that faults in the ANAD region are inactive and thus incapable of producing surface rupture. Surface ruptures are seldom, if ever, produced by historical earthquakes in the eastern United States (Nuttli 1981), although site-specific information is not available to support this assertion. Investigation of the ages of faults in the vicinity of the Sequoyah and Bellefonte nuclear reactor sites (Fig. 7) indicates that where Holocene or Pleistocene strata lay astride a fault trace, these strata have not been cut by the fault (NRC 1974, 1980). No faults capable of causing surface rupture [faults displaying Mid-Pleistocene to Holocene surface rupture (10 CFR 100)] have been reported in the Southern Valley and Ridge seismotectonic province. Thus it is unlikely that any capable faults will be found in the ANAD region. The Jacksonville Fault (Figs. 7 and 11) is the nearest to ANAD of the many inactive thrust faults in this province.

When the FPEIS was prepared very little site-specific seismic information was available. The maximum expected earthquake (worst-case earthquake) and associated peak ground acceleration (PGA) data were not provided. Furthermore, the potential for liquefaction, ground motion magnification, and faults capable of producing surface rupture was considered to be low (based on professional judgment rather than site-specific geotechnical data).

Foundation conditions and topography at ANAD may require that some process facility foundations be supported on deep foundation systems. If a deep foundation system is used on process facilities, the potential for magnification of earthquake induced ground motions will exist. Magnification is a design consideration under control of the U.S. Army.

ANAD is located in seismic zone 2 (potential for moderate earthquake damage). All General Purpose Support Facilities (GPSF) will be designed in accordance with Uniform Building Code (UBC) standards for seismic zone 2. All process facilities inside the main Munitions Demilitarization Building (MDB), with the exception of the Toxic Cubicle, will be designed in accordance with UBC standards for seismic zone 3 (potential for major damage). Seismic zone 3 standards are significantly more stringent than those for seismic zone 2. The MDB has been assigned the highest importance factor (I-1.5) permitted by code. To reduce the risk associated with a seismic event, the Toxic Cubicle will be designed for a worst-case earthquake response spectrum defined by the maximum peak ground acceleration and duration of motion (which are more stringent conditions than those addressed by seismic zone 3).

No other significant differences exist between the FPEIS and the site-specific seismic risk characterization. The potential for liquefaction and surface rupture during earthquakes at ANAD remains the same as presented in the FPEIS.

Aircraft activity

A review of the ANAD accident database indicates that aircraft crashes have the potential to significantly affect only continued storage risks. For example, consideration in the FPEIS risk analysis of airspace restriction for ANAD as a mitigative measure indicated that such action would have no significant impact on risk at ANAD for any alternative

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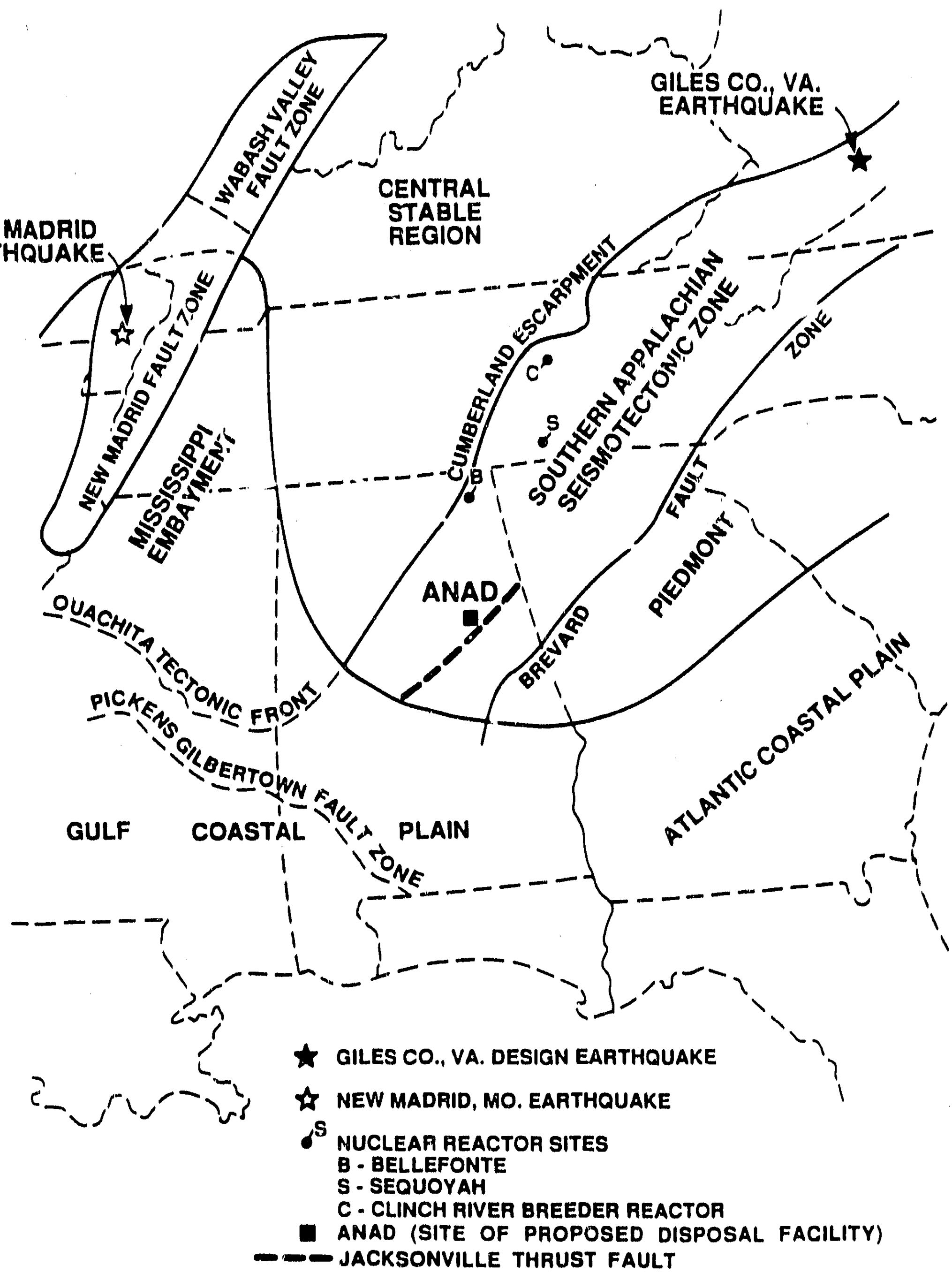


Fig. 7. Geologic provinces, fault zones, and locations of seismic data (nuclear reactor sites) with respect to the location of Anniston Army Depot.

other than continued storage (see U.S. Army 1988a). For this reason, any new data on aircraft activity would not have the potential to preferentially affect measures of risk at ANAD from on-site disposal or on-site activities associated with transportation (i.e., only continued storage would be affected). Consequently, new information would have little potential to affect risk among alternatives, and thus is not considered further in this section. However, such new data could be of interest in assessing the potential benefits from airspace controls as interim mitigation measures for continued storage until the ANAD stockpile is destroyed. These data have been gathered and are reviewed in Sect. 3.2.6.

Meteorites/Tornadoes

Data used in the FPEIS for expected frequencies of tornadoes and meteorite strikes in the ANAD vicinity are contained in Appendix A (Table A.1). These data were examined and found to be reasonable. No more recent or detailed data for these parameters beyond those in the FPEIS were located.

3.1.1.2 Population

The FPEIS presented residential population as of the 1980 census by radial sector and distance out to 100 km (62 miles), as shown in Table 3 (U.S. Army 1988a). As stated in Sect. 2, the FPEIS method for identifying the environmentally preferred alternative is based on residential population only, and does not include place-of-work or on-post populations. Because the 1980 census of population data will be nearly 10 years old by the time construction and operation of the proposed disposal facility begin at ANAD, the latest population estimates (i.e., for 1986) have been used to adjust the 1980 census data. Population estimates in noncensus years are limited to estimates of county populations and populations within incorporated areas. A two-step process was used in this assessment for each potentially impacted county to estimate the population change at the enumeration district level. First, the estimated population changes for incorporated areas were equally apportioned among enumeration districts comprising the named area. Second, the unaccounted-for change in county population was equally apportioned among enumeration districts comprising the nonincorporated areas.

As in the FPEIS, these population estimates were assigned to a grid. Whereas the estimates used in the FPEIS considered only population and enumeration district location in creating the grid-based population, the Phase I estimation method excludes population from areas that are clearly not residential (e.g., installation boundaries of ANAD and Ft. McClellan, Coldwater Mountain, and Weiss and Guntersville lakes).

The effect of using this exclusion information is to create population distributions with larger concentrations of population than were in the FPEIS. However, these concentrated population areas are now accompanied by unpopulated areas which had small, but nonzero, populations in the FPEIS.

The revised residential population data are presented in Table 4 in the same format used in the FPEIS. The effect of including the 1986 population estimates is to increase the total population within the 100-km (62-mile) zone by about 3%. It is estimated that 43,181 additional people are located in the potentially impacted population zone around ANAD compared with the population in that zone as described in the FPEIS. The data collected during Phase I show that no off-post residents are located within 2 km (1.2 miles) of ANAD, whereas the FPEIS assumed persons lived as close as 500 m (1500 ft) to the proposed ANAD disposal facility.

Table 3. Residential population distribution around the Anniston Army Depot proposed disposal facility site as given in the final programmatic environmental impact statement

Direction	Incremental population data at specified distances[a] (km)							
	0–1	1–2	2–5	5–10	10–20	20–35	35–50	50–100
N	0	0	0	95	682	16,129	35,217	34,854
NNE	1	0	0	233	2,555	2,875	5,396	30,815
NE	1	3	3	148	5,286	12,852	8,112	68,820
ENE	1	4	59	872	17,811	2,443	2,048	40,877
E	1	4	90	3,727	18,326	2,371	3,035	59,858
ESE	1	4	112	5,721	17,166	1,832	3,351	22,796
SE	0	7	241	1,318	8,029	907	2,025	19,223
SSE	0	2	145	1,559	1,578	1,414	4,287	13,795
S	0	0	16	2,448	2,197	2,225	2,040	30,393
SSW	0	0	18	356	513	18,146	4,753	27,917
SW	0	C	10	203	1,667	4,879	3,735	28,287
WSW	0	0	7	146	2,636	7,191	5,509	424,425
W	0	1	9	232	364	2,819	8,250	251,498
WNW	0	1	7	481	1,718	2,711	3,147	41,555
NW	0	1	0	180	472	2,323	4,646	45,550
NNW	0	0	0	89	533	11,157	24,006	58,677
Total	5	27	717	17,808	81,533	92,274	119,557	1,199,340

[a]Multiply by 0.6214 to obtain miles.

Source: U.S. Department of Commerce, Bureau of the Census, *County and City Data Book*; U.S. Government Printing Office, Washington, D.C., 1983.

Table 4. Residential population distribution around the Anniston Army Depot proposed disposal facility site using data collected during Phase I

Direction	Incremental population data at specified distances[a] (km)						
	0–2	2–5	5–10	10–20	20–35	35–50	50–100
N	0	0	32	761	11,856	35,961	34,584
NNE	0	0	26	3,535	2,703	6,210	30,599
NE	0	2	276	8,235	13,624	8,120	68,223
ENE	0	22	1,989	20,256	1,350	1,882	43,290
E	0	361	7,929	14,963	3,275	3,327	71,029
ESE	0	662	3,829	14,325	1,594	3,128	23,173
SE	0	449	917	7,694	1,006	2,245	19,123
SSE	0	114	1,131	1,196	1,485	3,971	13,603
S	0	161	2,152	1,825	2,160	2,049	30,302
SSW	0	0	939	906	18,033	4,631	27,084
SW	0	0	205	1,557	5,745	3,593	32,151
WSW	0	0	262	3,142	8,123	5,112	386,039
W	0	0	218	136	3,766	10,060	301,562
WNW	0	0	427	1,423	3,206	3,454	42,037
NW	0	0	146	665	2,926	5,182	49,078
NNW	0	0	0	742	12,155	25,008	62,015
Total	0	1,771	20,478	81,361	93,007	123,933	1,233,892

[a]Multiply by 0.6214 to obtain miles.

Source: U.S. Department of Commerce, U.S. Bureau of the Census, *Current Population Reports,* Series P-26, No. 86-S-SC, South-1986 Population and 1985 Per Capita Income Estimates for Counties and Incorporated Places, U.S. Government Printing Office, Washington, D.C., 1988.

Even though the relative change in residential population is not large, it does warrant reexamination of the FPEIS measures of risk for two reasons: (1) the absolute number of people affected is important, regardless of percentages, when dealing with potential fatalities, and (2) the relocation of the population resulting from use of the actual boundary of ANAD could affect the FPEIS measures of risk in a beneficial way because the number of accident scenarios may decrease. An examination of the accident database for ANAD shows that at least 70% of the total accidents at ANAD could occur within distances of 2 km (1.2 miles) from the release point. Eliminating population in this distance category by using actual installation boundaries could thus have a substantial effect on reducing the magnitudes of some of the FPEIS measures of risk for ANAD. Also, the effects of the new data on the risk measures for the three alternatives being addressed are not clear and warrant closer examination.

3.1.1.3 Summary

Evaluation of data collected during Phase I for ANAD indicates that in terms of information used to develop the five FPEIS measures of risk, only the new residential population data warrant recalculation of risk. The accident database did not undergo sufficient change to be factored into computation of risk and thus is not further considered in this Phase I Environmental Report. On-site transportation factors at ANAD (haul distance and road conditions) would tend to increase the probability of a transportation-related accident over values assumed for the FPEIS, which in turn could affect the risk values for each alternative; however, upon examination of the accident data base in light of the FPEIS risk pictogram for ANAD, it was determined that changes in transportation factors offer little potential to result in a statistically significant change to the ranking of the alternatives with respect to the five measures of risk. Thus, on-site transport is not examined further in this report. Similarly, because aircraft activity at ANAD affects only continued storage, new data that were located have limited, if any, potential to preferentially affect risk for either on-site or off-site disposal, as addressed in this Phase I report.

3.1.2 Evaluating Measures of Risk with Data Collected During Phase I

As discussed in Sect. 2, comparison of FPEIS and Phase I data is used as a screening tool to identify those factors that should be incorporated into a recalculation of the FPEIS measures of risk. Recomputing the five measures of risk with the data collected during Phase I and evaluating the results using the FPEIS decision method allow an evaluation of the suitability of on-site disposal.

As discussed in the previous section, changes in population data were found to be large enough to warrant reestimation of fatalities and recomputation of the five measures of risk. To maintain consistency with the FPEIS, only residential population is used. On-post population data have been gathered for use in the ANAD EIS, and are presented in Sect. 3.2.5. All population data will be considered in estimating fatalities for the site-specific EIS. The first step in evaluating the measures of risk is to compute estimated maximum and average fatalities. For each distance category, average fatalities are computed by calculating the mean fatalities for 360 equally spaced plumes around the site of the proposed disposal facility, and potential maximum fatalities are taken to be the largest number of fatalities from these 360 plumes.

Overlaying the updated population of Table 4 with the same assumed meteorological conditions used in the FPEIS (see Appendix A, Fig. A-3) gives new fatality estimates for accidental releases of agent at ANAD. These revised fatality estimates are presented in Table 5. For comparison, Table 6 repeats the original ANAD fatality estimates from the FPEIS (see FPEIS, Table 4.3.5).

The major difference between the revised and the FPEIS fatality estimates is that the number of fatalities for distances of 2 km (1.2 miles) or less drops to zero because, contrary to what was assumed in the FPEIS, there is no off-post residential population this close to the site of the proposed disposal facility. For distances beyond 2 km (1.2 miles), the fatality estimates based on the new residential population estimates are only slightly larger than those in the FPEIS. This increase is due largely to the increase in population since the 1980 census. The greatest increases in potential fatalities are maximum fatalities associated with accidents in the downwind distance categories of 10 km (6.2 miles) or greater. The greatest increase in estimated potential maximum fatalities is in the 50-km (31 mile) worst case category, where the estimate increases 17% (from 5000 in the FPEIS to 5850 in Phase I). This category contains the largest non-storage accident at ANAD. The next largest increase of 500 persons in the 100-km (62-mile) category is a 4.5% increase in estimated fatalities.

The fatality estimates given in Table 5 were then used to compute each of the five measures of risk for on-site disposal, continued storage, and on-site activities associated with off-site transport. The revised risk pictogram is shown in Fig. 8b along with values from the original FPEIS pictogram (FPEIS, Fig. 4.3.2) for comparison (Fig. 8a). Because this Phase I report is concerned with site-specific data differences from the FPEIS, the only alternatives included in Fig. 8 are continued storage, on-site disposal, and national disposal. The ANAD risks from national disposal are representative of those for off-site transport of the ANAD stockpile. Two other FPEIS alternatives for ANAD–regional disposal (involving ANAD as a receiving site for other installations' inventories) and partial relocation–have been omitted from Fig. 8 since they are not within the scope of this Phase I report.

3.1.3 Differences in the Measures of Risk from Those in the FPEIS

Figures 8a and 8b present a pictogram depicting the five measures of risk for appropriate alternatives at ANAD using FPEIS and Phase I data, respectively. Details on the computation of the five measures of risk presented in Fig. 8 are discussed in Appendix A. The discussion below is limited to the differences between the FPEIS risks and the risks computed from newly collected data collected during Phase I. Site-specific conclusions are presented in Sect. 3.1.4.

- Probability of one or more fatalities. As shown in Table 4, there are no off-post residents within 2 km (1.2 miles) of the proposed disposal site at ANAD. This value should be compared to the 32 residents specified in the FPEIS for the same region. As explained in Sect. 3.1.1.2, the difference is due to the use of the actual ANAD installation boundary to locate the site-specific population. The FPEIS generically assumed that this distance was 500 m (0.31 miles).

  The significance of this difference in population is directly reflected in the revisions to fatality estimates (Table 5) from those presented in the FPEIS (Table 6). As a result of fewer people living close to the ANAD installation boundary, small accidental releases of chemical agent, which in the FPEIS caused fatalities within 2 km (1.2 miles), now produce no fatalities. Many accidents are therefore eliminated from consideration in the accident database. Thus, the "probability of one or more fatalities," which is the sum of probabilities for all accidents causing at least one fatality, decreases for all alternatives (Fig. 8).

Table 5. Estimated fatalities by downwind distance for selected meteorological conditions at Anniston Army Depot using data collected during Phase I

	PHASE I fatalities[a,b]			
	Average		Potential maximum	
Downwind distance (km)	Conservative most likely meteorological conditions	Worst case meteorological conditions	Conservative most likely meteorological conditions	Worst case meteorological conditions
1.0	0	0	0	0
2.0	0	0	0	0
5.0	1	0	3	2
10.0	25	9	170	65
20.0	420	175	2,900	1,450
50.0	NA[d]	1,050	NA[d]	5,850
100.0	NA[d]	3,450	NA[d]	11,500

[a]The number of deaths is rounded.

[b]The potential maximum fatalities equals the fatalities from a plume traveling over the greatest population density. The average fatalities equals the mean of fatalities from all possible plumes in a 360° arc around the site. Data are based on residential population only; on-post population is not included.

[c]The fatality estimates are larger for an accident in the same downwind distance category under conservative most likely (CML) meteorological conditions than for an accident under worst case (WC) meteorological conditions because the CML plume is wider and hence of greater area. The accidental release of the same quantity of agent would travel further downwind under WC conditions than under CML conditions. An accident that results in a certain downwind distance under CML weather would travel one or two distance categories further under WC weather. Conversely, an accident that traveled into a certain distance category in WC weather would reach one or two distance categories less in CML weather.

[d]NA = not applicable, because the largest credible accident does not travel this distance under CML weather conditions.

Table 6. Estimated fatalities by downwind distance for selected meteorological conditions at Anniston Army Depot as given in the final programmatic environmental impact statement

	FPEIS Fatalities[a,b]			
	Average		Potential Maximum	
Downwind distance (km)	Conservative most likely meteorological conditions	Worst case meteorological conditions	Conservative most likely meteorological conditions	Worst case meteorological conditions
1.0	0	0	0	0
2.0	1	1	1	1
5.0	2	1	6	3
10.0	50	20	150	60
20.0	500	225	2,600	1,450
50.0	NA[d]	1,075	NA[d]	5,000
100.0	NA[d]	3,100	NA[d]	11,000

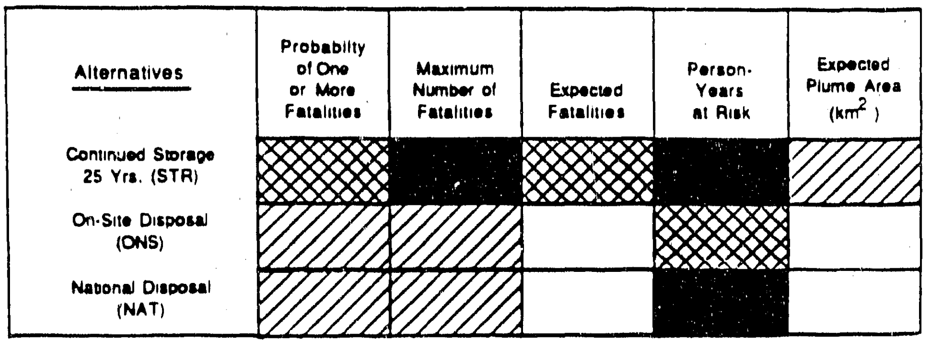
[a]The number of deaths is rounded. FPEIS = final programmatic environmental impact statement.

[b]The potential maximum fatalities equals the fatalities from a plume traveling over the greatest population density. The average fatalities equals the mean of fatalities from all possible plumes in a 360° arc around the site. Data are based on residential population only; on-post population is not included.

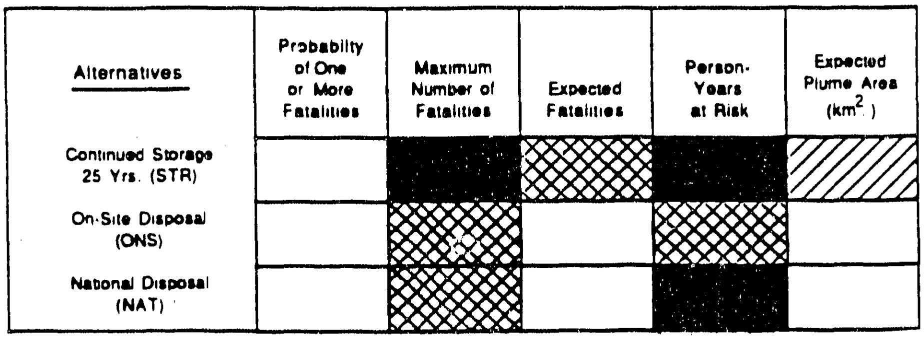
[c]The fatality estimates are larger for an accident in the same downwind distance category under conservative most likely (CML) meteorological conditions than for an accident under worst case (WC) meteorological conditions because the CML plume is wider and hence of greater area. The accidental release of the same quantity of agent would travel further downwind under WC conditions than under CML conditions. An accident that results in a certain downwind distance under CML weather would travel one or two distance categories further under WC weather. Conversely, an accident that traveled into a certain distance category in WC weather would reach one or two distance categories less in CML weather.

[d]NA = not applicable, because the largest credible accident does not travel this distance under CML weather conditions.

A. ORIGINAL RISK PICTOGRAM (FROM THE FPEIS)



B. REVISED RISK PICTOGRAM (USING PHASE I FATALITY DATA)



Numerical Equivalents

Legend: Relative Risk	Shading	Probability of One or More Fatalities	Maximum Number of Fatalities	Expected Fatalities	Person-Years at Risk	Expected Plume Area (km^2)
Higher		$>10^{-3}$	>10,000	$>10^{-2}$	$>10^{6}$	$>10^{-2}$
		10^{-4} - 10^{-3}	5000 - 10,000	10^{-3} - 10^{-2}	10^{5} - 10^{6}	10^{-3} - 10^{-2}
		10^{-5} - 10^{-4}	1000 - 5000	10^{-4} - 10^{-3}	10^{4} - 10^{5}	10^{-4} - 10^{-3}
Lower		$<10^{-5}$	<1000	$<10^{-4}$	$<10^{4}$	$<10^{-4}$

Fig. 8. Risk with mitigation, in the vicinity of Anniston Army Depot (ANAD) for programmatic alternatives. (Risk along transportation corridors or at a national destruction site is not included. For the on-site and national disposal alternatives, this diagram does not include the risk associated with approximately 3 years of stockpile storage at ANAD.)

- Maximum number of fatalities. Based upon newly collected population data, the "maximum number of fatalities" for a 50-km accident at ANAD would be 5850 (Table 5). For a 100-km (62-mile) accident the number would be 11,500. These numbers compare to 5000 and 11,000 respectively as presented in the FPEIS (Table 6). The 100-km (62-mile) accident is associated with continued storage; the other alternatives at ANAD have a 50-km (31-mile) accident as their worst case.

  The revised pictogram shading for continued storage does not change from the FPEIS. However, the larger number of potential fatalities for the 50-km (31-mile) accident (5850 from data collected during Phase I versus 5000 in the FPEIS) creates one higher level of pictogram shading than was presented in the FPEIS for the other alternatives.

- Expected fatalities. The revised pictogram representation of the "expected fatalities" measure of risk does not change from that presented in the FPEIS.

- Person-years at risk. The total population within the 100-km (62-mile) potential impact zone increased by 2.8% over the population data presented in the FPEIS for the ANAD area. For the 50-km (31-mile) potential impact zone, the increase was 2.7%. Since the periods for disposal or off-site transport operations at ANAD are the same as they were in the FPEIS, "person-years at risk" for each alternative increased by only about 3%. Therefore, the pictogram representation of "person-years at risk" does not change from that presented in the FPEIS.

- Expected plume area. Because neither the probability of an accident nor the resulting plume area was changed by the collection of data collected during Phase I, the "expected plume area" measure of risk did not change from that presented in the FPEIS.

3.1.4 Identifying the Site-Specific Environmentally Preferred Alternative

Figure 8b presents the revised, site-specific measures of risk for ANAD. This figure depicts risks from the perspective of the population residing near ANAD. Figure 8b includes the national disposal alternative as a surrogate for off-site transport from ANAD. Cross-country transportation risks for an off-site disposal alternative are not shown, but would be the same as presented in the FPEIS for a regional or national disposal option. Results for the five measures of risk are as follows:

Measure of risk	Result
Probability of one or more fatalities	All alternatives statistically indistinguishable
Maximum number of fatalities	All alternatives statistically indistinguishable. Continued storage worse than others but not at a statistically significant level
Expected fatalities	Continued storage rejected (risk is higher by two pictogram shading patterns than either on-site or national disposal)

Person-years at risk	All alternatives statistically indistinguishable. On-site disposal better than others but not at a statistically significant level
Expected plume area	All alternatives statistically indistinguishable. Continued storage worse than others but not at a statistically significant level

Based on the above examination of Fig. 8b, the continued storage alternative at ANAD can be rejected. The other alternatives (i.e., on-site disposal and off-site disposal) are statistically indistinguishable. However, it should be noted that the risks from the proposed action (on-site disposal) are in all cases equal to, or less than, the risks from other alternatives.

The conclusion is that on-site disposal remains valid as the "environmentally preferred alternative" for ANAD. From the perspective of the population near ANAD, the risks from on-site disposal are in all cases equal to, or less than, the risks from other alternatives. If one adds the off-site transportation risks (not shown in Fig. 8 and beyond the scope of this report), the on-site alternative is clearly preferable given the opportunity for risk reductions associated with emergency planning and preparedness activities that are under way at ANAD.

3.2 NEW INFORMATION AFFECTING SITE-SPECIFIC IMPLEMENTATION

As discussed in Sect. 2, some of the resources and information, although considered in the FPEIS, were not overriding factors in comparing programmatic alternatives and in identifying the environmentally preferred alternative. These factors are: air quality; surface water and groundwater; land use; ecology; and social, economic, and cultural resources. Some types of resource data (e.g., meteorology and aircraft activity) are germane to both Sects. 3.1 and 3.2 in that they were used to identify the environmentally preferred alternative and they were also used to assess potential environmental impacts not considered in the risk-based method for identifying the environmentally preferred alternative. Aspects of these data types are discussed in this section to the extent that they pertain to potential impacts from construction, incident-free operation, and accident scenarios. In this Phase I review, these resources are again being examined to determine if significant resources are present that could be affected by the proposed on-site disposal facilities. Emergency response is also discussed to provide a status of planning and preparedness activities at ANAD.

3.2.1 Meteorology/Air Quality

Since the completion of the FPEIS, on-site meteorological data, including wind speed and direction, have been obtained for a 3-year period (July 1985 to August 1988) from four meteorological towers located within the ANAD installation (Fig. 9). These data can be compared with data that were used in the FPEIS from Anniston (Calhoun County) Airport, located approximately 15 km (9.3 miles) southeast of the site for the proposed disposal facility, to determine which are more representative of the wind at the site of the proposed facility. Although the available period of record is longer at Anniston Airport, it is less recent (January 1949 to December 1954). Winds were measured at approximately 10 m (34 ft) above ground level (agl) at Anniston Airport and at multiple

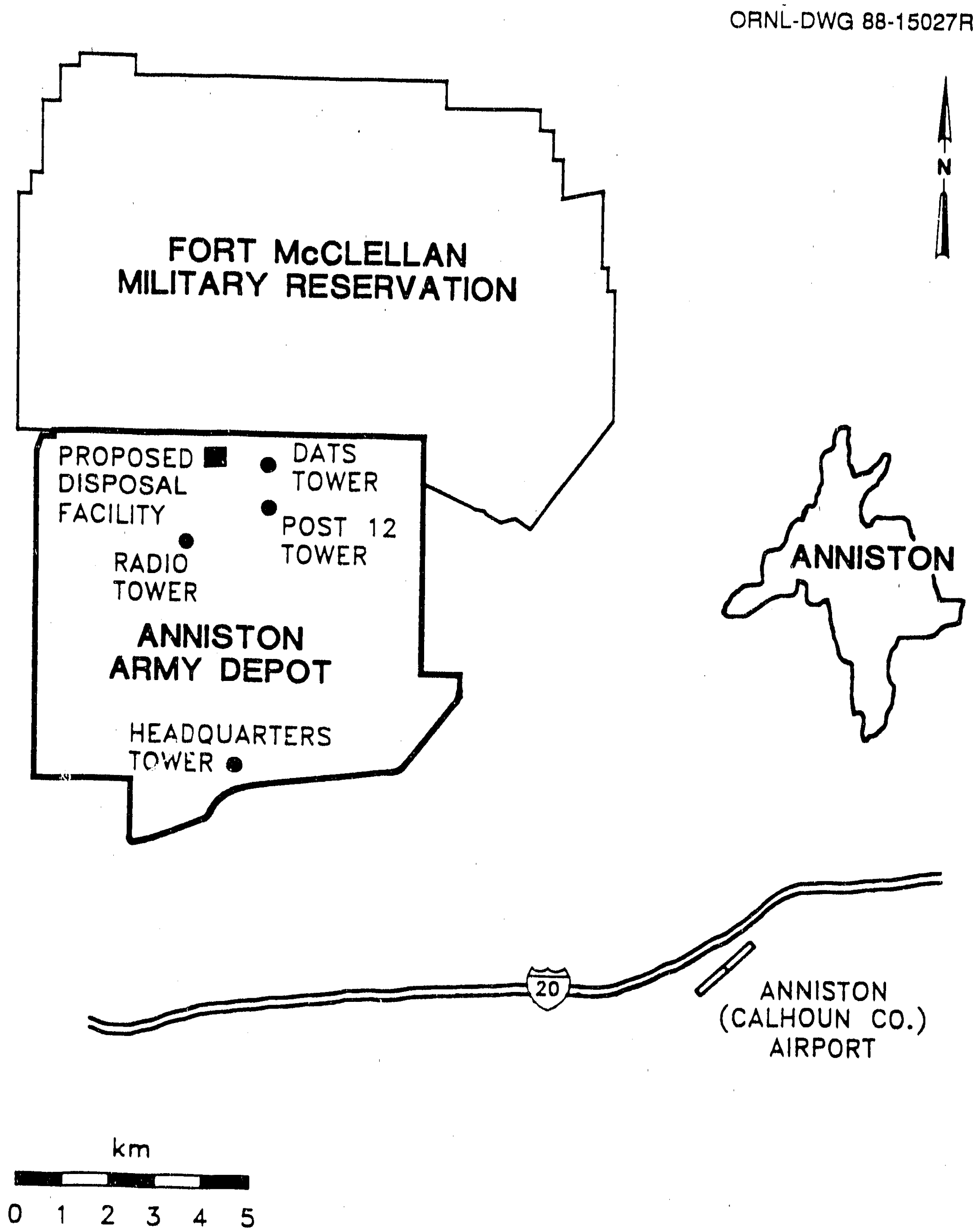


Fig. 9. Locations of Anniston Army Depot meteorological towers (providing site-specific data) and the Anniston Airport.

levels at ANAD [30 m (98.4 ft) agl at two towers and both 2 and 32 m (6.6 and 105 ft) agl at the other two towers].

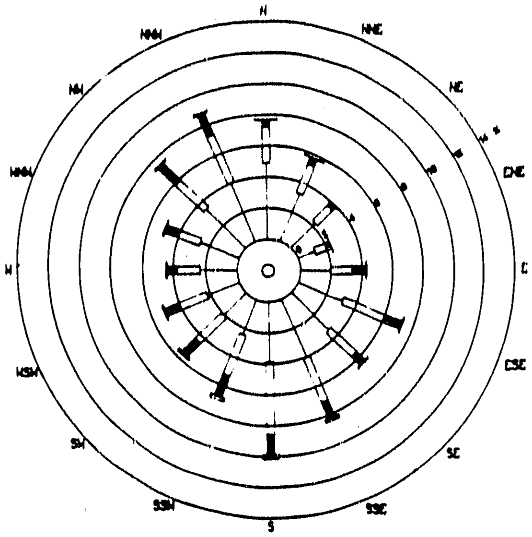
Quality control procedures were performed to determine if the data recorded at ANAD are reliable. Because large gaps exist in the ANAD data for the 3-year period (1985–1988), a 1-year "core" period that contains few gaps was used in the quality assurance analysis to include a relatively equal sample of data from throughout the year. Data measured at the 2-m (6.6-ft) levels were not used because this level is located beneath the tree canopy, resulting in extremely localized wind patterns that are not expected to be representative of the site of the proposed facility. The data collected 30 m (98.4 ft) agl at the Headquarters tower (Fig. 9) were not used because adequate records of data were available for locations closer to the site of the proposed disposal facility. The quality of data at the remaining locations appears reasonable for use in the site-specific EIS.

The wind data can be compared most easily in the form of wind roses that summarize the wind direction and speed at the sites. Figures 10a–c present wind roses for ANAD for the three towers with a useful period of record: the Post 12 tower at 32 m (105 ft) agl, the Drill and Transfer System (DATS) tower at 32 m (105 ft) agl, and the Radio tower at 30 m (98.4 ft) agl, respectively. Figure 10d displays the wind rose for Anniston Airport that was used in the FPEIS. The wind roses depict the annual joint frequency distribution of wind speed and wind direction. In these graphs, winds blowing from each direction are plotted as individual bars that extend from the center of the circular diagram. Wind speeds are denoted by bar widths; the frequency of wind speed within each wind direction is depicted according to the length of the bar. Note that the points on the wind roses represent the directions from which the winds come. The frequency is given as the percentage of the total number of measurements at the location.

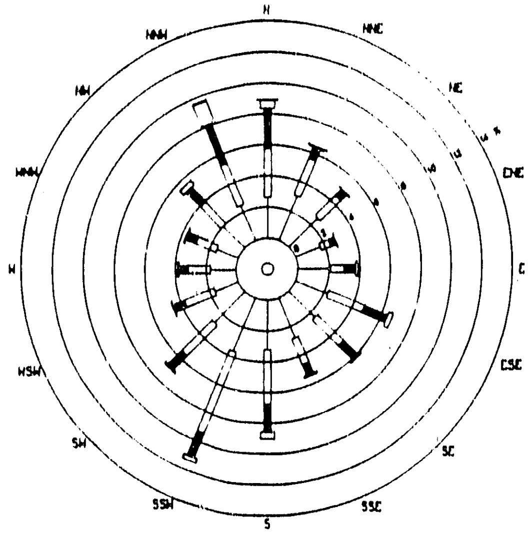
A comparison of the three wind roses for ANAD reveals a similar pattern: prevailing winds are generally from the south, with secondary peaks from the north-northwest and north. This similar pattern suggests that the quality of data appears reasonable. Although the terrain at ANAD is hilly, there is no dominant topographic feature that broadly influences the wind by channeling the flow. The small differences among wind roses are probably due to extremely localized flows. Because the Radio tower is located on top of a large hill, whereas the Post 12 tower and DATS tower are situated in fairly level terrain, a larger frequency of high wind speeds occurs at the Radio tower than at the other two sites.

The wind rose for Anniston Airport displays a strikingly different pattern from the wind roses for ANAD. The prevailing winds are from the east and northeast at Anniston Airport, with high occurrences of westerly wind. Anniston Airport is located in a fairly broad valley that is oriented along an axis from west-southwest to east-northeast; as a result, the wind flow tends to be channeled along the axis of the valley. In contrast, the wind towers at ANAD are located at higher elevations on hilly terrain beyond significant influence from the valley. The wind rose for Anniston Airport also displays a bias toward the eight principal points of the compass because of the method in which the observers took the readings. In addition to wind direction, a comparison of wind speeds reveals a larger frequency of low wind speeds at Anniston Airport, which is due to the instrument being sited nearer the ground [10 m (34 ft) agl] and to the site's location in a valley.

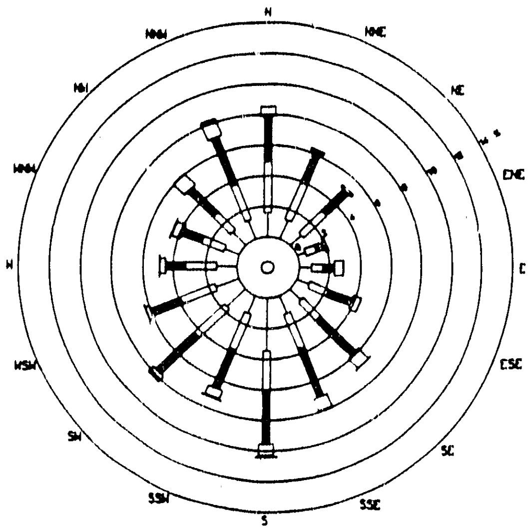
The wind data from within the ANAD installation are distinctly different from data at Anniston Airport, and data within the ANAD installation are more representative of the wind at the site of the proposed disposal facility. For the ANAD site-specific EIS, wind data from all four data sets will be considered in assessing impacts during incident-free operations. Results will be compared with applicable ambient air quality standards. The EIS will discuss the range of predicted ground-level concentrations using the various data sets.



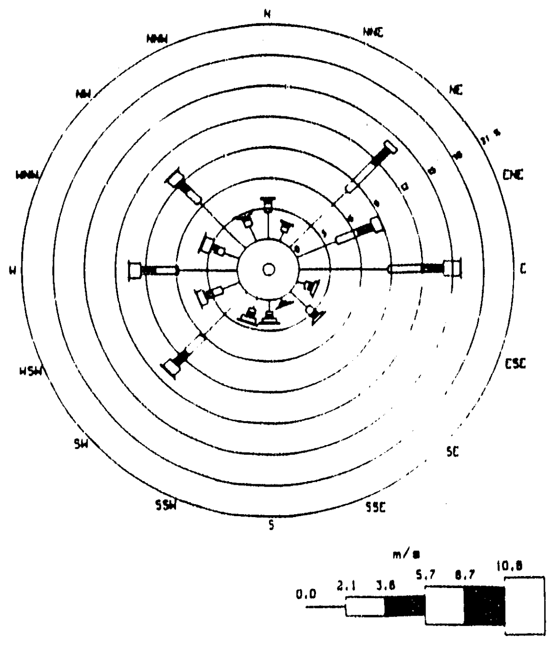
a. WIND ROSE for Post 12 Tower (32 m)
for 07/02/85–07/06/86



b. WIND ROSE for DATS Station (32 m)
for 08/02/85–07/05/86



c. WIND ROSE for Radio Tower (32 m)
for 07/02/85–07/05/86



d. WIND ROSE for Anniston (Calhoun Co.) Airport,
1950–54

Fig. 10. Wind roses (annual joint frequency distribution of wind speed and wind direction) for data collected at Anniston Army Depot and at Anniston Airport.

With regard to existing ambient air quality, the Anniston area is currently designated as an attainment area for all criteria pollutants [W.G. Hardy, Alabama Department of Environmental Management (DEM), personal communication with R. L. Miller, Oak Ridge National Laboratory, Oak Ridge, Tenn., Feb. 3, 1989]. The nearest Class I Prevention of Significant Deterioration (PSD) area, designated to greatly restrict the degradation of ambient air quality, is Sipsey Wilderness Area, located 165 km (102 miles) northwest of the site of the proposed disposal facility. The potential effects of the proposed disposal facility on air quality at Sipsey Wilderness Area will be considered in the ANAD EIS.

Five coal-fired boilers, each with heat input of approximately 30 million Btu and a capacity factor ranging from 30 to 40%, operate at ANAD under permits with the Alabama DEM. A natural-gas fired boiler with heat input of 61.5 million Btu is also operating under permit. The combined emissions from these sources are of sufficient magnitude to result in ANAD being designated as a major stationary source of air emissions. Consequently, emissions from the proposed disposal facility would be evaluated against lower thresholds to determine the need for more comprehensive reviews during the air permitting process for the disposal facility. The nature and extent of these reviews will be addressed in the ANAD EIS. In addition, open burning of obsolete/nonfunctional ammunition items and crates and pallets contaminated with explosive material is conducted at the depot burning grounds and demolition pit. The Alabama DEM has granted conditional approval for the burning.

3.2.2 Water Resources

Detailed data concerning surface water and groundwater resources in the immediate vicinity of ANAD were gathered during the Phase I process and are summarized in Appendix C. Two new pieces of information have been identified that warrant discussion.

First, Coldwater Spring has been identified as an important source of municipal groundwater in Calhoun County. Ninety-three percent of the total water consumption in Calhoun County is supplied by groundwater (Baker and Mooty 1987). Most of this groundwater is obtained from Coldwater Spring, which supplies drinking water to the cities of Anniston, Blue Mountain, Oxford, and several suburban areas, as well as the Fort McClellan Military Reservation and ANAD. Coldwater Spring has served as the municipal water supply for Anniston since 1890. The groundwater regime supplying Coldwater Spring has been designated as a Class I aquifer by the U.S. Environmental Protection Agency (EPA) (Scott, Harris, and Cobb 1987).

The principal direction of groundwater movement directly beneath the site of the proposed disposal facility is the second piece of important new information. The water table map displayed in Fig. 11 indicates that groundwater from the site of the proposed disposal facility at ANAD flows down the northwestern slope of Choccolocco Mountain into Anniston Valley where it then contributes to the baseflow of Cane Creek and the Coosa River. This principal groundwater flow direction is away from the recharge area of Coldwater Spring. The location of the proposed disposal facility straddles the groundwater divide that apparently coincides with the topographic and surface water divide formed by the crest of Choccolocco Mountain. The principal groundwater flow direction from the southern part of the chemical agent and munitions storage area is southward towards Choccolocco Creek and possibly Coldwater Spring.

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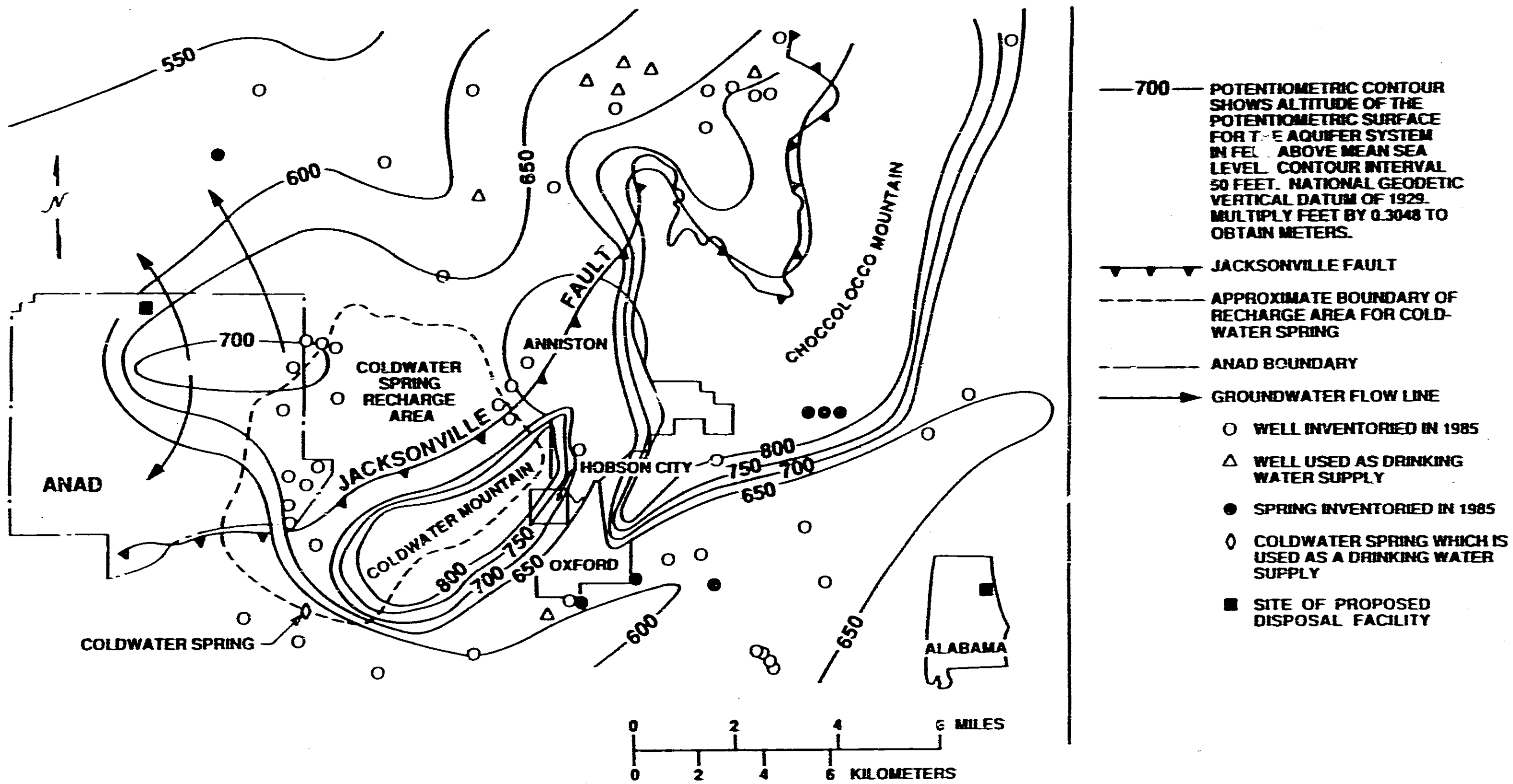

Fig. 11. Potentiometric map and groundwater flow directions in the vicinity of Anniston Army Depot. *Source:* J. C. Scott, W. F. Harris, and R. H. Cobb, *Geohydrology and Susceptibility of Coldwater Spring and Jacksonville Fault Areas to Surface Contamination in Calhoun County, Alabama,* Water-Resources Investigations Report 87-4031, U.S. Geological Survey, Denver, 1987.

These new pieces of information indicate that groundwater beneath the site of the proposed disposal facility flows away from Coldwater Spring, while groundwater beneath the southern part of the existing chemical munitions storage area flows southward and possibly towards Coldwater Spring, whose groundwater regime has been designated as a Class I aquifer by the U.S. EPA. This information will be further evaluated in the site-specific EIS for ANAD.

3.2.3 Land Use

Supplemental information collected for the ANAD area indicates that there has been relatively little change in the generalized data presented in the FPEIS. No unique land-use resources have been identified for the region around ANAD. Additional, detailed information about site-specific land use is given in Appendix D.

3.2.4 Ecological Resources

Accidental releases of agents and munitions could result in direct and indirect effects on ecological resources. Direct effects would primarily be death of plants or animals. Indirect effects are possible death of organisms through stress caused by loss of habitat and food. For identifying potential ecological resources that could be affected by releases of all agent types, the distances for the "no-effects" and human "no-deaths" zones are based on the most serious accident for each alternative under worst-case meteorological conditions (see Appendix A).

For releases of agents GB and VX, assessment of potential impacts to ecological resources in the site-specific EIS will use the "no-effects" zones, which usually reflect distances that are about seven times greater than those used for the "no-deaths" zones (U.S. Army 1988a). For ANAD, the "no-deaths" distance is 100 km (62 miles) for continued storage, and 50 km (31 miles) for on-site disposal. The "no-effects" distances would thus extend hundreds of kilometers from the site of the proposed disposal facility at ANAD for the alternatives of interest. Due to the uncertainties associated with dispersion modeling at distances beyond 100 km (62 miles), ecological resources located beyond this distance will not be considered for the site-specific EIS. Even within the human health "no-effects" zones, impacts to ecological resources could result.

For releases of mustard, "no-effects" distances are not considered because the agent is a carcinogen and the human "no-effects" concentration is unknown (U.S. Army 1988a). Thus, the "no-deaths" zone for mustard agent [5 km (3.1 miles)] is used to identify potential ecological resources for this type of agent.

Ecological resources are of interest because they provide the backbone of support for the human population, including employment (e.g., agriculture, lumber, industry, etc.) and recreational opportunities (e.g., fishing, hunting, and outdoor sports). Threatened and endangered species are of particular interest because of their greater sensitivity to extinction given their limited numbers. Protecting species from extinction is important because of the need to maintain biodiversity, which has direct bearing on the quality of the human environment. Furthermore, the Endangered Species Act of 1973 (Pub. L. 93-205) requires federal agencies to ensure that their actions do not jeopardize the continued existence of endangered or threatened species, nor destroy or adversely modify designated critical habitat for such species. Resource areas of special ecological interest include wilderness and wildlife areas, Nature Conservancy areas, and national parks.

More detailed information on ecological resources gathered since the FPEIS is shown in Tables 7 and 8. Contacts made in preparing this Phase I report [Larry Goldman, U.S. Fish and Wildlife Service (FWS), Daphne, Ala., personal communication to V. R. Tolbert, ORNL, Oak Ridge, Tenn., Feb. 7, 1989] have determined that there are endangered species that occur within the impact zone and that were not included in the FPEIS (see Appendix E). Other species that were listed in the FPEIS occur in parts of counties not included in the 100-km (62-mile) zone and have been eliminated from consideration during the Phase I process. Consultation for the site-specific EIS for ANAD has been initiated with FWS. Ecological resources of special interest that were identified in preparation for the site-specific EIS are identified in Table 8, and their locations are identified in Fig. 12. The pygmy sculpin and the sculpin snail, which occur within 20 km (12.4 miles) of the site, are candidate species for the federal list of threatened and endangered species (Sandy Tucker, FWS, Daphne, Ala., personal communication to Virginia Tolbert, ORNL, Oak Ridge, Tenn., Jan. 26, 1989). One wilderness area and one wildlife refuge have been identified since preparation of the FPEIS: Cheaha National Wilderness Area (NWA) (located within the Talladega National Forest) and the Watercress Darter National Wilderness Refuge (NWR) [located approximately 100 km (62 miles) west of ANAD].

Endangered species could be affected by a release of chemical agent. Prevailing wind direction at ANAD is generally from the south, such that the Talladega National Forest and associated Cheaha National Wilderness Area (see Fig. 12) are generally not downwind of ANAD, which would help minimize potential impacts from a release. If an atmospheric release were to occur when the wind direction was from the NNW or NW, impacts could occur to ecological resources both within and outside these ecological resource areas. An accidental release could result in extensive losses of wildlife (77% of the area within the three impact zones is forest land).

The U.S. Fish and Wildlife Service stated during informal consultation for this Phase I report that the Indiana Bat, eastern cougar, fine-rayed pigtoe and shiny pigtoe clams, pearly mussels (pink mucket, Alabama lamp, and pale lilliput), and snail darter (previously identified) do not occur within the 100-km (62-mile) zone. The flattened musk turtle was a proposed species and the little amphianthus plant, Mohr's Barbara's button plant, and the Alabama leatherflower were candidate species during the FPEIS process; all are now designated as threatened or endangered species. (Larry Goldman, FWS, personal communication to V.R. Tolbert, Oak Ridge National Laboratory, February 7, 1989). The orange-footed pimple-back mussel identified by FWS during the preparation of this Phase I Report occurs between approximately 80 and 100 km (50–62 miles) NW of the site and is separated from the site by Sand Mountain; the terrain and distance between the site and this endangered species would minimize the potential for any effect from an atmospheric release. The pygmy sculpin was listed in the FPEIS as a state endangered species that could be adversely impacted by a chemical agent accident. If agent is released in sufficient concentrations by aerosolization during storage or on-site disposal and the wind direction is from the northwest, this species, as well as the coldwater darter and sculpin snail, could be adversely impacted by atmospheric deposition on Coldwater Spring. Drainage from the site of the proposed disposal facility is to the northwest and away from the recharge area of Coldwater Spring; consequently, the potential for impact on these two species (pygmy sculpin and sculpin snail) from a spill of agent onto the ground is small. The habitat of the red cockaded woodpecker in the northeastern section of the Talladega National Forest is downwind of the proposed site much of the time, while the habitat in the southwestern section of the national forest is

Table 7. Number of ecological resources of special interest within 100 km (62 miles) of the site of the proposed disposal facility at Anniston Army Depot as identified during the Phase I process[a]

Resource	Agent released	
	H, HD, HT[a]	GB and VX[b]
National park units	0	1
Wilderness areas	0	1
National forests	0	2
Threatened and endangered species[b]	2	10
Wild and scenic rivers	0	0
Nature Conservancy areas[c]	1	5
Total	3	19

[a]Based on the most serious on-site accidents under worst-case meteorological conditions.
[b]Does not include candidate species.
[c]Updated information will be included in the site-specific EIS for ANAD. Values given are from the FPEIS.

Table 8. Ecological resources of special interest located within 100 km (62 miles) of the site of the proposed disposal facility at Anniston Army Depot

Area	Location (County)	Acreage[a]	Distance to site[b]
	National Forests (NF)		
Talladega NF, Ala.	Calhoun	22,730	15 km SSE
	Clay	64,586	
	Cleburne	86,546	
	Macon	10,734	
	Talladega	46,101	
Chattahoochee NF, Ga.	Chattooga	19,339	~100 km NNE
	National Parks		
Horseshoe Bend National Military Park, Ala.	Tallapoosa	2,040	75 km SSE
	National Wilderness Areas (NWA)		
Cheaha NWA, Ala.	Clay	6,780	20 km SSE
	National Wildlife Refuges (NWR)		
Watercress Darter NWR, Ala.	Jefferson	7	~100 km W
	State Parks (SP)		
Buck's Pocket SP, Ala.	Dekalb		85 km NNW
Cheaha SP, Ala. (in Talladega NF)	Clay		25 km SSW
James H. Floyd SP, Ga.	Chattooga	269	100 km NNE
John Tanner SP, Ga.	Carroll	136	75 km E
Lake Guntersville SP, Ala.	Marshall		80 km NNW
Oak Mountain SP, Ala.	Shelby		85 km WSW
Rickwood Caverns SP, Ala.	Blount		85 km WNW

[a]Multiply by 0.4047 to convert to hectares.
[b]Multiply by 0.6214 to convert to miles.
Sources: U.S. Forest Service, *A Summary of Recreation Use (M/RVDS) for FY 1986 by Activity*, Washington, D.C., 1987; U.S. Forest Service, *Land Areas of the National Forest System, as of September 30, 1988*, Washington, D.C., 1988; National Park Service, Statistical Office, *National Park Statistical Abstract 1987*, Denver, 1988.

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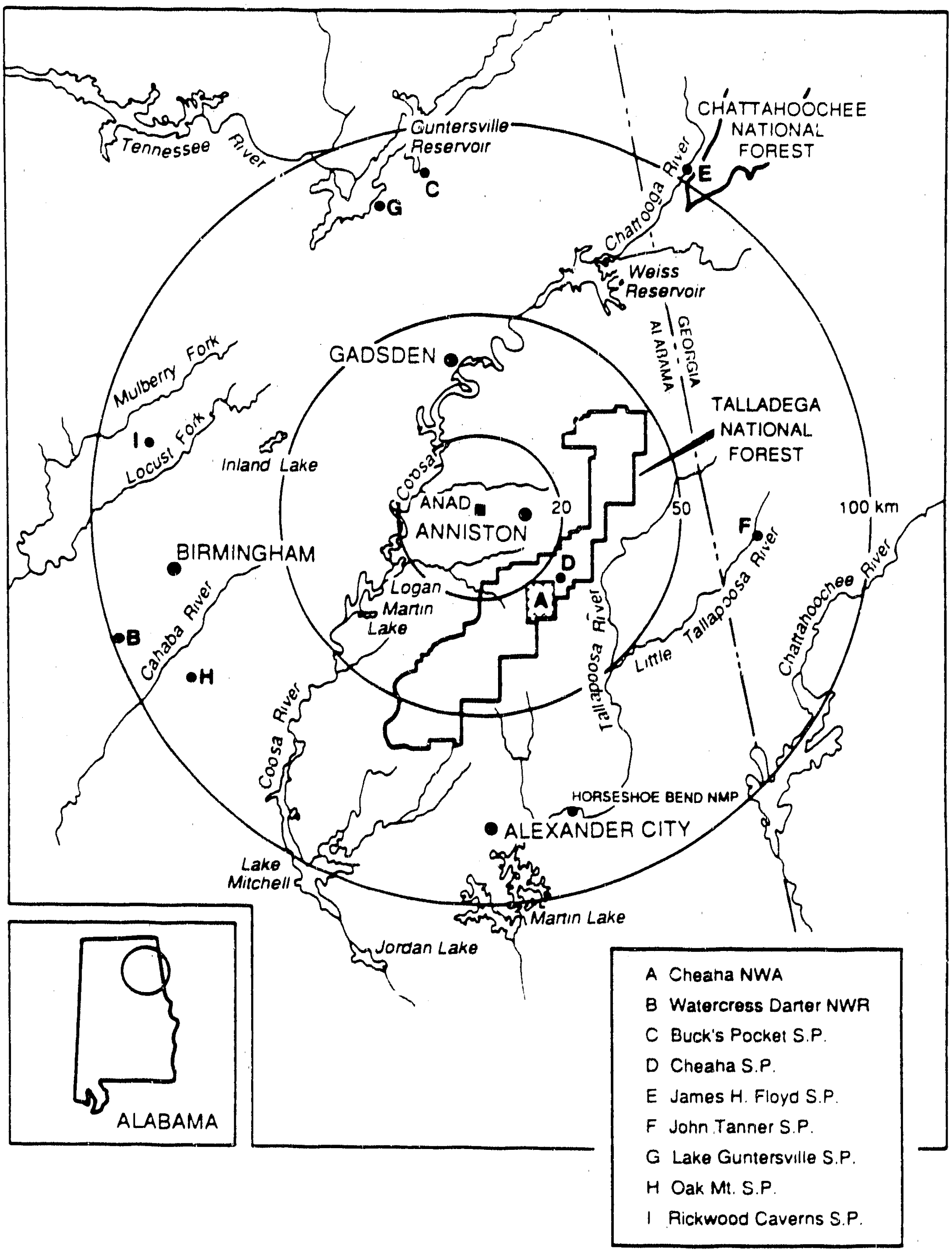

Fig. 12. Ecological resources of special interest within 100 km (62 miles) of the site of the proposed disposal facility at Anniston Army Depot.

less likely to be affected given the frequency of wind direction. An accidental release poses little potential for adverse impact to the transient bald eagle. These and other ecological issues will be evaluated further in the site-specific EIS for ANAD.

3.2.5 Social, Economic, and Cultural Resources

Supplemental information collected for the ANAD region since the preparation of the FPEIS indicates that there has been relatively little change in the data presented in the FPEIS. Additional data have also been collected for the region beyond the 10-km (6.2-mile) zone used in the FPEIS but within 100 km (62 miles) of ANAD. These data include police and fire department staffing and equipment; county school enrollment within the 50-km (31-mile) zone; post-secondary school enrollment within the 100-km (62-mile) zone; hospital capacity within the 50-km (31-mile) zone; transportation, utilities, wastewater treatment and water supply within the 50-km (31-mile) zone; employment, housing vacancy, and agricultural land use within the 100-km (62-mile) zone; and an updated cultural resource inventory. Detailed information about site-specific social, economic, and cultural resources is given in Appendix F, and Appendix B describes site-specific population data.. With the exception of the larger database that extends beyond the 10-km (6.2-mile) zone, no unique resources were identified.

The cumulative social, economic, and cultural impacts from other projects in the ANAD area were not discussed in the FPEIS; however, a preliminary survey of proposed activity in the region indicates only small potential for cumulative impacts. These will be addressed in the site-specific EIS for ANAD.

For the purposes of examining human health impacts in the site-specific EIS for ANAD, additional data were gathered on nonresidential population. Nonresidential populations were not used in the FPEIS for identifying the environmentally preferred alternative. However, these populations are of interest from the standpoint of estimating potential fatalities. These data include on-post population, daytime population, and special populations. All population data will be considered in estimating fatalities in the site-specific EIS for ANAD.

The FPEIS did not consider the on-post population at any of the Army installations. The ANAD population data (up to 5400 employees) for daytime, evening, and night are presented in Table 9. Other on-post populations exist at or near both sections of Ft. McClellan—to the north of ANAD and to the east of the city of Anniston (Fig. 1).

Likewise, the FPEIS did not consider the daytime population around any of the Army installations. The state of Alabama does not have detailed data available on place-of-work population for the area surrounding ANAD. Instead, this information has been requested from the Federal Emergency Management Agency (FEMA) but has not yet been obtained.

Special populations, such as those attending sporting events, have been identified in the area around ANAD, including the Talladega Speedway located approximately 15 km (9.3 miles) southwest of the proposed facility. The speedway is used twice per year for automobile races, and thus represents an infrequent event. In addition, military training programs occasionally bring troops into the region. This subject will be addressed in the site-specific EIS for ANAD. Additional, detailed information on site-specific populations is included in Appendix B.

3.2.6 Aircraft Activity

The FPEIS described aircraft activity in the ANAD area for both commercial and private aviation and for military aircraft. There are several restricted airspaces near the ANAD installation. Restricted area R-2102A,B,C lies over Pelham Range at Fort McClellan directly north of and adjacent to ANAD. Effective flight altitudes for this restricted area are surface to 2,450 m (8000 ft) mean sea level (MSL); 2,450 to 4,250 m (8,000 to 14,000 ft) MSL; and 4,250 to 7,300 m (14,000 to 24,000 ft) MSL, respectively. This airspace is used intermittently by Fort McClellan on a daily basis from 6:00 a.m. to 10:00 p.m. Activities on the range are classified. Restricted area R-2101 lies above a demolition pit in the northwest corner of ANAD; effective altitude for this airspace is from the surface to an altitude of 1500 m (5000 ft) MSL. Anniston Army Depot uses and also controls this airspace Monday through Friday from 7:00 a.m. to 6:00 p.m. Current aeronautical charts show that military training route IR-69 passes directly over the southwest corner of R-2102A,B,C, then turns and passes over the southwest corner of ANAD. The flight corridor of this route, which is authorized for low-level operations, is 9.3 km (5 nautical miles) on either side of the route centerline. Although this would place the disposal site beneath the route, there is currently no military aircraft activity on IR-69 over or near the disposal plant site. The heliport noted in the FPEIS no longer appears on the flight charts (U.S. Department of Defense 1988a, 1988b).

The absence of military low-altitude operations in the airspace over the site of the proposed disposal facility and absence of the heliport noted in the FPEIS would

Table 9. On-post population at Anniston Army Depot by time of day[a]

Location	Population		
	Day	Evening	Night
East Industrial Area	3200	250	250
West Area	2000	50-75	50-75
Remainder of ANAD	150-200	NA[b]	NA[b]

[a]Refer to Fig. 2 for locations of areas.
[b]NA = Not available. Security work force only.
Source: Michael Williams, Chemical Demilitarization Officer, ANAD, personal communication with G. Rogers, Oak Ridge National Laboratory, Oak Ridge, Tenn., Oct. 5, 1988.

decrease the likelihood of aircraft crashes and damage to the proposed disposal facility. The site of the proposed disposal facility meets the criteria set by the Nuclear Regulatory Commission (NRC) for distance from airports and federal airways.

3.2.7 Emergency Planning and Preparedness

Emergency planning and preparedness played a key role in identifying the programmatic environmentally preferred alternative. The difficulty of planning emergency response activities for an accident along any off-site transportation route was an important consideration in rejecting an alternative requiring off-site transport. The Army is enhancing emergency planning and preparedness at each installation regardless of the proposed action; thus, emergency planning will benefit each of the alternatives under consideration in this report equally (continued storage, on-site disposal, and on-site activities associated with off-site disposal) and was not a key factor is reexamining the environmentally preferred alternative in Sect. 3.1. Consequently, emergency planning and preparedness are discussed in the context of new information affecting on-site disposal that will be addressed in the site-specific EIS. Following is a brief discussion of emergency planning activities in the ANAD vicinity. Appendix F presents additional details on emergency planning and preparedness in the vicinity of ANAD.

The Army has begun enhancement of emergency response capabilities at ANAD by requesting funds from Congress to implement the Emergency Response Concept Plan (ERCP) (Jacobs Engineering Group, Inc., and Schneider EC Planning and Management Services 1987) at all eight storage sites, including ANAD. The Army also has funded planners to work with local governments to upgrade existing plans. In addition, the Army is committed to provide technical assistance and coordinate local planning efforts. Furthermore, the Army intends to request funds to significantly improve emergency response capabilities through capital improvements in fiscal years 1989 and 1990. Combined, these enhancements are aimed at upgrading the emergency response capabilities commensurate with the ERCP, and should greatly improve emergency response capabilities in the ANAD vicinity. Appendix F presents additional details on emergency planning and preparedness in the vicinity of ANAD.

Calhoun County has taken a lead role in planning and managing emergencies involving potential releases of chemical agent. The final draft of the first comprehensive county-wide emergency plan for Calhoun County was distributed to appropriate organizations in the area in January 1989. Talladega County's draft emergency operations plan was completed in April 1989. A series of tabletop training and full field exercises is envisioned by local officials to strengthen existing capabilities.

3.3 TECHNOLOGY STATUS/MATURITY

The purpose of this section is to provide a status report on the developments in the proposed disposal technology since the FPEIS, with an emphasis on the continuing operational experience being gained during this time. Technology status/maturity refers to the continuing refinement of designs and procedures from the conceptual design stage to the operation of the initial disposal facility, through the time the chemical stockpile is destroyed. This section focuses on technology developments that have occurred since the FPEIS.

As CSDP progresses with site-specific implementation, more and more of the stockpile would be destroyed. Facilities built and operated in the latter stages of the program will benefit from the lessons learned in the design and operation of earlier facilities. Figure 13 illustrates the projected cumulative stockpile destruction in future years as the site-specific facilities are built and operated. By July 1994, when the ANAD

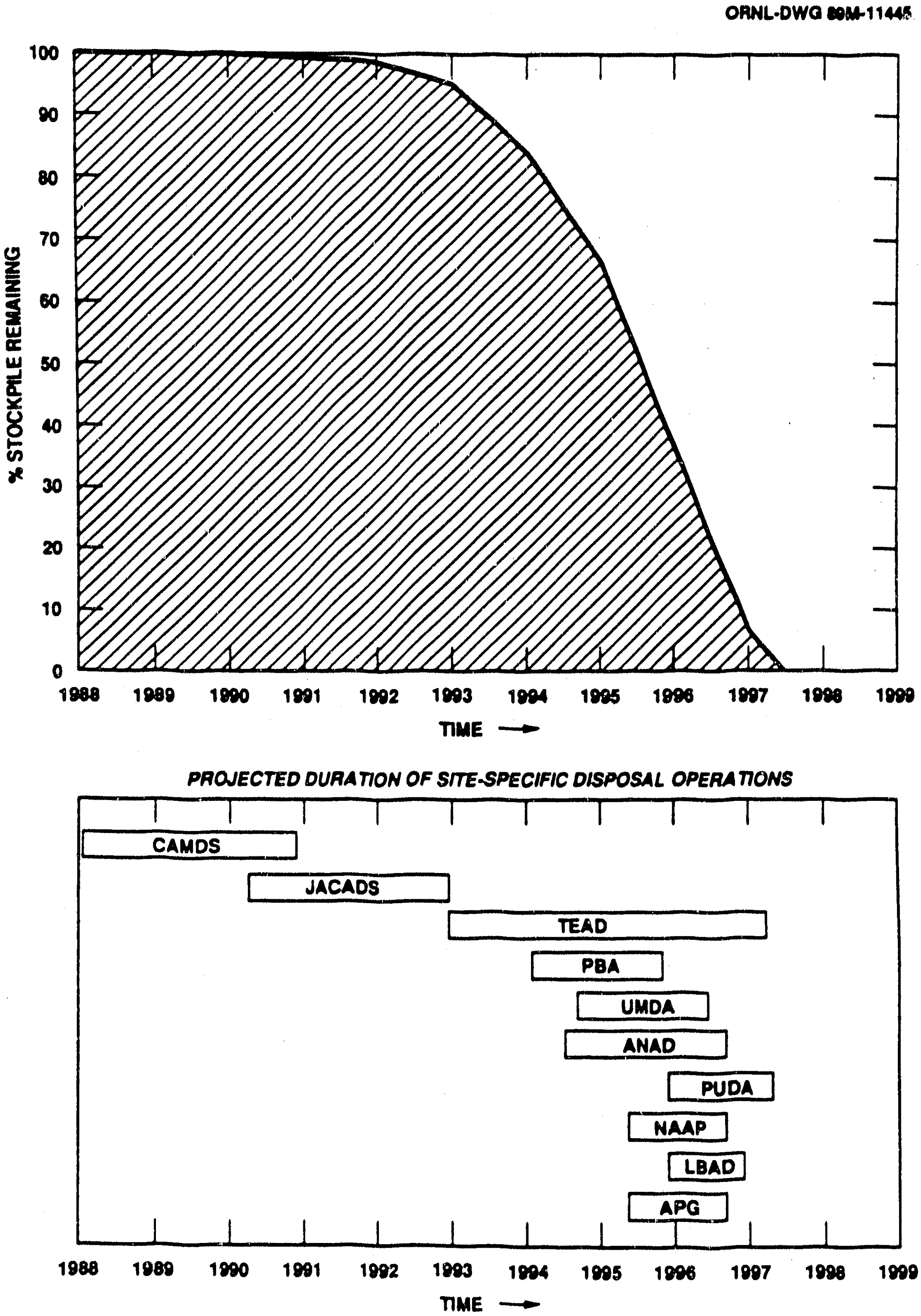

Fig. 13. Projected chemical agent stockpile destruction versus time.

facility is projected to begin operation, about 32.5% of the total U.S. stockpile is projected to have been destroyed.

Experience to date in destroying agents and munitions benefits all proposed CSDP operation, but will be of greatest value to the installations where disposal operations are scheduled to begin first (e.g., TEAD and PBA). Chemical demilitarization operations have been conducted in demilitarization facilities in former production facilities at Rocky Mountain Arsenal (RMA), located in Denver, and at the Chemical Agent Munitions Disposal System (CAMDS), located at TEAD, Utah. Also, beginning in 1979, the U.S. Army instituted a Drill and Transfer System (DATS) to dispose of leaking munitions that were declared unserviceable, unrepairable, or obsolete, or that were received from firing ranges and disposal grounds. DATS, which is no longer in operation, was a transportable facility mounted on a series of trailers designed to drain chemical agents from leaking munitions at the installations where they are currently stored. Through calendar year 1988, about 6.6 million kg (14.6 million lb) of agent had been destroyed at RMA, the TEAD CAMDS, and DATS locations. Table 10 summarizes the U.S. Army's experience in industrial scale disposal of chemical agents and munitions.

3.3.1 BZ Demilitarization Operations

Since issuance of the FPEIS, the Army has initiated the operation of a demilitarization facility at Pine Bluff Arsenal (PBA) for the destruction of the nonlethal but incapacitating agent BZ. The BZ disposal process was developed based on knowledge gained from disposal operations at CAMDS and RMA. Selected BZ equipment, including the deactivation furnace system and heated discharge conveyor, was purchased to comply with specifications for equipment technical data packages from CAMDS. Because the disposal procedures for BZ and the lethal unitary agents and munitions are based on a common technology, much of what was learned from disposal of the BZ has been applicable to the CSDP. In addition, although BZ is a nonlethal agent, the BZ disposal plant is being operated in terms of safety, surety inspections, and guidelines as if it were disposing of lethal agents. The BZ facility and the CSDP facilities have been designed for maximum agent containment and destruction as well as maximum protection of both workers and the public from agent exposure. Specific contributions from the BZ disposal operations are as follows:

- The BZ training program included extensive hands-on training which, due to its success, will be implemented at Johnston Atoll Chemical Agent Disposal System (JACADS) (Sect. 3.3.2) and the Chemical Demilitarization Training Facility (CDTF) to support the CSDP.
- At the end of systemization and prior to startup of the BZ disposal operations, a preoperational survey was conducted by a team of experts (U.S. Army and Department of Health and Human Services) to ensure that the BZ disposal system conformed to all applicable safety, environmental, quality assurance, security and safety standards and that an acceptable level of performance could be maintained during the BZ disposal operations. All findings essential to the safe and/or efficient operation of the BZ facility requiring correction were corrected prior to start of operations. Many of the problems identified during the BZ pre-operational survey could have been resolved much earlier in the systemization period. For this reason, operational and readiness evaluations will be conducted at JACADS and CSDP facilities prior to the formal preoperational

Table 10. Summary of Army's experience in industrial-scale chemical agent/munitions disposal

Operation	Description	Date	Agent	Site[a]	Process[b]	Quantity (1,000 lbs)
Project Eagle Phase I	Ton Containers	Jul 72–Mar 74	H	R	I	4,428.0
Project Eagle Phase I	Ton Containers	Jul 72–Mar 74	HD	R	I	1,714.0
Project Eagle Phase II	M34 Cluster Bombs	Oct 73–Nov 76	GB	R	N/I	4,129.6
Project Eagle Phase II (Expanded)	Underground Storage Tanks	Sep 74–Nov 74	GB	R	N	378.0
Project Eagle Phase II (Expanded)	Ton Containers	May 75–Nov 75	GB	R	N/I	3,604.5
Project Eagle Phase II (Expanded)	Honest John Warhead (M139)	Apr 75–Nov 76	GB	R	N/I	76.5
Chemical Agent Identification Sets Disposal	Chemical Agent Identification Sets	May 31–Dec 82	(c)	R	I	36.7
M55 Rocket Disposal		Sep 79–Apr 81	GB	C	N/I	128.0
Agent Injection Incineration Tests		Apr 81–Jan 84	GB	C	I	11.2
Agent Injection Incineration Tests	Ton Containers	Jun 81–Aug 84	VX	C	I	7.9
155mm Projectile Disposal		Jul 81–Jul 82	GB	C	N	60.5
105mm Projectile Disposal		Mar 82–Jul 82	GB	C	N	
In Situ Agent Incineration		Oct 82–Dec 83	GB	C	I	17.6
M55 Rocket Incineration		Nov 85–Nov 86	GB	C	I	2.3
Liquid Incinerator Test		Aug 85–Aug 86	GB	C	I	37.9
Grand total disposed						14,632.7

[a]R refers to Rocky Mountain Arsenal and C to Chemical Agent Munitions Disposal System.
[b]N refers to agent neutralization only; I to incineration of agent and explosive (and/or metal parts thermal decontamination); N/I to agent neutralization and explosive incineration (and/or metal parts thermal decontamination).
[c]Agents include: phosgene, chloropicrin, mustard, lewisite, cyanogen chloride, nitrogen mustard and GB.

survey. These evaluations will be conducted periodically during the plant systemization periods to inspect designated systems and subsystems for compliance with regulatory requirements; to assess the progress of the facility toward achieving an operational status in accordance with the schedule; and to the maximum extent possible, to identify and resolve problem areas prior to the formal preoperational survey, thereby minimizing schedule impacts.

- The BZ disposal facility is the first government owned/contractor operated facility managed by the Program Manager for Chemical Demilitarization (PMCD). Experience has been gained regarding schedule durations and potential problems associated with hiring contractor personnel under the Chemical Personnel Reliability Program. This program ensures that personnel assigned to positions involving access to chemical surety material are emotionally stable, loyal to the United States, trustworthy, and physically fit to perform assigned duties. This program will be instituted also at the JACADS and CSDP facilities.
- A study was initiated based on BZ lessons learned when the rotary kiln in the BZ plant experienced equipment problems during operations; however, the problems did not result in the release of BZ to the environment. This experience resulted in renewed concern for the potential for failure of the rotary kilns at JACADS and the CSDP. To satisfy these concerns, a study was initiated to analyze commercially available materials, material coatings, and fabrication techniques for extending the life expectancy of the CSDP and JACADS rotary kilns.

As of July 1989, about two-thirds of the BZ stockpile at PBA had been destroyed at the facility. Much of the operational information gained during this period has been incorporated into ongoing CSDP design efforts.

3.3.2 Johnston Atoll

Johnston Atoll is a coral atoll located in the central Pacific Ocean about 1300 km (800 miles) southwest of Honolulu, Hawaii. Johnston Island is the largest island of the atoll and is a storage site for three types of chemical agents and munitions: GB, VX, and mustard (H and HD). These agents are present in rockets, mines, projectiles, bombs, and ton containers. In January 1986, the U.S. Army began construction of the Johnston Atoll Chemical Agent Destruction System (JACADS) on Johnston Island. The purpose of JACADS is to provide a capability for complete demilitarization of all lethal chemical agent-filled projectiles, rockets, mines, bombs, and bulk quantities of agent stored in ton containers at Johnston Island.

JACADS equipment procurement was initiated in October 1985 and completed in November 1988. Equipment installation and field testing of the equipment required for disposal of M-55 rockets was completed in August 1988. Equipment startup and personnel training have been initiated and will continue until plant operations begin, which is expected to occur in March 1990. Currently, approximately 250 personnel from the operations and maintenance contractor are on the island. This staff is being used to conduct equipment tests and perform facility systemization efforts.

Due to the experience previously acquired (maturity) with the disposal technology and the means to perform operational proveouts at the JACADS facility, the Army has chosen to use the JACADS reverse assembly incineration process for the proposed disposal facilities at the eight CONUS disposal sites. Because of the process similarities between JACADS and CONUS disposal facilities, experience from the JACADS will be directly transferrable to the CSDP plant designs, startup, and operations.

In the 1988 CSDP Implementation Plan (U.S. Army 1988b), the Army proposed, and Congress later approved, the delay of construction of all but the TEAD CSDP facility until operational verification testing (OVT) at JACADS could be completed. This test program was developed to give additional confidence to the public and the Congress that these munitions can be safely destroyed prior to initiating demilitarization operations at the CONUS CSDP plants. The JACADS Test and Evaluation Master Plan (Duff et al. 1989) for the OVT program has been reviewed by the Department of Health and Human Services and the National Research Council. JACADS OVT is to be conducted during the first 16-18 months of JACADS operations. This test period represents the first time the JACADS process will be tested and evaluated as a full-scale facility. During this period, the overall JACADS process, and in particular the performance of the incinerator systems, will be evaluated with all three chemical agents [mustard (H, HD, HT), GB, and VX] in conjunction with the processing of rockets, projectiles, and ton containers. The general objective of the OVT is to demonstrate the operability of the entire plant, including personnel and all support systems, under toxic operating conditions. The plant's response to emergency situations will be demonstrated during JACADS systemization (the period prior to startup of lethal agent incineration) during which time deliberate nonagent challenges to plant subsystems will be conducted. The overall JACADS system will be evaluated for environmental compliance, industrial and chemical agent safety, and system reliability.

Test data from JACADS systemization and OVT will be evaluated for implementation into the ANAD facility prior to construction. Findings from the OVT will be incorporated into the ANAD design and equipment specifications. A four-month design and procurement verification period has been incorporated into the schedules for all the CSDP plants. This verification period will be used for corrections dictated from OVT and from the experience gained from the program.

3.3.3 1989 VX Test Program at CAMDS

The Chemical Agent Munitions Disposal System (CAMDS) is the Army's pilot plant for proof testing chemical demilitarization technology using agents and munitions stored at TEAD. It is located at TEAD, about 50 km (30 miles) west of Salt Lake City. In mid-year 1989, VX testing is scheduled to begin at CAMDS. Although VX has been incinerated at CAMDS in the past, this testing will provide additional experience prior to the beginning of JACADS OVT. During this test period, the performance of the demilitarization equipment will be further evaluated and VX incinerator tests will be conducted in the liquid incinerator (LIC), metal parts furnace (MPF), and deactivation furnace system (DFS). A test burn will be conducted in the LIC, MPF, and DFS to characterize effluents and solid residues and compare them against regulatory standards. The feed to the furnaces will be varied to characterize furnace performance under varying operating conditions. Ton containers punched and drained at the bulk drain station will be thermally decontaminated in the MPF to confirm processing rates and to characterize emissions and residues.

3.3.4 Individual Equipment Advancements

In addition to experience gained from ongoing demilitarization programs, separate test programs and research and development efforts are ongoing to improve the performance of individual equipment systems and ensure that state-of-the-art technology is continually incorporated into the CSDP facilities. For example, major advancements have been made since the FPEIS to the automatic continuous air monitoring system (ACAMS) and ventilation filtration system.

During 1988, a research and development program was initiated to modify the ACAMS so that it could detect time-weighted average (TWA) concentrations of the agents HD, GB, and VX within a 3–5 min cycle. This was an improvement over the response time cited in the FPEIS (U.S. Army 1988a), in which high-level detection was assumed to be achieved within 5 min but detection to the TWA level could only be achieved within 8–22 min. These reduced response times were successfully achieved during demonstration tests in mid-1988, and the JACADS ACAMS is being modified to include this new technology prior to the start of operations.

Dugway Proving Ground is currently conducting adsorption tests on carbon to determine the effects of agent GB concentration, relative humidity, and temperature on adsorption and desorption performance of carbon filters. Test conditions were selected based on an experimental design chosen to provide a response surface at carbon bed depths of 5, 10, and 20 cm (2, 4, and 8 in.). The results should indicate the optimal and less desirable operating conditions for the carbon, and will enable the Army to assess the optimal carbon depth and the optimal operating conditions for the filters.

3.4 TECHNOLOGY RISK ASSURANCE

Many of the disposal technology design attributes used in the FPEIS were to a large extent conceptual (i.e., a full engineering design was not available for the FPEIS). Since the FPEIS was completed, the development of the disposal technology has continued. Design changes result from Army efforts to make the disposal facilities safer; to make them more efficient at destroying agents and munitions; to incorporate lessons learned from CAMDS, JACADS, and other facilities (as discussed in Sect. 3.3); and to respond to changing environmental permit requirements.

As discussed in Sect. 2.2, the Army is examining recent changes in the proposed disposal technology design and operating procedures in light of potential effects on the FPEIS risk analysis. This effort tracks the development of the technology, assesses the impacts of any design changes on the FPEIS risk analysis, and provides assurance that the overall human health effects do not exceed the values presented in the FPEIS. The first step in this process is documenting the data, assumptions, and commitments on which the FPEIS risks are based. Next, these programmatic data are compared with current design information, and human health effects are reassessed where warranted. Also, design changes undergo rigorous safety reviews before approval and adoption into the final design.

A mechanism for carrying out these tasks has been developed and the technological basis of the FPEIS risk analysis has been documented. Design and operational procedure changes are being reviewed to assure that they have not adversely impacted the FPEIS risk analyses. Once the system is in place, results will be reported periodically.

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4. FINDINGS AND CONCLUSIONS

4.1 REEXAMINING THE ENVIRONMEN' .LLY PREFERRED ALTERNATIVE

The data used in the FPEIS to select the environmentally preferred alternative were identified, and more recent and more detailed site-specific data of the same types were gathered during the Phase I process. These new data were then examined and compared with the FPEIS data to determine if they have changed enough to warrant recomputation of the five measures of risk used to identify the programmatic environmentally preferred alternative. Of all of the data types examined, only residential population (off-post) was identified as having changed enough to warrant recomputation of risk. This is due primarily to population growth (from 1980 data in the FPEIS to 1986 data now available) and to a change in the location of the residents [instead of living within 500 m (1600 ft) of the site of the proposed disposal plant, as was assumed in the FPEIS, residents were assumed to be located no closer than the actual installation boundary]. For the areas of meteorite frequency, seismicity, and meteorology either new data were not identified during the Phase I process or, if located, were not sufficiently different from data used in the FPEIS risk assessment to warrant recalculation of risk. For on-site transport of agents and munitions, data gathered during Phase I indicate that probabilities of transportation accidents would be greater than assumed for the FPEIS but that the increase is not enough to change the relative rankings of ANAD alternatives as given in the FPEIS. New data on aircraft activity were also located. A review of the accident database indicated that aircraft activity affects only continued storage at ANAD and thus any new data located would not affect the relative ranking of alternatives under examination in this report.

As a first step in reassessing risk, the new population data were used to compute average and maximum fatalities using the same computation methods as in the FPEIS and using the programmatic values for all other parameters. This calculation showed that the number of fatalities for distances of 2 km (1.2 miles) or less drops to zero because residential population is not allowed as close to the site of the proposed disposal facility as was assumed in the FPEIS.

The revised fatality estimates were then used to compute the five measures of risk for on-site disposal, continued storage, and on-site activities associated with transport. These risk measures were summarized in pictogram form as was done in the FPEIS. Based on an examination of the Phase I pictogram, continued storage at ANAD can be rejected because one of the measures of risk was greater, by a statistically significant amount, than the values for the other alternatives. The other alternatives are statistically indistinguishable. However, risks from on-site disposal are in all cases equal to or less than risks from other alternatives.

The conclusion is that on-site disposal remains valid as the environmentally preferred alternative for ANAD. From the perspective of the population near ANAD, on-site disposal is at least equivalent to all other alternatives in terms of the potential for human health impacts. If one adds the off-site transportation risks (not addressed in this document because they are beyond the scope), the on-site alternative is clearly preferable given the opportunity for risk reductions associated with emergency planning and preparedness activities that are under way at ANAD.

4.2 RESOURCE DATA RELATED TO SITE-SPECIFIC IMPLEMENTATION

During the Phase I process, data on resources that could be affected by on-site disposal at ANAD were gathered to determine if any significant new or site-specific resources are present that could affect construction and operation of the on-site disposal facility (including incident-free operations and accident scenarios): population (including residential, on-post, daytime, and special populations), meteorology/air quality, surface and groundwater, land use, ecology, socioeconomics, and aircraft activity. Some of these resources were examined in the FPEIS in assessing potenti.' impacts of the programmatic alternatives, whereas others represent new information that was not appropriate for examination on the programmatic level. No assessment of potential impacts was done during the Phase I process with these data. Rather, the data were examined to help identify potential issues to be analyzed under Phase II. Results for the principal resource areas are presented below.

- Population. Residential population within the 100-km (62-mile) zone of the site of the proposed disposal facility at ANAD increased about 3% from 1980 (FPEIS data) to 1986 (Phase I data). Using the actual ANAD boundary, no off-post residential population was found within 2 km (1.2 miles) of the site. The significance of these changes has been discussed in Section 4.1. On-post population was found to range from 3200 in the East Industrial Area in the daytime to 50–75 in the West Area nights and evenings. Place-of-work population data were not available from the state of Alabama but have been requested from FEMA. Special populations (infrequent events) have been identified at the Talladega Speedway and on the military areas at and near ANAD. All of these data will be considered, in conjunction with data on residential population, in estimating fatalities in the site-specific EIS for ANAD. Additional data were also collected regarding American Indian entities. No legally designated Indian country or federally recognized Indian communities exist within either Calhoun or Talladega Counties.

- Meteorology and air quality. The weather conditions of CML and WC assumed in the FPEIS were found to be appropriate for ANAD. Wind data from within the ANAD installation are distinctly different from data at Anniston Airport (used in the FPEIS to assess the impacts of incident-free operations) and are more representative of the wind pattern at the site of the proposed disposal facility. These data will be used in assessing potential impacts from construction and incident-free operations. A Class I PSD area located about 165 km (102 miles) northwest of ANAD was located. Potential impacts of air emissions from the proposed disposal facility on this area of pristine air quality will be considered in the site-specific EIS for ANAD.

- Social, economic, and cultural resources. Additional data were collected beyond the 10-km (6.2-mile) zone used in the FPEIS. These data include updates on police and fire department staffing and equipment; county school enrollment within the 50-km (31-mile) zone; post-secondary school enrollment within the 100-km (62-mile) zone; hospital facility capacity within the 50-km (31-mile) zone; transportation, utilities, waste treatment and water supply within the 50-km (31-mile) zone; employment, housing vacancy, and agricultural land use within the

100-km (62-mile) zone; and an updated cultural resources inventory. No unique resources that would prevent or delay implementation of on-site disposal at ANAD have been identified.

- Surface water and groundwater. Additional site-specific data collected since publication of the FPEIS reinforce the programmatic conclusions. The principal groundwater flow direction at the site of the proposed disposal facility is away from the recharge area of Coldwater Spring, which has been designated as a Class I aquifer by the U.S. EPA. The principal groundwater flow direction from the southern part of the chemical agent storage area is southward toward Choccolocco Creek and possibly Coldwater Spring. This information will be addressed in the site-specific EIS for ANAD.

- Ecological resources. Ecological resources of concern are primarily threatened and endangered species and areas of special ecological interest such as wilderness and wildlife areas, state and national parks, and Nature Conservancy areas. Within 100 km (62 miles) of the site of the proposed disposal facility at ANAD, 15 threatened and endangered species (including candidate species) and 12 resource areas of special interest (national forests, parks, wilderness areas, wildlife refuges, and state parks) have been identified. Many of the species and resource areas are found at locations that could be affected by accidental releases of agent to the air and water given the site-specific information on water resources and weather conditions found during this Phase I study. These and other potential effects of the proposed action on ecological resources will be addressed in the site-specific EIS. No ecological resources were located that offer significant potential to prevent or delay construction and operation of the proposed disposal facility at ANAD.

- Aircraft activity. Additional information on military aircraft activity in the ANAD vicinity has been gathered. Since aircraft activity at ANAD has the potential to significantly affect only continued storage, any new data regarding this parameter are not vital to selecting among on-site alternatives and thus were not examined further in the selection method for the environmentally preferred alternative. The new data may be useful, however, in evaluating the use of airspace controls as an interim mitigation measure for continued storage until the ANAD stockpile is destroyed.

- Land Use. No unique resources that would prevent or delay implementation of on-site disposal at ANAD have been identified after examining more recent and detailed data.

- Emergency Preparedness. Emergency preparedness and response enhancements on-site have been initiated since the FPEIS. The Army has begun implementing an emergency response plan at ANAD, has funded planners to work with local governments to upgrade existing plans, and is committed to providing technical assistance and coordination to local planning efforts.

4.3 OTHER FACTORS

Technology maturity and technology tracking/risk assurance were also examined during the Phase I process, although neither factor was instrumental in reaching conclusions identified in the previous two sections for ANAD.

For technology maturity, four principal technology developments have occurred since the FPEIS and should be of value in the implementation of on-site disposal at ANAD: BZ disposal, Johnston Atoll agent disposal, VX disposal tests at CAMDS, and equipment advances. BZ destruction at PBA has helped to establish preoperational surveys, personnel hiring practices, operations schedules, and rotary kiln manufacture and operation procedures that will be of value to ANAD disposal operations. Destruction of lethal unitary chemical agents and munitions at Johnston Atoll will provide data from equipment startup, personnel training, and OVT that will be evaluated for incorporation into the ANAD facility before construction. At TEAD, CAMDS will be conducting tests with the agent VX, which should provide valuable information to the Johnston Atoll operations, as well as ANAD, on equipment performance, emissions, and effluents. Last, advances have occurred since the FPEIS in the areas of air monitoring and air filters. Advances in air monitoring technology now allow detection of a TWA concentration of agent within 3–5 min, which is a substantial improvement over the 8–22 min assumed in the FPEIS. Filter tests are ongoing to optimize the performance of filters designed to remove agent GB from an air stream.

Technology tracking/risk assurance refers to tracking the disposal facility design changes that have occurred since the FPEIS to provide assurance that the changing design does not exceed the risk ceiling identified in the FPEIS. The FPEIS was based on a facility design that was largely conceptual. Since then, the design has progressed toward completion and thus may have changed, in some respects, from that used to develop the FPEIS risk ceiling. Other factors that can change the design include incorporating lessons learned from technology maturity and responding to changing environmental permit requirements. At this point these activities are concerned with establishing a system for technology tracking and risk assurance and with documenting the FPEIS technology factors used to develop the risk ceiling.

APPENDICES

APPENDIX A

IMPACT ANALYSIS IN THE FINAL PROGRAMMATIC ENVIRONMENTAL IMPACT STATEMENT

This appendix provides a summary of the impact analysis conducted in the final programmatic environmental impact statement (FPEIS), including the method and data used to identify the programmatic environmentally preferred alternative, the examination of the acceptability of the alternative for ANAD, and nonrisk impact analyses conducted for the stockpile at ANAD. Because the Army's stockpile of chemical agents contains some of the most toxic materials in the world, and because some of the present storage installations are located near highly populated areas, public concern about the safety of the proposed disposal alternatives was the key issue addressed in the FPEIS. Specifically, concerns about the safety of incineration operations and about impacts to human health from both incident-free operations and accidental releases of chemical agent became the primary focus of the FPEIS impact analyses.

A.1 IDENTIFYING THE ENVIRONMENTALLY PREFERRED ALTERNATIVE

A.1.1 Approach Taken in the Programmatic Assessment

In order to categorize the environmental impacts of the programmatic disposal alternatives, the FPEIS identified three distinct activities required for the destruction of the continental United States (CONUS) stockpile: (1) construction (or modification) of disposal facilities (incinerators and/or shipping/receiving facilities), (2) disposal operations, including transportation (off-site, as well as on-site), and (3) decommissioning of all disposal facilities upon completion of the program. These activity categories existed for each programmatic disposal alternative, although the applicability and phasing of these activities at each storage installation were dependent on each particular alternative.

Early on, the construction and decommissioning activities were determined to be rather insignificant in regard to being able to use impacts from these activities in distinguishing among the various programmatic disposal alternatives. In fact, construction activity at each storage location (irrespective of the alternative) would be typical of that for any medium-scale industrial facility.

In contrast, the nature and significance of the environmental impact of disposal operations depend upon whether or not the operations would be incident-free. Therefore, incident-free disposal operations were defined as occurring without any intentional release of chemical agent above prescribed emission levels; abnormal operations were defined as those involving major accidents with off-site consequences. It is obvious that accidents could have environmental consequences of major proportions. These consequences could include human fatalities and chronic illnesses, destruction of wildlife and wildlife habitat, destruction of economic resources, and adverse impacts on the quality of life in the affected areas.

Fortunately, such high-consequence accidents would be unlikely. This low likelihood would be ensured principally through plant design, munition packaging, and well-conceived and well-implemented transportation and operating procedures. The area affected by (and the potential severity of) accidents would be specific both to the storage site and the point of occurrence along the transportation corridor. The impacts from potential accidents would be largely dependent upon population distributions, the chemical agents and munitions involved, and natural conditions and features at the accident location. Hence, the principal thrust of the FPEIS was directed toward the examination of accident scenarios, their probabilities of occurrence, and attendant environmental impacts.

A.1.2 Approach to the Analysis of Accidents

In support of the FPEIS, a comprehensive study was performed to identify the credible accidents and the expected effects on human health, ecological systems, water resources, and socioeconomic resources. Such accidents were identified in risk analyses (GA Technologies 1987a, 1987b, and 1987c) and integrated by MITRE and Oak Ridge National Laboratory (ORNL) (see U.S. Department of the Army 1988a, Vol. 3, Appendix J).

Each programmatic disposal alternative was included in the study. The principal areas of focus were plant operations; off-site transportation (for national, regional, and partial relocation options); on-site transportation via truck; and munition-handling operations. Accident initiators that were considered included equipment failures and human error, as well as external events (seismic events, meteorites, tornadoes and high winds, lightning, and air crashes). In addition, crashes (truck, train, and airplane) and train derailment were considered as initiators for the transportation accidents. Except for the inventory differences among storage installations and certain site-specific events, such as earthquakes and tornadoes, the hazards associated with plant operations are the same for all sites and all disposal alternatives.

Some 3000 potential accidents were identified and included in the programmatic analysis. Each potential accident was characterized by its probability (i.e., its expected frequency); its source size (i.e., the size of the release as expressed by weight of specific chemical agent); the type of agent released; its mode of release (e.g., spill, detonation, fire); the possible accident location (e.g., storage area, disposal plant, along a transportation corridor); and the duration of time during which that accident could occur (i.e., the total time during which agent could be released, from the onset of the disposal program until the completion of that particular activity). Using a computerized atmospheric dispersion method, each accident involving agent release was also characterized in terms of its plume geometry and its lethal downwind distance; fatalities were estimated for these accidents using 1980 census data (U.S. Dept. of Commerce 1980) around the appropriate site of release.

Because it is impossible to develop a "no risk" alternative for the disposal of the chemical agent stockpile, the possibilities of an accident and the resulting adverse impacts were included in a hazards analysis to determine the relative importance of each accident. The selected measure of the hazard was the "risk." The risks associated with the numerous activities of the programmatic disposal alternatives were quantified, and were then used to compare the hazards associated with each programmatic alternative. Risk analyses have been widely used in the nuclear and chemical industries to evaluate related hazards and to communicate these results to both the public and decision makers.

To assess the impacts of accidents on human health and environmental and socioeconomic resources, various probabilistic measures of risk were developed and applied to each programmatic alternative for comparison among alternatives. Five measures of risk were chosen as follows.

1. Probability of one or more fatalities. The chance that there will be at least one fatality at a given site or along a transportation corridor, or for the nation as a whole, during implementation of a given programmatic alternative. This measure was computed mathematically as the sum of probabilities for only those credible accidents which result in one or more fatalities under most-likely meteorological conditions; this measure of risk was expressed as a probability or frequency per stockpile (e.g., 2×10^{-5}).
2. Maximum number of fatalities. The maximum human health consequences among all credible accidents at a site or along a transportation corridor, or for the nation as a whole, for a given programmatic alternative. This measure was computed as equal to the largest number of fatalities associated with that single credible accident which has the greatest lethal downwind distance under worst-case meteorological conditions; this measure of risk was expressed as fatalities (e.g., 2100 people).
3. Expected fatalities. A statistical measure equal to the sum of the risk contribution of all credible accidents at a site or along a transportation corridor, or for the nation as a whole, for a given programmatic alternative. This measure was computed mathematically as the summed product of probabilities for all credible accidents and the fatalities for those same accidents under most likely meteorological conditions. This measure of risk was expressed as fatalities (e.g., 9×10^{-4}). This risk measure is widely used in the nuclear and chemical industries to evaluate the hazards associated with these industries; it is regarded as the best measure for representing the integrated hazards associated with numerous activities for a particular action.
4. Person-years at risk. A statistical measure equal to the product of the number of persons near a site or along a transportation corridor, at risk from that credible accident that has the greatest lethal downwind distance for a given programmatic alternative and the length of time during which that accident could occur. This measure of risk was expressed in person-years (e.g., 5×10^{6} person-years).
5. Expected plume area. A statistical measure equal to the cumulative risk contribution of all potential plume areas from all credible accidental agent releases for a given programmatic alternative. This measure was computed mathematically as the summed product of all accident probabilities and the resulting plume areas; it is analogous to expected fatalities and is computed in an identical manner except that the plume area is used instead of the number of fatalities. This measure of risk was expressed in units of area (e.g., 3×10^{-3} km^2). This measure of risk is sensitive not only to the size of the areas potentially affected by releases, but also to the probabilities of those releases. This risk measure was used as the surrogate for (or indicator of) impacts to environmental, cultural, and socioeconomic resources.

To present the results of this risk analysis in a format that could be easily comprehended by the public and would not reveal classified details (such as agent and/or munition quantities) for the site-specific stockpiles, pictograms (as shown in

Figs. A-1 and A-2) were developed. Pictograms display a pictorial indicator (the darkness of the shading) of the relative magnitude of each of the above measures of risk. This array of data allows direct comparison of risk at all sites for a given programmatic disposal alternative or, alternatively, comparison among all alternatives for a given site. Both sets of pictograms are employed and presented in the FPEIS (see U.S. Department of the Army 1988a). These risk pictograms provide a visual impression of the relative magnitude of public risk for all combinations of alternatives and locations; they contain the data used in the method for the selection of the environmentally preferred alternative.

A.1.3 Method for Identifying the Environmentally Preferred Alternative

The Army and its subcontractors developed a method (see U.S. Department of the Army 1988a) for systematically comparing the programmatic alternatives to select an environmentally preferred alternative. That method was based on a comparison of alternatives in terms of the activities associated with implementing each alternative and the impacts of those activities under both normal operations and accident scenarios. Although the principal purpose of the method was to facilitate the selection of the environmentally preferred alternative, the method as presented in the FPEIS also allowed other interested and affected groups to (1) compare the public health and environmental impacts of the various alternatives and (2) identify the public health and environmental trade-offs associated with each programmatic alternative.

The method used to identify the environmentally preferred alternative consisted of a sequential consideration and comparison of the factors embracing the programmatic objectives of no fatalities and minimal or no environmental impact. This comparison involved three consecutive tiers of examination for each programmatic alternative: (1) the comparisons were first made for human health impacts using the previously defined measures of risk; (2) the "expected plume area" was then used for comparison of ecosystem and environmental impacts; and finally, (3) the feasibility and potential effectiveness for emergency planning and preparedness was used as a basis for comparison.

These three tiers of comparison were applied sequentially; if an alternative proved to be significantly worse than others on the basis of human health impacts, it was removed from further consideration. Similarly, if a single alternative was significantly superior to all others on the basis of human health impacts, it was to be selected as the environmentally preferred alternative. If more than one alternative proved to be relatively equivalent (but superior to the other, rejected alternatives) during this first tier of comparison, then these alternatives were selected for inclusion in the next tier of comparison (i.e., ecosystem and environmental impacts).

The same technique was used in the second tier of comparison to compare only those alternatives that survived the first tier; this second tier of comparison considered the potential for ecosystem and environmental impacts. If there were still alternatives that were judged to be relatively equivalent following this comparison, they were compared on the basis of the feasibility and potential effectiveness for emergency planning and preparedness (i.e., the third and final tier of the selection method).

Improved emergency response planning and preparedness can significantly reduce both the maximum number of fatalities and the expected fatalities in the unlikely event of catastrophic agent release. However, no proven or acceptable method exists to quantify this potential for reduction in impacts. Nevertheless, implementation of an emergency response program yielding comparable reductions would be more difficult, if not

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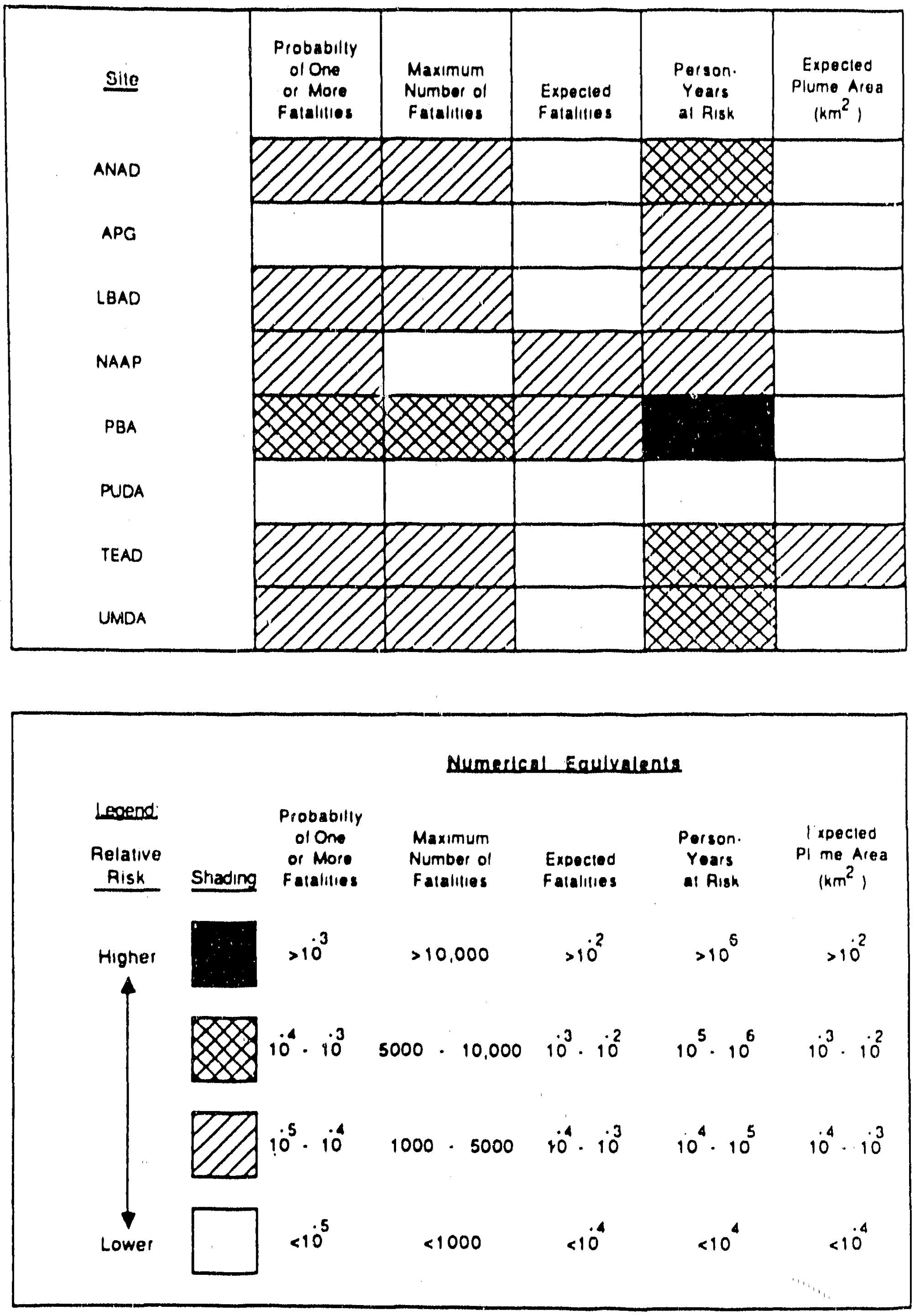

Fig. A-1. Risk with mitigation: site-specific comparison for on-site disposal. (Risk along transportation corridors not included. This diagram does not include the risk associated with approximately 3 years of stockpile storage at the existing facilities.)

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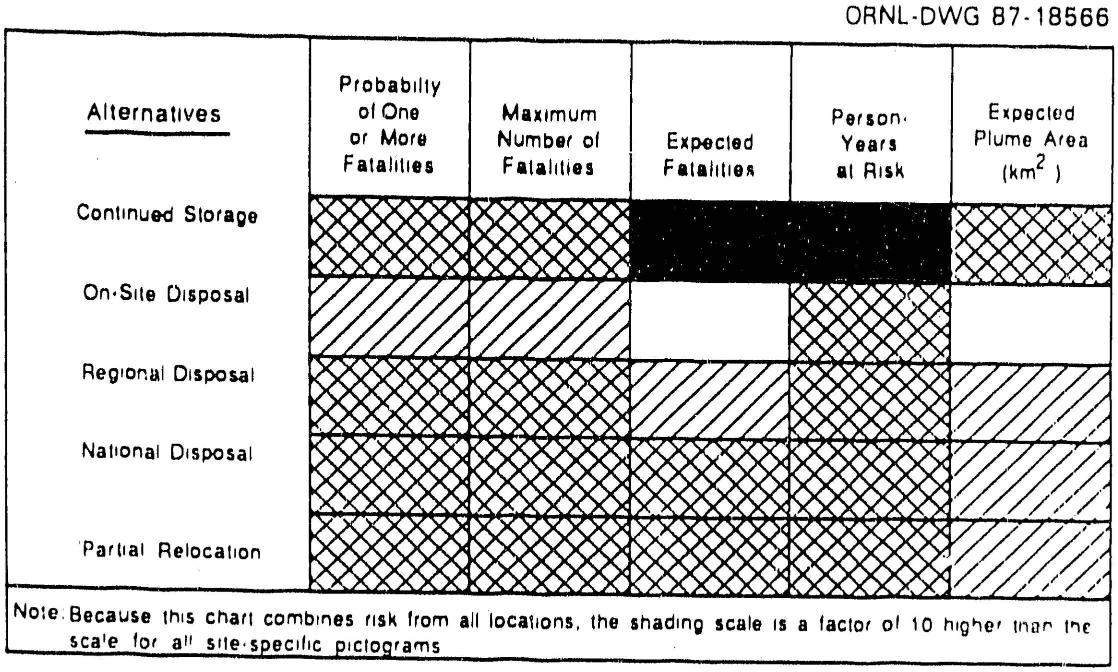

Numerical Equivalents

Legend Relative Risk	Shading	Probability of One or More Fatalities	Maximum Number of Fatalities	Expected Fatalities	Person-Years at Risk	Expected Plume Area (km²)
Higher		$>10^{-2}$	>100,000	>0.1	$>10^{7}$	>0.1
		$10^{-3} - 10^{-2}$	10,000-100,000	10^{-2} - 0.1	$10^{6} - 10^{7}$	10^{-2} - 0.1
		$10^{-4} - 10^{-3}$	1000 - 10,000	$10^{-3} - 10^{-2}$	$10^{5} - 10^{6}$	$10^{-3} - 10^{-2}$
Lower		$<10^{-4}$	<1000	$<10^{-3}$	$<10^{5}$	$<10^{-3}$

Fig. A-2. Risk was mitigation: comparison for programmatic alternatives, all locations combined. (For the disposal alternatives, this diagram does not include the risk associated with approximately 3 years of stockpile storage.)

impossible, along the transportation routes as compared to implementation at any or all of the eight existing storage installations.

Finally, if no clear choice could be made after three levels of comparison, then no single environmentally preferred alternative exists. In any event, at whichever tier a final choice was made, the environmentally preferred alternative would then be examined with respect to the stockpile at each installation to ensure that the selection method had indeed identified an alternative that was correct for each stockpile.

For the purpose of accepting or rejecting alternatives at each tier, a determination of the relative significance of the risk measures was made. The accident and risk analyses attempted to ensure that uncertainties about the values for the five measures of risk were treated consistently and systematically for all alternatives. It was acknowledged that these values might be in error by as much as a factor of 10 in either direction. However, it should be noted that the maximum number of fatalities did not depend on accident probabilities or frequencies and therefore had no expressed uncertainty. At each tier in the selection method, a comparison was made between those risk values shown in the pictograms for each alternative. Because actual numerical values for the five measures of risk were classified and could not be released for public review, and because the pictograms used shadings and patterns to depict the range of each measure of risk, it was determined that two differences in shading (i.e., a two-order of magnitude, or factor-of-100, difference) would be used as the criterion to define the statistical significance of differences between alternatives.

In view of the above criterion, it is important not to emphasize the absolute values of the risk measures; rather, differences between the risk measures become the key to the comparisons. Statistically significant (i.e., valid) differences in one or more measures of risk depict a definite risk difference and are sufficient to reject the more risky alternative(s). Furthermore, where there are consistent differences in the measures of risk between alternatives (even at one order of magnitude of difference in the pictograms), this consistent difference is an indication that significant differences between alternatives may exist from an overall perspective. However, such consistent differences were never used in the selection method to either select or reject an alternative.

A.1.4 Data Used in the Programmatic Assessment

Data needed for the FPEIS assessment were drawn from several support studies, each of which was separately published and incorporated by reference into the FPEIS. Key support studies addressed (1) packaging, (2) transportation, (3) safety improvements, (4) hazards, (5) risk, (6) monitoring, and (7) emergency response. Of these, the analysis and results of the risk study were the most important in the selection of the environmentally preferred alternative.

The data used in the FPEIS risk analysis were of two broad types: (1) historical data, derived from records of a large number of actual events that are related to specific types of accidents or events leading to accidents, and (2) hypothesized data, derived from largely subjective modeling of assumed accident sequences with the aid of fault and event trees. The use of fault and event trees is a standard procedure to investigate sequences of occurrences in a complex system.

GA Technologies (GA Technologies 1987a, 1987b, 1987c), with technical assistance from H&R Technical Associates, JBF Associates, and Battelle-Columbus Laboratories, conducted the comprehensive assessment of accident probabilities for all munition types. The event and fault tree analyses, together with information on mechanical and thermal threshold conditions for each munition type, were used to estimate the probability of agent release and the quantity of agent released. Some accidents were postulated to be caused by external initiating events, i.e., those outside U.S. Army control. Table A.1 summarizes the assumed frequencies of these accidents for ANAD.

The human health impact at downwind locations following an accidental release of agent would be dependent on meteorological conditions, which dictate the extent of atmospheric dispersion. The FPEIS used the D2PC atmospheric dispersion model (Whitacre et al. 1986) to predict downwind transport of agent. The D2PC computer program (or code) is an air dispersion model that assumes a Gaussian distribution of agent in the vertical and cross-wind directions as the agent disperses downwind. This assumption has been documented extensively in the literature and is used by a multitude of current models (EPRI 1985). Although more sophisticated dispersion codes are available, the assumption of straight-line transport with unvarying meteorological conditions results in conservative estimates of the effects of releases because the major parameter used in subsequent analyses was the distance to a given dose rate. This simple, conservative approach, while inappropriate for estimating the impacts of any given release under real-time conditions, is appropriate for analyzing and comparing the potential effects of postulated accidental releases. A specific location was not specified in the D2PC model runs, but rather a generic location was used. This assumption was employed because of the number of potential release sites at each facility as well as the potential for release during the transportation alternatives analyzed. Therefore, identical downwind distances were obtained for identical accidents for all alternatives.

In the FPEIS, results from the D2PC model were obtained for two generic meteorological conditions: "conservative most likely" and "worst case." The conservative-most-likely scenario represents a frequently occurring meteorological condition that results in relatively large doses compared with other frequently occurring conditions. Specifically, neutral atmospheric stability (Class D) with a wind speed of 3 m/s (6.7 miles/hr) was selected for the conservative-most-likely condition. The worst-case scenario represents a credible condition that results in near-maximum doses. Specifically, a stable atmosphere (Class E) with a wind speed of 1 m/s (2.2 miles/hr) was chosen for the worst-case condition. Other atmospheric conditions were kept constant for the two meteorological scenarios. Wind direction was not specified, but was assumed to remain constant throughout individual runs of the D2PC model. Downwind distances and areas that were predicted by the model were subsequently rotated about the point of release to evaluate all directions of interest. The height of the mixed layer of the atmosphere was assumed to be 750 m (2460 ft).

The D2PC code predicts the "dose" of agent (defined as the mathematical product of agent concentration and the duration of exposure) expected at locations downwind of the release point. Within each downwind dispersion plume were three dose-response contours, representing fatality rates of 0, 1, and 50%. The dose corresponding to the 0% rate (also called the "no-deaths" dose in the FPEIS) is the largest dose that would result in no fatalities to healthy adults. Figure A.3 illustrates the plume geometries and dose-response contours under the two meteorological conditions used in the FPEIS.

To simplify the analysis of the many accidents identified in the FPEIS risk analysis, the accidents were grouped into categories defined by their downwind "no-deaths" distance. These "downwind no-deaths distance categories" were used generically in the FPEIS to (1) define all accidents by category and (2) estimate fatalities by category. The distance categories used in the FPEIS are shown in Table A.2. Every accidental release was assigned a distance category, and the maximum downwind boundary of that category

Table A.1. Site-specific frequencies of external initiating events for Anniston Army Depot

Large aircraft crash (events/year-mile^2)	7.9×10^{-6}
Small aircraft crash (events/year-mile^2)	1.2×10^{-5}
Meteorite (>1.0 lb) strikes (events/year-ft^2)	6.4×10^{-13}
Earthquakes (events/year)	
0.15 g	1.5×10^{-4}
0.2 g	7.0×10^{-5}
0.25 g	4.0×10^{-5}
0.3 g	2.5×10^{-5}
0.4 g	1.2×10^{-5}
0.5 g	6.0×10^{-6}
0.6 g	3.5×10^{-6}
0.7 g	2.5×10^{-6}
Tornadoes (events/year)	
100 mph windspeed	---
140 mph windspeed	---
150 mph windspeed	---
180 mph windspeed	---
200 mph windspeed	1.0×10^{-5}
250 mph windspeed	---
260 mph windspeed	1.0×10^{-6}
320 mph windspeed	1.0×10^{-7}

was used to represent the entire class of similar releases. For example, an accidental release that was predicted by the D2PC code to result in a downwind no-deaths distance of 11 km was placed into the 10- to 20-km accident category, and a distance of 20 km was used to characterize that particular accident in the FPEIS. Human health impacts, as defined by potential fatalities, were based upon the generic plumes described by these distance categories.

In the FPEIS, the description of the distribution of population around each Army installation was taken from 1980 Bureau of the Census data. The coordinates of the census enumeration district centroids were first used to estimate the boundaries and areas of each district. Next a population density was estimated within these areas. Finally, a predefined grid of very small cells [roughly 370 × 370 m (1214 × 1214 ft)] was overlaid on

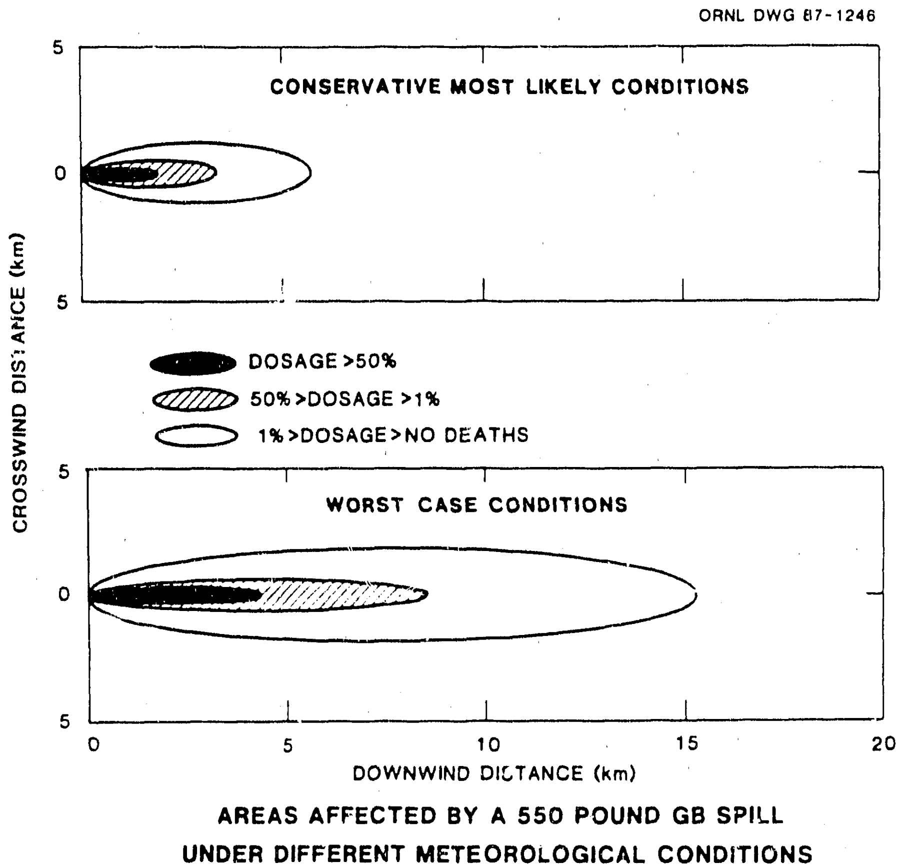

Fig. A-3. A hypothetical scenario illustrating plume distances and shapes for the same accident under different meteorological conditions.

the distributed population, and the number of people per cell was determined. This grid-based population was used in the estimation of fatalities from accidental releases of agent.

Fatality estimates were developed by overlaying the plume geometries [including the three dose-response contours (50% lethal dose, 1% lethal dose, and no deaths)] on the population grid. First, the number of people between each dose-response contour was counted. Then "fatality multipliers" were applied to the populations in each zone as follows: of the people inside the 50% dose-response contour, 75% were assumed to die; 25% of the people in the region between the 50% and the 1% dose-response

Table A.2. Downwind no deaths distance categories used in the FPEIS to characterize chemical agent releases

Category	Predicted accident downwind distance: Greater than or equal to (km)[a]	But less than (km)
1 km	500 m[b]	1
2 km	1	2
5 km	2	5
10 km	5	10
20 km	10	20
50 km	20	50
100 km	50	100

[a]Distance to the "no deaths" contour as predicted from the D2PC atmospheric dispersion model in kilometers except as noted. Multiply kilometers by 0.6214 to obtain miles.

[b]Accidents with downwind distances less than 500 m will not produce plumes which go beyond the installation boundary and, thus, were eliminated from the FPEIS risk analysis.

contours were assumed to die; and 0.5% of the people in the region between the 1% dose-response and the no-deaths contours were assumed to die.

This fatality estimation process was repeated 360 times for each downwind no-deaths distance category and for each of the two meteorological conditions. That is, each plume was rotated in increments of one compass degree around the point of release, and fatality estimates were computed for each of these increments. Among all 360 computations, the absolute largest number of fatalities was identified in the FPEIS as the "maximum number of fatalities" associated with that particular downwind no-deaths distance category. This computational technique does not take wind direction into account; instead, it is assumed conservatively that the wind has some nonzero probability of blowing in the direction that would cause the most fatalities in the event of a release.

The following assumptions and qualifications of the fatality estimation process were enumerated in the FPEIS (U.S. Dept. of the Army 1988a).

1. The assumed values of the fatality multipliers were based on linear variations of agent doses within each dose-response contour. In actuality, the doses decrease with distance from the release point at a greater than linear rate; thus, the FPEIS estimates of maximum fatalities are conservatively high.
2. The D2PC atmospheric dispersion model was originally developed as a planning tool for estimating the magnitude of battlefield casualties under war-game scenarios. The model predicts dose-response contours based on the expected

response of healthy adult males to battlefield agent concentrations. The variation of dose response among age classes (e.g., infant children, and the elderly) was not included in the estimation of fatalities in the FPEIS. It was assumed that the dose response of healthy adult males would closely approximate the response of an average member of the general public.
3. Downwind no-deaths distance estimates from D2PC are accurate to within only ±50%. This limitation of the atmospheric dispersion model resulted in a systematic uncertainty that applied equally to all fatality estimates for all alternatives.
4. Variations in wind direction, atmospheric stability, and terrain during a release would cause the plume to have a much more complex geometry than the simplistic ellipsoidal shape used in the FPEIS. The longer the time period over which the plume develops, the greater the likelihood that changes in the wind conditions will affect the plume geometry.
5. The same variations in wind direction, atmospheric stability, and terrain make it impossible to reliably predict the shape of a very large plume contour. For this reason, fatality counts for accidents with extremely large downwind no-deaths distances were truncated at 100 km (62 miles) in the FPEIS.
6. The census data used to develop the distribution of population around each site are representative of the place of residence; thus, these data more closely depict nighttime populations than daytime populations. Furthermore, transient populations (such as people in shopping centers or at major sporting events) and on-post employees were not included in the population data in the FPEIS.
7. The grid-based population allowed all grid cells beyond this zone to be filled with a distributed population even though, in reality, no such population existed for certain cells. Likewise, other known uninhabited regions (such as lakes, forested areas, federally restricted areas, as well as the actual site boundaries) were not accounted for in the FPEIS grid-based population; all such zones were filled with population according to the method described above.
8. The locations used in the FPEIS for the source of every chemical agent release were assumed to be the proposed location of the CSDP disposal facilities as estimated from a 1:250,000-scale map. All plumes used this release point for estimating fatalities. In the accident analyses, where storage area accidents or on-site transportation accidents resulted in agent release, the release point may not be exact in the FPEIS; however, the implication of this assumption would be more significant for small releases of agent than for large releases. That is, for large releases, the downwind distances predicted by the atmospheric dispersion model are significantly larger than the distance between any possible points of release at a particular site.

The probability data from GA Technologies, agent release data from GA Technologies, meteorological data from ORNL, and fatality estimates from ORNL were integrated by MITRE (MITRE 1987) to develop the five measures of risk described above.

A.1.5 Summary of Results

For accidental agent releases, the five measures of risk were used to distinguish among alternatives. Implementation of the three-tiered selection method resulted in the following conclusions:

1. The continued storage, national, and partial relocation alternatives were rejected from further consideration based on the method's first tier of comparing human health impacts.
2. The on-site disposal and regional alternatives survived the first tier of comparison and were then subjected to the second tier. Of note, however, was that the on-site disposal alternative was consistently less risky in all areas (except person-years at risk) than the regional alternative, but not at a statistically significant level. Nevertheless, the consistency of less risk for the on-site option was an important factor in the overall selection method.
3. In the comparison of on-site and regional alternatives at the second tier (ecosystem and environmental impacts), again the on-site disposal alternative was better than the regional alternative, but not to a statistically significant level. Therefore, both alternatives were allowed to survive to the third tier of comparison.
4. Considering the greater degree and extent of mitigation (potential for saving lives) afforded by emergency response for the on-site alternative as compared to the regional alternative, the on-site alternative was determined to be better than the regional alternative. This conclusion is strengthened by the consistently better ranking of the on-site alternative at the first and second tiers of comparison.

The key findings of the FPEIS have resulted in the Army selecting the on-site disposal alternative as its environmentally preferred alternative. The CONUS stockpile of chemical agents and munitions can be destroyed in a safe, environmentally acceptable manner. The environmental impacts of construction and incident-free disposal operations would be minimal. The risk of catastrophic accidents is relatively low for all programmatic alternatives; however, on-site disposal poses less risk than those alternatives involving off-site movement of the stockpile and is therefore the best choice from a public health and environmental perspective.

A.2 SITE-SPECIFIC ACCEPTABILITY OF PROGRAMMATIC PREFERENCE

After the environmentally preferred alternative was identified, the final step in the analysis was to examine this alternative (on-site disposal) against each installation inventory to ensure that the method did not identify an alternative that was incorrect for one or more installations' inventories. The following discussion examines the selected alternative for ANAD, comparing the selected alternative against the site- and corridor-specific risk pictograms.

Using the two-risk shadings decision rule discussed previously, the likely site preference was also identified (where possible) and compared with the programmatic preference for on-site disposal. Because the Army will implement enhanced emergency planning and preparedness at the installation regardless of the alternative selected, the benefits or risk reductions attributable to emergency planning and preparedness, although more relevant to the maximum fatalities and expected fatalities measures, should not affect site preference and have not been considered.

The preliminary selection of the on-site disposal alternative as the environmentally preferred alternative from a programmatic viewpoint was verified against each storage site to ensure that this alternative did not present an unusual problem or risk to a specific site based on its inventories, population, geography, or any other feature unique to the site. Therefore, the purpose of this exercise was not to depict that on-site destruction is statistically or significantly better than other alternatives, rather, it was to demonstrate that on-site disposal was at least equal.

From the perspective of the population near ANAD, on-site disposal was found to be at least equivalent to all other options in terms of human health effects measures; there was no clear choice among programmatic alternatives for ANAD. On-site and national disposal were found to be equivalent for all measures of risk except person years at risk, for which on-site disposal was found to be better. Indeed, with ANAD as a regional site, a statistically significant difference between the national and on-site alternatives and the regional alternative was clearly depicted. Additionally, if one added the transportation risks, the on-site alternative became even more clear-cut given the opportunity of risk reductions associated with emergency planning and preparedness that was not afforded off-site transportation alternatives.

A.3 FPEIS IMPACT ASSESSMENT FOR ANAD

In addition to the risk-based impact assessment used to select the environmentally preferred alternative, the FPEIS also presented potential environmental impacts from implementing the programmatic alternatives at each of the sites (as appropriate). Potential effects from construction, incident-free operations, accidents, and decommissioning were described. Note that the impacts from accidents were discussed in a deterministic sense and were not used in a risk assessment, as was done to identify the environmentally preferred alternative. Section A.3 summarizes this part of the FPEIS as it applies to ANAD.

Disposal activities can be viewed as a three-phase set of activities. Construction involves activities to procure and build the disposal plant(s) and support functions. Operations involves activities to dispose of the chemical munitions. This includes activities at the site of existing storage, movement of stockpiles from those storage sites to disposal plants, and disposal plant operations. Movement is defined to include on-site handling and transport, as well as off-site transport. Decommissioning involves closure and dismantlement of disposal facilities.

A.3.1 Construction Impacts

Minor impacts from increased spending and the creation of new employment and from the ecological disruption at the plant site are expected. No significant impacts to human health, air quality, or water quality are expected.

The construction of a disposal facility will produce an average of 150 new jobs per facility during the time required for construction. The construction will also likely result in increased sales in construction-related industries in the region. Additional tax revenues will be produced. The total economic impact of the creation of jobs and increased spending at each site under on-site disposal will be minor. The direct and indirect employment will not result in significant inmigration and impacts to local economic infrastructures are unlikely. The local economic impacts of a disposal facility construction will occur only at TEAD and ANAD under the regional disposal option and at TEAD under the national disposal option. While these impacts will be larger than for on-site disposal, they will not be significantly different and pose no problems for the local infrastructures. Economic impacts from construction also would not occur around LBAD or APG under partial relocation; however, the stockpiles at these sites are sufficiently small to preclude the construction of additional disposal plants at receiving sites.

Minor impacts are expected on ecological resources from construction of the disposal facilities. Construction at each site under the on-site disposal alternative will require about 4 ha (11 acres) of land; regional sites or a national site will require about 13 ha (32 acres) or 22 ha (55 acres), respectively. Variable amounts of land will also be required for construction of rail spurs and air fields. The impacts of construction on land use and loss of ecological resources vary among sites and will be described in site-specific NEPA documents. Best available technologies for sediment control during construction will minimize any potential effects to surface waters. These impacts would only occur at ANAD and TEAD under regional disposal and at TEAD for national disposal. No construction impacts would occur at APG and LBAD under partial relocation.

A.3.2 Incident-Free Operations Impacts

Overall, the impacts of disposal are quite limited in scope and significance. Construction impacts include the socioeconomic impacts of increased spending and the creation of new employment and the ecological disruption at the plant site. By definition, incident-free operations are characterized by no releases of agent above emission criteria. Operations impacts of concern include exposure to low, but permitted, levels of chemical agent, air quality impacts, socioeconomic impacts to community resources and well-being, solid waste disposal, and water use. Impacts to socioeconomic resources primarily come from the need for local communities to upgrade emergency response planning for an accidental release of agent. Finally, decommissioning impacts of concern include the socioeconomic impacts of plant closure and disposal of hazardous wastes.

A.3.3 Accident Impacts

In order to assess the environmental impacts of accidents it is necessary to identify the credible accidents that could occur and how agent released in those accidents is dispersed in the environment. The identification of an accident also involves an understanding of how much agent is released, which is frequently referred to as an agent source term. It also requires a knowledge of how the agent is released. It can be spilled, vaporized by an explosion, released by a fire, or some combination of these release modes. Furthermore, identification of an accident requires information on the duration of release.

The ways in which the agent is dispersed after a release are called environmental pathways. The basic paths include the movement of small droplets of agent in the air; the movement of vapor in the air; the deposition of agent from air movement onto underlying lands, vegetation, or water; the movement of agent into bodies of water through runoff or deposition; and the movement of agent into groundwater.

Once agent is released into the environment, it may have effects on human health, ecological systems, water use and/or socioeconomic resources. Any effects would be estimated by the dispersion processes which tell us about the form and level of the agent in the environment and the response of various ecological systems to the agent.

It is important to realize that each of the three stages of the analysis have uncertainties and error bounds associated with them. These uncertainties are largely a function of imperfect knowledge. The application of these methods to the specific areas of concern (i.e., the installations and their environs, and the transportation corridors) provides assessments of impacts.

The pictogram in Fig. A.4 summarizes the risks from accidents for the alternatives at ANAD. The probability of one or more fatalities is greatest for regional disposal and continued storage. Other sites' munitions are shipped to ANAD for the regional disposal alternative, increasing the probability of an accident at ANAD. Continued storage risks are associated with aircraft crashes.

The relatively small magnitude for the maximum fatalities measure for all alternatives except continued storage indicates a low potential for catastrophic accidents at ANAD (usually large releases associated with external events such as aircraft crashes or earthquakes) except in the storage area. The large values for person-years at risk for ANAD indicate the potential for large releases to occur for all alternatives. The value is larger for the national disposal center and continued storage alternatives because of the concentration of agent in the relatively small holding areas. It is larger for the regional disposal centers alternative because of the extended processing time associated with disposing of inventories from other installations. Because the expected-fatalities measure incorporates all of the aspects that influence the risk, this measure will be described in detail by alternative. Individual time at risk ranges between 4.5 and 5.5 years for all alternatives. In the following discussions, the dominant risks are those accidents that have the largest number of expected fatalities. The cumulative risk is the sum of the expected fatalities for all accidents contributing to the risk for a specific alternative.

Continued storage alternative

The risk of continued storage at Anniston is dominated by accidents resulting from large aircraft crashes into the storage area and a forklift collision accident resulting in a detonation or fire. The expected fatalities resulting from these events are both in the range of 10^{-5} to 10^{-4} per year. The cumulative risk associated with this option is in the range of 10^{-5} to 10^{-4} expected fatalities per year. The continued storage alternative is assumed to continue for 25 years.

On-site disposal alternative

The on-site disposal risks are dominated by plant upsets. The largest risks are from (1) earthquakes that cause extensive plant damage, (2) the accidental feeding of a burstered munition into the dunnage furnace, (3) on-site vehicle collisions, and (4) dropping of a munition during handling. These events result in expected fatalities in the range of (1) 10^{-6} to 10^{-5}, (2) 10^{-6} to 10^{-5}, (3) 10^{-6} to 10^{-5}, and (4) 10^{-6} to 10^{-5} per stockpile, respectively. The cumulative risk associated with this alternative is in the range of 10^{-5} to 10^{-4} expected fatalities per stockpile.

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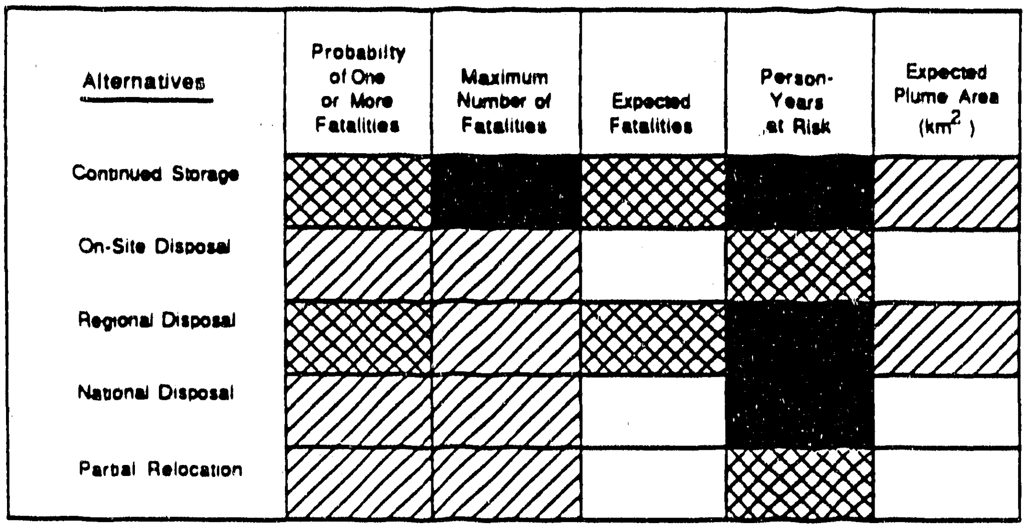

Numerical Equivalents

Legend: Relative Risk	Shading	Probability of One or More Fatalities	Maximum Number of Fatalities	Expected Fatalities	Person-Years at Risk	Expected Plume Area (km^2)
Higher		$>10^{-3}$	>10,000	$>10^{-2}$	$>10^{6}$	$>10^{-2}$
		10^{-4} - 10^{-3}	5000 - 10,000	10^{-3} - 10^{-2}	10^{5} - 10^{6}	10^{-3} - 10^{-2}
		10^{-5} - 10^{-4}	1000 - 5000	10^{-4} - 10^{-3}	10^{4} - 10^{5}	10^{-4} - 10^{-3}
Lower		$<10^{-5}$	<1000	$<10^{-4}$	$<10^{4}$	$<10^{-4}$

Fig. A-4. Risk, with mitigation, in the vicinity of Anniston Army Depot (ANAD) for programmatic alternatives. (Risk along transportation corridors or at destination sites not included. For the disposal alternatives, this diagram does not include the risk associated with approximately 3 years of stockpile storage at ANAD.)

Regional disposal alternative

The major risk contributors are (1) the feeding of the burstered munitions into the dunnage furnace, (2) on-site vehicle accidents, (3) earthquakes that cause severe plant damage, and (4) dropping of a pallet of bare munitions, resulting in expected fatalities in the range of (1) 10^{-5} to 10^{-4}, (2) 10^{-4} to 10^{-3}, (3) 10^{-6} to 10^{-5}, and (4) 10^{-5} to 10^{-4} per stockpile, respectively. The cumulative risk associated with this alternative is in the range of 10^{-3} to 10^{-2} expected fatalities per stockpile.

National disposal alternative

The dominant risks for this option are (1) aircraft crashes into the holding area, (2) on-site vehicle collisions leading to detonation, and (3) dropping a pallet of munitions resulting in a range of expected fatalities of (1) 10^{-7} to 10^{-6}, (2) 10^{-6} to 10^{-5}, and (3) 10^{-6} to 10^{-5} per stockpile, respectively. The cumulative risk associated with this alternative is in the range 10^{-5} to 10^{-4}.

A.3.4 Decommissioning Impacts

Based on the information available on the procedures for decommissioning (dismantling and disposing) disposal facilities, minor, but insignificant, impacts would occur to socioeconomics and solid waste. Prior to implementing decommissioning, further NEPA documentation is required and more detailed impact assessments will be conducted.

On completion of a disposal program at a site, the decommissioning of a facility will involve the employment of both construction- and industrial-type work force. When decommissioning ends, local economic impacts from the increased jobs from construction, operations, and decommissioning will no longer be experienced. Once operation ends, the risk of an accident and the potential for any associated impacts also end. Overall no significant impacts are expected from decommissioning.

Final closure activities for the chemical stockpile disposal facilities will result in removal or decontamination of all process equipment, structures, soils, or other materials containing or contaminated with hazardous waste or hazardous constituents. The projected types of containerized wastes that will be shipped to off-site permitted waste facilities are listed below; amounts of these wastes are presently unknown: (1) brine salt generated during closure, (2) incinerator ash, (3) baghouse dust and cyclone residue, and (4) miscellaneous nonagent related wastes generated during facility closure. The metal parts of agent tanks, furnaces, and incinerators will be disassembled and decontaminated to 5X level (1000°F for 15 min) which means that an item is clean and may be released from government control. Closure plans for the sites are described in Sect. I of Part B of the RCRA permit applications for each site.

REFERENCES FOR APPENDIX A

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APPENDIX B

DESCRIPTION OF SITE-SPECIFIC POPULATIONS

B.1 GENERAL POPULATION SURROUNDING ANAD

Table B-1 identifies the population distributions within 100 km (62 miles) of the Anniston Army Depot (ANAD), by distance intervals and by 22.5° radial sectors. These data are essential to the impact analysis of an accidental agent release and for pollutants associated with normal operations. These data indicate that (1) relatively large concentrations of people reside close to the ANAD's operation and (2) they are concentrated in small towns.

B.2 NEARBY COUNTIES AND COMMUNITIES

Table B-2a describes the total populations of selected counties within a 100-km (62-mile) radius. The 100-km (62-mile) impact area is considered here because the accident analysis presented in the final programmatic environmental impact statement (FPEIS) indicates that resources as far away as 100 km (62 miles) could be impacted by low-probability but high-consequence events associated with continued storage of agents and munitions.

The counties within 50 km (31 miles) are considered those that are affected both by potential high-consequence but low probability events associated with construction and operation as well as population- and economy-driven socioeconomic impacts. The overall population and income characteristics for selected counties within the 50-km (31-mile) radius are presented in Table B-2b.

B.3 SPECIAL POPULATIONS

Table B-3 presents residential populations by potentially sensitive age groups. The most potentially sensitive age groups include infants to 4 years, children 5–14 years, and the elderly aged 65 years or more.

B.4 ON-SITE POPULATION

Up to 5400 people may be found on-post. The evening and night time populations range from 50 to 75 in the West Area to 250 in the East Area, plus security guards. During the day, on-post population is about 3200 in the East Industrial Area, 2000 in the West Area, and 150–200 in the remainder of ANAD.

Table B-1. Residential population distribution around the site of the proposed disposal facility at Anniston Army Depot using updated population statistics

Direction	Incremental population data at specified distances (km)[a]							
	0-1	1-2	2-5	5-10	10-20	20-35	35-50	50-100
N	0	0	0	32	761	11,856	35,961	34,584
NNE	0	0	0	26	3,535	2,703	6,210	30,599
NE	0	0	2	276	8,235	13,624	8,120	68,223
ENE	0	0	22	1,989	20,256	1,350	1,882	43,290
E	0	0	361	7,929	14,963	3,275	3,327	71,029
ESE	0	0	662	3,829	14,325	1,594	3,128	23,173
SE	0	0	449	917	7,694	1,006	2,245	19,123
SSE	0	0	114	1,131	1,196	1,485	3,971	13,603
S	0	0	161	2,152	1,825	2,160	2,049	30,302
SSW	0	0	0	939	906	18,033	4,631	27,084
SW	0	0	0	205	1,557	5,745	3,593	32,151
WSW	0	0	0	262	3,142	8,123	5,112	386,039
W	0	0	0	218	136	3,766	10,060	301,562
WNW	0	0	0	427	1,423	3,206	3,454	42,037
NW	0	0	0	146	665	2,926	5,182	49,078
NNW	0	0	0	0	742	12,155	25,008	62,015
Total	0	0	1,771	20,478	81,361	93,007	123,933	1,233,892

[a]Multiply by 0.6214 to obtain miles.

Source: U.S. Bureau of the Census, *Current Population Reports, Series P-26, No. 86-S-SC, South—1986 Population and 1985 Per Capita Income Estimates for Counties and Incorporated Places*, U.S. Government Printing Office, Washington, D.C. 20402.

Table B-2a. Overall population characteristics by county within 100 km (62 miles) of the site of the proposed disposal facility at Anniston Army Depot

County	Population 1986	Change 1980–86	Percentage change[a]	Net migration[a]
Blount, Ala.	39,000	2,500	6.8	1,700
Calhoun, Ala.	123,800	4,100	3.4	(300)
Chambers, Ala.	39,800	600	1.6	(100)
Cherokee, Ala.	19,200	500	2.6	300
Chilton, Ala.	31,100	500	2.0	(100)
Clay, Ala.	13,100	(600)	-4.5	(800)
Cleburne, Ala.	12,900	300	2.2	0
Coosa, Ala.	10,700	(700)	-6.1	(900)
Cullman, Ala.	66,000	4,400	7.0	2,900
De Kalb, Ala.	53,900	200	0.4	(900)
Etowah, Ala.	102,300	(800)	-0.7	(2,800)
Jackson, Ala.	49,900	(1,500)	(3.0)	(3,100)
Jefferson, Ala.	676,400	5,000	0.7	(17,500)
Madison, Ala.	233,700	36,700	19.0	25,900
Marshall, Ala.	71,500	5,900	9.0	4,200
Morgan, Ala.	98,800	8,500	10.0	4,800
Randolph, Ala.	19,900	(200)	-0.8	(600)
St. Clair, Ala.	46,900	5,700	13.9	4,000
Shelby, Ala.	81,200	14,900	22.5	10,200
Talladega, Ala.	76,500	2,700	3.6	(300)
Tallapoosa, Ala.	38,800	0	0.0	(500)
Bartow, Ga.	48,100	7,300	18.0	5,000
Carroll, Ga.	64,900	8,600	15.0	5,700
Chattooga, Ga.	21,400	(500)	-2.2	(900)
Coweta, Ga.	46,400	7,200	18.2	5,000
Douglas, Ga.	68,200	13,600	25.0	10,000
Floyd, Ga.	78,700	(1,100)	-1.4	(3,200)
Haralson, Ga.	20,300	1,900	10.2	1,300
Heard, Ga.	7,200	700	10.6	600
Paulding, Ga.	32,500	6,400	24.6	4,800
Polk, Ga.	33,900	1,500	4.6	600
Troup, Ga.	54,200	4,200	8.4	2,300
Total	2,381,200	138,500		57,300

[a]Parentheses indicate a deficit, negative trend, or a quantity less than zero.

Source: U.S. Department of Commerce, *County and City Data Book, 1988*. Files on Diskette (1986 Data). Bureau of the Census, Washington, D.C.

Table B-2b. Overall population and income figures for towns and communities in Calhoun, Etowah, and Talladega counties

	Population April 1, 1980	Population July 1, 1986	Per capita Population percentage change 1979-85
Anniston (Calhoun)	29,135	29,370	0.8
Glencoe (Etowah, Calhoun)	4,648	4,880	5.0
Jacksonville (Calhoun)	9,735	9,800	0.7
Piedmont (Calhoun, Cherokee)	5,544	5,540	-0.1
Southside (Etowah, Calhoun)	5,139	5,260	2.4
Weaver (Calhoun)	2,765	2,930	6.0
Oxford (Calhoun, Talladega)	8,939	10,990	22.9
Childersburg (Talladega)	5,084	5,190	2.1
Lincoln (Talladega)	2,601	2,790	7.3
Sylacauga (Talladega)	12,708	12,900	1.5
Talladega (Talladega)	19,128	19,630	2.6

Source: U.S. Department of Commerce. *County and City Data Book, 1988.* Files on Diskette (1986 Data). Bureau of the Census, Washington, D.C.

Table B-3. Sensitive population by age distribution for selected counties[a] within 100 km (62 miles) of the site of the proposed disposal facility at Anniston Army Depot
(Percentage of total population)

County	<5 yrs years 1984	5-14 years 1984	65-74 years 1984	75+ years 1984
Blount, Ala.	7.2	16.1	7.5	4.9
Calhoun, Ala.	6.8	15.7	6.3	3.8
Chambers, Ala.	7.2	16.3	9.4	6.1
Chilton, Ala.	7.3	15.8	8.3	5.3
Cullman, Ala.	6.8	15.6	8.4	5.3
De Kalb, Ala.	6.6	16.4	8.4	5.8
Etowah, Ala.	7.0	15.3	8.7	5.2
Jackson, Ala.	6.7	16.9	6.9	4.0
Jefferson, Ala.	7.3	14.4	7.4	5.2
Madison, Ala.	7.5	14.9	5.0	2.9
Marshall, Ala.	6.4	15.7	8.2	5.1
Morgan, Ala.	7.2	15.9	6.7	4.1
Randolph, Ala.	7.2	16.7	9.0	6.4
St. Clair, Ala.	7.7	17.1	6.3	3.9
Shelby, Ala.	8.7	15.5	4.9	3.0
Talladega, Ala.	7.6	17.8	7.3	4.2
Tallapoosa, Ala.	6.4	16.1	8.8	5.7
Bartow, Ga.	7.7	16.6	6.7	3.6
Carroll, Ga.	6.7	15.9	6.7	4.2
Chattooga, Ga.	6.5	15.1	9.0	5.0
Coweta, Ga.	8.2	16.3	6.9	4.1
Douglas, Ga.	9.0	18.0	4.1	2.5
Floyd, Ga.	6.7	14.3	8.2	5.1
Paulding, Ga.	8.7	17.4	5.5	3.1
Polk, Ga.	7.0	15.6	8.9	5.3
Troup, Ga.	7.9	15.9	8.2	5.1

[a]Data are not available for Cherokee, Clay, Coosa, and Cleburne counties, Alabama and for Haralson and Heard counties, Georgia.

Source: U.S. Department of Commerce. *County and City Data Book, 1988*. Files on Diskette (1986 Data). Bureau of the Census, Washington, D.C.

B.5 TRANSIENT POPULATIONS

Transient populations within the 50-km (31-mile) range include as many as 900 military staff and their dependents, utilizing the training programs offered at ANAD. Some of these trainees rent housing in Anniston and the communities nearby. Table B-4 summarizes other transient populations visiting public areas within 100 km (62 miles) of the proposed disposal facility at Anniston Army Depot.

B.6 INDIAN ENTITIES

Upon their earliest known arrival in 1540, the Europeans under DeSoto found the area around Anniston to be inhabited by the Creek Indians. Extending mostly into Georgia and Alabama, they were bordered by the Cherokee to the northeast, the Chickasaw to the northwest, and the Choctaw in the Central west. At Anniston, the closest neighbors of the Creeks were the Cherokees, who maintained their boundary at the Calhoun/Etowah boundary (Douglas Stewert, Anniston Public Library Historian, Anniston, Ala., personal communication with Mark Schoepfle, Oak Ridge National Laboratory (ORNL), Oak Ridge, Tenn., Nov. 11, 1988). In July of 1836 the remaining Creek Indians in the area (about 15,000) were removed to Arkansas and Oklahoma.

No legally designated Indian country or federally recognized Indian communities remain within either Calhoun or Talladega Counties. At present, the Creek Indians in Oklahoma still lay claim to ancestral burial sites in the Anniston area. The U.S. Forest Service maintains a program in which alternative reburial is arranged and supported should activities disturb burials. (Harry Holstein, Department of Anthropology, Jacksonville State University, personal communication with Mark Schoepfle, ORNL, Oak Ridge, Tenn., Jan. 11, 1989).

Table B-4. Transient populations visiting public areas within 100 km (62 miles) of the site of the proposed disposal facility at Anniston Army Depot

Area	Location (County)	Acreage[a]	Distance to site[b]	Visitor use
	National Forests (NF)			
Talladega NF, Ala.	Calhoun	22,730	15 km SSE	
	Clay	64,586		
	Cleburne	86,546		114.6 M/RVDS[c]
	Macon	10,734		(FY 1987)
	Talladega	46,101		
Chattahoochee NF, Ga.	Chattooga	19,339	~100 km NNE	32,876 visitors
	National Parks (NP)			
Horseshoe Bend National Military Park, Ala.	Tallapoosa	2,040	75 km SSE	47,688 (1987)
	National Wilderness Areas (NWA)			
Cheaha NWA, Ala.	Clay	6,780	20 km SSE	7.5 M/RVDS (FY 1987)
	National Wildlife Refuges (NWR)			
Watercress Darter NWR, Ala.	Jefferson	7	~100 km W	
	State Parks (SP)			
Buck's Pocket SP, Ala.	Dekalb		85 km NNW	26,055 (FY 1988)
Cheaha SP, Ala. (in Talladega NF)	Clay		25 km SSE	276,475 (FY 1988)
James H. Floyd SP, Ga.	Chattooga	269	100 km NNE	158,315 (FY 1985)
John Tanner SP, Ga.	Carroll	136	75 km E	177,686 (FY 1985)
Lake Guntersville SP, Ala.	Marshall		80 km NNW	292,845 (FY 1988)
Oak Mountain SP, Ala.	Shelby		85 km WSW	679,005 (FY 1988)
Rickwood Caverns SP, Ala.	Blount		85 km WNW	119,144 (FY 1988)
	Miscellaneous			
Alabama International Motor Speedway	Talladega Talladega			~130,000 (twice annually)

[a]Multiply by 0.4047 to convert to hectares.
[b]Multiply by 0.6214 to convert to miles.
[c]M/RVDS = Thousands of recreation visitor days, where a visitor day equals one visitor for 12 hours, or 12 visitors for one hour, or any combination equalling 12.

Sources: U.S. Forest Service, *A Summary of Recreation Use (M/RVDS) for FY 1986 by Activity*, Washington, D.C., 1987; U.S. Forest Service, *Land Areas of the National Forest System, as of September 30, 1988*, Washington, D.C., 1988; National Park Service, Statistical Office, *National Park Statistical Abstract 1987*, Denver, 1988.

APPENDIX C.

DESCRIPTION OF SITE-SPECIFIC SURFACE WATER AND GROUNDWATER RESOURCES

C.1 SURFACE WATER

The Alabama-Coosa River basin is the principal watershed near Anniston Army Depot (ANAD) (see Fig. C-1). The Coosa River, which partially defines the western boundary of Calhoun County to the northwest of ANAD, flows in a southwesterly direction before joining the Tallapoosa River north of Montgomery to form the Alabama River. The Cahaba River, which empties into the Alabama River southwest of Selma, is located within the 100-km (62-mile) radius of ANAD (U.S. Water Resources Council 1977). The Neely Henry Dam regulates the flow of the Coosa River in the immediate vicinity of ANAD. Perennial streams discharging to the Coosa River that drain ANAD include Choccolocco and Cane creeks. Flow in each of these streams is sustained by natural storage released as spring flow even during periods of prolonged drought. Many additional perennial and ephemeral streams are present in Calhoun County that flow into the Choccolocco and Cane creek drainage basins or directly into the Coosa River (Harkins 1965).

An east-to-west trending surface water divide extends through the northern portion of ANAD (see Fig. C-1). The proposed site for the ANAD disposal facilities is located on the north side of this divide where runoff drains into Cane Creek 8 km (5 miles) to the north (Jacobs Engineering Group 1987). Runoff having an easterly or westerly overland flow component would also drain to this creek because unnamed tributaries to Cane Creek are located to the east and west of the proposed site for the ANAD disposal facilities, as shown in Fig. C-1. Runoff from ANAD emanating from the southern side of the drainage divide enters Choccolocco Creek [located 5 km (3 miles) south of the southern ANAD boundary] or its tributaries. Coldwater Mountain essentially isolates Hobson City and Oxford from runoff that leaves ANAD in a southerly direction. Uninterrupted runoff from ANAD or the proposed disposal site ultimately flows into the Coosa River. The Coosa River is located 14 km (9 miles) to the northwest of the proposed site of the ANAD disposal facilities.

Flood-crest elevations on Cane and Choccolocco creeks reached very high, record-breaking stages in March 1951 when total rainfall over a 3-d period exceeded 18 cm (7 in.) (Peirce 1955). Flood stages on Cane and Choccolocco creeks near ANAD during this storm measured approximately 158 and 155 m (520 and 510 ft) respectively (Harkins 1965). Elevations at the proposed ANAD site range between 221 and 244 m (725 and 800 ft) above mean sea level (Jacobs Engineering Group 1987), well above the measured flood-crest elevations. It is unlikely that the proposed site will ever be inundated by flooding from Cane or Choccolocco creek.

The Coosa River along the western boundary of Calhoun County has an average flow of 270 m^3/s (6200 Mgd), which is approximately 300 times greater than the 1972 rate of use (Harkins 1972). Cane Creek has an average flow of 4 m^3/s (85 Mgd) at Francis Mill northwest of ANAD (Harkins 1972), while Choccolocco Creek near Jenifer, which is directly south of ANAD in Talladega County, has an average flow of 55 m^3/h (1.4 ft^3/s) per square kilometer of area drained (Harkins 1965). This volume is equivalent to an

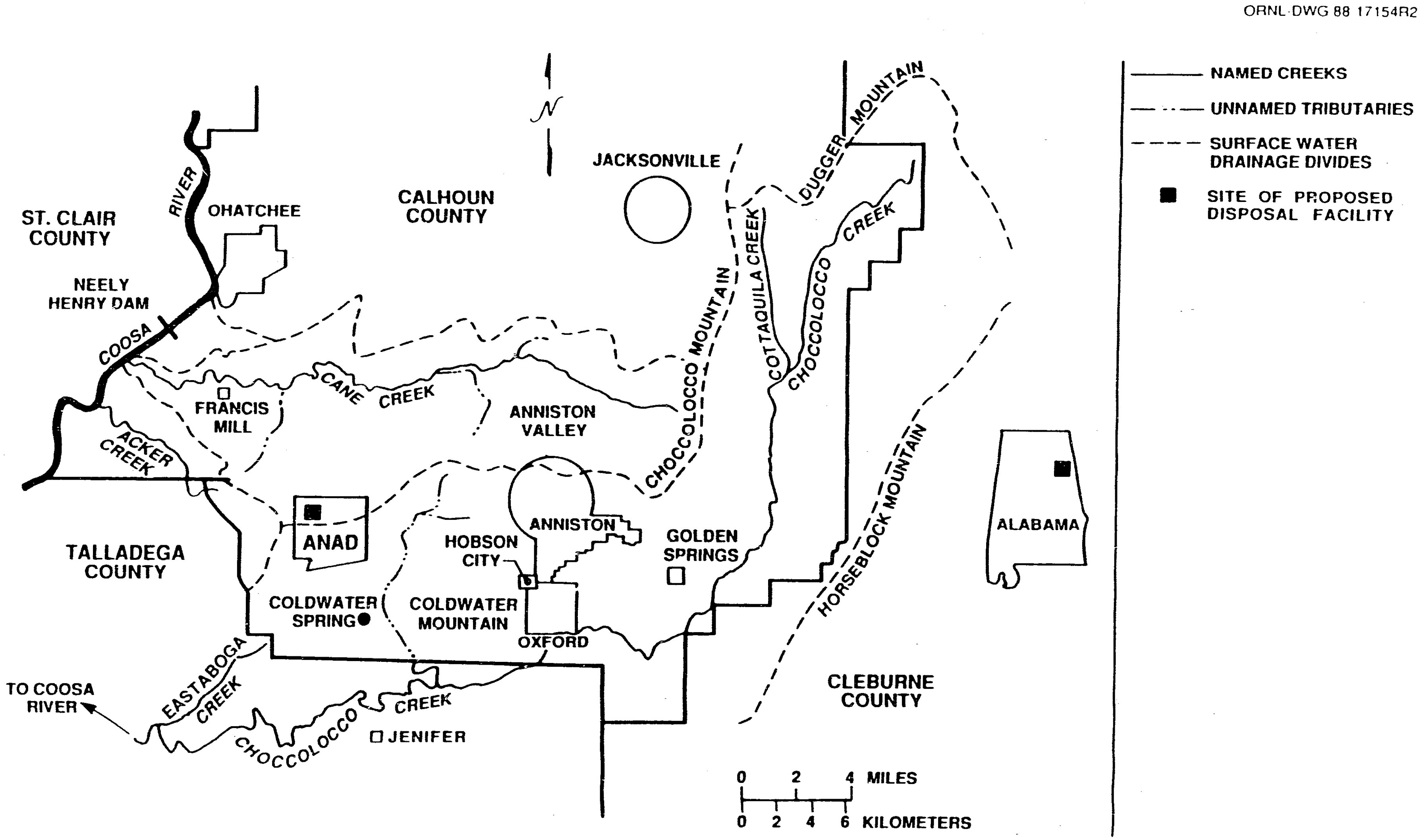

Fig. C-1. Rivers, creeks, and surface water drainage divides for Anniston Army Depot and vicinity. *Source:* J. R. Harkins. *Surface Water Resources of Calhoun County, Alabama,* Circular 33, Geological Survey of Alabama, Division of Water Resources, Tuscaloosa, Ala., 1965.

average flow of 11 m^3/s (249 Mgd) based on the drainage area above Jenifer of 712 km^2 (275 $miles^2$) (Peirce 1955). Approximately 12% of the total streamflow of Cane Creek is supplied by subsurface inflow from springs and seeps, or baseflow, while the corresponding contribution to Choccolocco Creek ranges between 33 and 48% (Harkins 1965). An index of the low flow sustained by baseflow during extreme dry weather periods is the lowest average flow for 7 consecutive d that occurs in a recurrence interval of 2 years. This low flow index for the Coosa River along the western boundary of Calhoun County, Cane Creek at Francis Mill, and Choccolocco Creek at Jenifer is 44 m^3/s (1000 Mgd), 0.8 m^3/s (18 Mgd), and 4 m^3/s (85 Mgd) respectively (Harkins 1965; Harkins 1972).

Water quality in the Coosa River (Peirce 1955) and the streams in Calhoun County (Harkins 1965; Harkins 1972) is generally good. Some surface water degradation occurs as a result of sediment runoff from agriculture and mining, nutrient loading, and municipal and industrial discharges (U.S. Environmental Protection Agency 1977). Values of pH vary from 6.4 to 8.2 within the range of most natural waters. Mineral content as indicated by the concentration of total dissolved solids is low (<200 mg/L), indicating that the water is satisfactory for domestic, agricultural, and most industrial uses, provided no single constituent is present in excessive amounts. Sulfate, chloride, fluoride, nitrate, and iron concentrations are all below recommended drinking water limits. Low silica and aluminum concentrations have been observed. Hardness ranges from soft to moderately hard in the Coosa River and Choccolocco Creek and is moderately hard to hard in Cane Creek. The increased hardness in Choccolocco Creek occurs because this stream originates in an area underlain by slate and flows over relatively insoluble shale, sandstone, and quartzite in eastern Calhoun County, while Cane Creek flows over more soluble limestone and dolomite. Bicarbonate concentrations, which measure below 100 mg/L in Choccolocco Creek and approximately 50% higher in Cane Creek, are indicative of this situation. The hardness and bicarbonate concentration generally increase as the streamflow rate decreases.

Surface water consumption in Calhoun County totals 4 m^3/min (1.5 Mgd), of which 1.3 m^3/min (0.49 Mgd) is used for agricultural purposes, while the remainder is used by public water systems (Baker and Mooty 1987). According to the U.S. Environmental Protection Agency (EPA) STORET data base, there are three public water supply intakes downstream from ANAD on the Coosa River and one on the Alabama River (U.S. Environmental Protection Agency 1982).

Each of the 25 small ponds on the ANAD installation has an average area of 0.1 ha (0.25 acre). Although not suitable for fish, these ponds are used as watering holes by wildlife and as standby water supplies for the ANAD fire protection system. Additional bodies of surface water include a 2-ha (5-acre) lake and a 14-ha (35-acre) reservoir (U.S. Department of the Army 1978). Topography at ANAD as well as at the proposed incinerator site is hummocky, consisting of many low wooded knobs and knolls rising in elevation to 274 m (900 ft) above mean sea level (Jacobs Engineering Group 1987). Relief averages 49 m (160 ft) but extends to 100 m (330 ft) at some locations. Some runoff leaving the proposed incinerator site would be intercepted by the valleys between the knobs and knolls instead of proceeding overland to Cane Creek.

The expected quantity of wastewater discharged from the proposed disposal facilities is 114 m^3/d (30,100 gal/d), consisting entirely of effluent from bathroom, shower, and laundry facilities, as well as laboratory cleaning and monitoring devices (Forsgren-Perkins Engineering 1988). No process water or hazardous material of any type will be discharged into this system. Sanitary waste will be treated and used as process water. Liquid wastes from the incineration process will be concentrated in an evaporator, and the remaining salts will then be precipitated in a dryer. The resultant solids will be packaged on-site, prior to transportation to a regulated, off-site disposal facility. No liquid effluents will be discharged at the proposed disposal facilities that enter the hydrologic cycle during operations.

C.2 GROUNDWATER

The U.S. EPA has determined that certain areas have a groundwater aquifer that is the sole or principal source of drinking water for the area. Contamination of these sources would pose significant hazard to public health. The counties in the continental United States with federally designated sole-source aquifers or associated recharge or streamflow source zones can be identified from information in the U.S. EPA determinations published in the *Federal Register*. *Federal Register* citations for these determinations were obtained from the U.S. EPA (R. Anzzolin, U.S. Environmental Protection Agency, Office of Drinking Water, Washington, D.C., personal communication to J. E. Breck, Oak Ridge National Laboratory, Oak Ridge, Tenn., April 8, 1986). There are no sole-source aquifers within 100 km (62 miles) of ANAD. However, Coldwater Spring is the principal municipal water resource for ANAD, Anniston, Oxford, Hobson City, and much of Calhoun County. The groundwater regime supplying Coldwater Spring has been designated as a Class I aquifer by the U.S. EPA (Scott, Harris, and Cobb 1987).

C.2.1 Geology

Geologic formations in the vicinity of ANAD consist primarily of Paleozoic sandstones, limestones, and shales of sedimentary origin that have been sharply folded into northeasterly trending synclines and anticlines complicated by thrust faults (Peirce 1955; Warman et al. 1960). The Jacksonville Fault is an extensive thrust fault that begins in the vicinity of Coldwater Spring south of ANAD, extending northeastward through Anniston and Jacksonville to Piedmont in the northeast corner of Calhoun County.

A geologic cross section is shown in Fig. C-2, displaying the stratigraphy between ANAD to the west and Golden Springs to the east of Anniston while the corresponding stratigraphic column for this cross section is contained in Table C-1, summarizing the geologic and hydrologic characteristics of the rock formations identified in Fig. C-2. ANAD is situated in an outcrop area of the Knox Group consisting of upper Cambrian and Ordovician age dolomites. The Knox Group has been mapped in Calhoun County as the undifferentiated Chepultepec and Copper Ridge dolomites whose combined thickness extends to 610 m (2000 ft) (Warman and Causey 1962; Jacobs Engineering Group 1987). Near ANAD, the thickness of the Knox Group decreases considerably (see Fig. C-2). The Conasauga Formation of middle and late Cambrian age underlies the Knox Group, while the Rome Formation of Cambrian age is situated beneath the Conasauga Formation. The Conasauga Formation is composed of 30—150 m (100—500 ft) of mudstone and shale with interbeds of limestone and siltstone. The Rome Formation consists of approximately 305 m (1000 ft) of shale, siltstone, and sandstone with lenticular beds of limestone and dolomite.

The Knox Group outcrop area is deeply weathered. A mantle of residuum, consisting of in-place decomposed carbonate bedrock composed of residual clay with chert boulders and fragments, has developed in which many sinkholes and depressions have formed. The residuum generally ranges in thickness from 9 to 30 m (30 to 100 ft),

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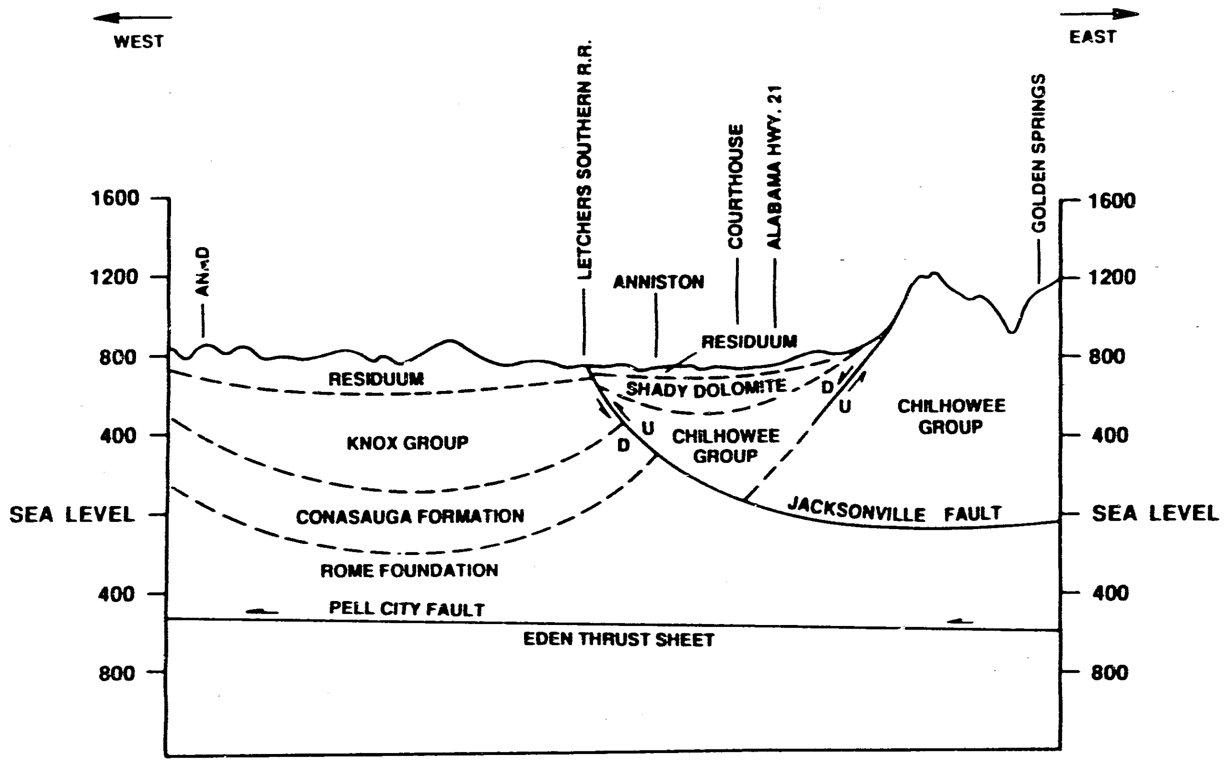

1. ⇄ DIRECTION OF MOVEMENT ALONG FAULT
2. U UPTHROWN FAULT BLOCK
3. D DOWNTHROWN FAULT BLOCK
4. VERTICAL EXAGGERATION X 10
5. ELEVATIONS EXPRESSED IN FEET ABOVE MEAN SEA LEVEL
6. MULTIPLY FEET BY 0.3048 TO OBTAIN METERS
7. THE CHILHOWEE GROUP OF LOWER CAMBRIAN AGE CONSISTS OF THE WEISNER AND WILSON RIDGE FORMATIONS AND IS SHOWN UNDIFFERENTIATED

Fig. C-2. East-to-west geologic cross section extending from Anniston Army Depot to Golden Springs. *Source:* J. C. Scott, W. F. Harris, and R. H. Cobb. *Geohydrology and Susceptibility of Coldwater Spring and Jacksonville Fault Areas to Surface Contamination in Calhoun County, Alabama,* Water-Resources Investigations Report 87-4031, U.S. Geological Survey, Denver, 1987.

Table C-1. Stratigraphic column for Anniston Army Depot and vicinity

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SYSTEM	STRATIGRAPHIC UNIT	THICKNESS[a] (ft)	ROCK CHARACTER	WATER-BEARING PROPERTIES
QUATERNARY	ALLUVIUM, COLLUVIUM AND UNDIFFERENTIATED DEPOSITS	----	ALLUVIUM, SANDY TO CLAYEY; SLOPE WASH, GRAVEL AND SAND.	GENERALLY POOR AQUIFERS. WATER FROM DUG WELLS IN THESE DEPOSITS COMMONLY CONTAINS EXCESSIVE IRON. MANY OF THESE WELLS ARE DRY DURING DROUGHT.
ORDOVICIAN AND CAMBRIAN	CHEPULTEPEC DOLOMITE, COPPER RIDGE DOLOMITE, AND KETONA DOLOMITE, UNDIFFERENTIATED	2000	DOLOMITE, SILICEOUS; ABUNDANT CHERT EXCEPT IN THE KETONA. THE KETONA IS PRESENT AT THE WEST END OF BROCK MOUNTAIN IN TALLEDEGA COUNTY, SOUTH OF ANNISTON.	SHALLOW DOMESTIC WELLS SUPPLY ADEQUATE WATER FOR DOMESTIC USE. SPRINGS THAT FLOW FROM FRACTURES OR SOLUTION CHANNELS HAVE ABUNDANT YIELDS.
CAMBRIAN	CONASAUGA FORMATION	500	LIMESTONE, DOLOMITIC LIMESTONE, AND CRYSTALLINE GRAY DOLOMITE; THIN BEDS OF GRAY SHALE THAT WEATHERS GREEN. SHALE IS DOMINANT FACIES TO THE NORTH AND NORTHWEST.	YIELDS ABUNDANT WATER FROM SOLUTION CHANNELS FORMED ALONG JOINTS AND OTHER FRACTURES IN CARBONATE ROCKS. SHALE YIELDS LITTLE WATER.
	ROME FORMATION	1000	SHALE AND SILTSTONE, RED; GREEN SHALE AND RED AND LIGHT-GRAY SANDSTONE; LOCALLY INCLUDES LENTICULAR BEDS OF LIGHT-GRAY LIMESTONE OR DOLOMITE.	LIMESTONE OR DOLOMITE, IN PLACES, MAY YIELD LARGE AMOUNTS OF WATER. WELLS IN SHALE OR SANDSTONE USUALLY WILL SUPPLY DOMESTIC NEEDS, BUT THE WATER MAY BE MODERATELY MINERALIZED.
	SHADY DOLOMITE	1000	LIMESTONE AND DOLOMITE, YELLOWISH-TO LIGHT-TO DARK-GRAY, CRYSTALLINE, MEDIUM-TO THICK-BEDDED; VARIEGATED CLAYEY SHALES IN LOWER PART.	YIELDS LARGE AMOUNTS OF MODERATELY HARD WATER TO DRILLED WELLS.
	WEISNER FORMATION	2500	SHALE, SILTSTONE, SANDSTONE, QUARTZITE, AND CONGLOMERATE: FORMS MOUNTAINS. LOCAL DEPOSITS OF BAUXITE, HEMATITE, AND LIMONITE.	SUPPLY IS DEPENDENT UPON FRACTURES WHICH MAY YIELD AN ABUNDANT SUPPLY. FAULT ZONES MAY GIVE RISE TO VERY LARGE SPRINGS. GOOD QUALITY.
PRECAMBRIAN (?) TO CARBONIFEROUS (?)	TALLADEGA SLATE	3000?	SLATE, DARK-GRAY TO BLACK, SERICTIC: INTERBEDDED WITH LIGHT-BROWN SANDSTONE, QUARTZITE AND CONGLOMERATE.	RELATIVELY IMPERVIOUS. WELLS AND SPRINGS USUALLY ARE ADEQUATE ONLY FOR DOMESTIC USE. GOOD QUALITY, SOFT WATER.

[a]MULTIPLY FEET BY 0.3048 TO OBTAIN METERS.

SOURCES: WARMAN, J. C., AND CAUSEY, L. V. 1962. GEOLOGY AND GROUND-WATER RESOURCES OF CALHOUN COUNTY, ALABAMA. COUNTY REPORT 7, GEOLOGICAL SURVEY OF ALABAMA, DIVISION OF WATER RESOURCES, TUSCALOOSA, ALABAMA. ALSO, JACOBS ENGINEERING GROUP. 1987. GEOLOGICAL-SEISMOLOGICAL INVESTIGATION OF EARTHQUAKE HAZARDS FOR A CHEMICAL STOCKPILE FACILITY AT THE ANNISTON ARMY DEPOT, ALABAMA. CONTRACTOR REPORT TO THE U. S. ARMY ENGINEER DIVISION, HUNTSVILLE, ALABAMA, PREPARED BY THE JACOBS ENGINEERING GROUP, INCORPORATED, AND URS/JOHN A. BLUME & ASSOCIATES, ENGINEERS UNDER CONTRACT NUMBER DACA87-86-D-0085, DELIVERY ORDER 0004.

although depths exceed 61 m (200 ft) at some places in the vicinity of ANAD (Scott, Harris, and Cobb 1987). The sinkholes and surface depressions within the ANAD installation boundary line up on two approximate axes—one 30° east of north and the other 60° west of north (Technos 1981). The second axis (west of north) appears to pass through the existing chemical agent storage area and very near the proposed disposal site. No obvious sinkholes have been observed in the immediate vicinity of the site of the proposed disposal facilities.

C.2.2 Groundwater Hydrology

The water-bearing properties of the stratigraphic formations underlying ANAD are summarized in Table C-1. Wells screened in the Shady Dolomite and Conasauga Formation can produce groundwater supplies adequate for domestic, industrial, and municipal uses. Yields vary between 380 and 1,900 L/min (100 and 500 gal/min), while one well completed in the Conasauga Formation at Jacksonville has a potential yield of 19,000 L/min (5,000 gal/min) (Warman and Causey 1962). Wells drilled in the Cambrian and Ordovician dolomites usually produce less than 190 L/min (50 gal/min), an amount suitable for most domestic water supplies but too small for use as a municipal water supply.

At least 148 springs in Calhoun County (Warman and Causey 1962) discharge groundwater to the surface. These springs are located primarily along thrust faults that form pathways by which groundwater from deep or distant sources migrates to the surface. The yield from these springs is relatively uniform and much larger than would be expected if only local recharge occurred as a result of incident precipitation. The largest and most used spring in Calhoun County is Coldwater Spring located southwest of Anniston and approximately 3 km (2 miles) from the southern boundary of ANAD (see Fig. C-1). The CSDP is located farther to the north, approximately 10 km (6 miles) from Coldwater Spring. Coldwater Spring has an average discharge of 1.37 m^3/s (31.2 Mgd) and the largest minimum flow [1.03 m^3/s (23.5 Mgd)] of any spring in northern Alabama (Scott, Harris, and Cobb 1987). Coldwater Spring receives groundwater from fractured and weathered zones in the Chilhowee Group, solution cavities and channels in the Shady Dolomite, the Conasauga Formation, the Knox Group underlying ANAD, and the Newala and Little Oak Limestones. Displacements along the Jacksonville Fault have interconnected these individual aquifers to form one large, hydraulically continuous aquifer system.

A water table map of southwest Calhoun County is shown in Fig. C-3. Groundwater flows down the northwest slope of Choccolocco Mountain and the southeast slopes of Choccolocco and Coldwater mountains into Anniston and Choccolocco valleys, respectively, and then southwestward toward the Coosa River. Significant baseflow contributions enter Cane and Choccolocco creeks as well as the Coosa River. The surface discharge point at Coldwater Spring diverts the flow of groundwater from the northwest slope of Coldwater Mountain and the south side of the east-to-west ridge traversing ANAD. This ridge appears as the relative high point defined by the 213-m (700-ft) closed contour in Fig. C-3 and as a surface water divide in Fig. C-1. Groundwater that is not diverted to Coldwater Spring flows northward or southward into Anniston or Choccolocco valleys, respectively, depending on its location with respect to the topographic and groundwater divides which, from currently available information, appear to coincide. The site of the proposed disposal facilities is located on the northwest slope of Choccolocco Mountain, while the chemical agents and munitions storage area straddles the crest of this mountain. Groundwater from the site of the proposed disposal facilities and the north

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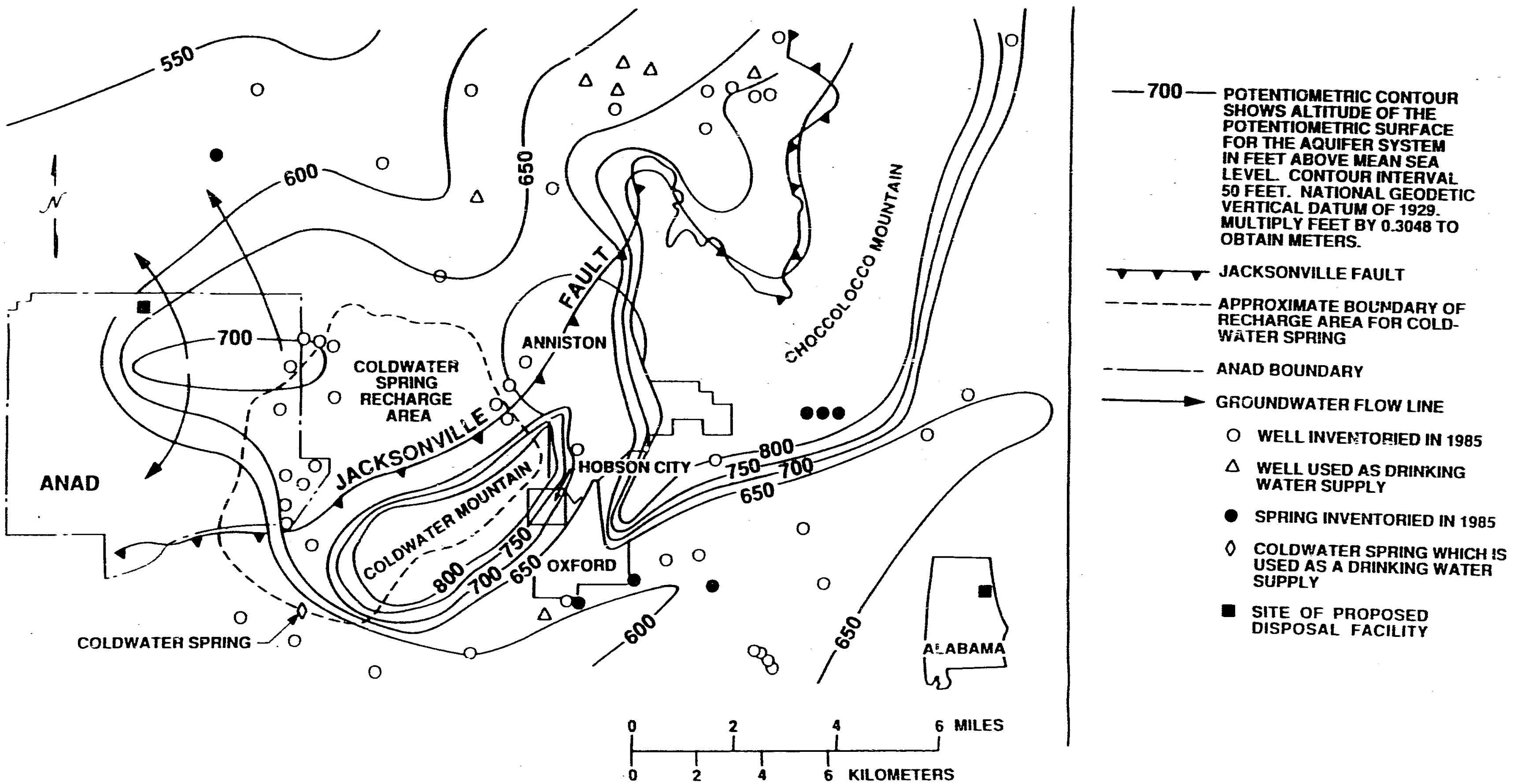

Fig. C-3. Potentiometric map and groundwater flow directions in the vicinity of Anniston Army Depot. *Source:* J. C. Scott, W. F. Harris, and R. H. Cobb. *Geohydrology and Susceptibility of Coldwater Spring and Jacksonville Fault Areas to Surface Contamination in Calhoun County, Alabama,* Water-Resources Investigations Report 87-4031, U.S. Geological Survey, Denver, 1987.

part of the chemical agents and munitions storage area flow away from Coldwater Spring. Groundwater beneath the south part of the chemical agents and munitions storage area flows southward in the direction of Choccolocco Creek and possibly toward Coldwater Spring.

The 6000-ha (23-mile^2) recharge area for Coldwater Spring is shown in Fig. C-3 as a closed, dashed contour southwest of Anniston. This area consists of the steep mountain slopes of Coldwater Mountain, which are underlain by rocks with relatively low permeabilities; a somewhat flat valley through which the Jacksonville Fault passes; and a series of rolling hills that culminate on the east-to-west ridge traversing ANAD. Within the recharge area, the Shady Dolomite, Rome, and Conasauga formations crop out to the southeast of the Jacksonville Fault, while the Knox Group crops out to the northwest. The Shady Dolomite, Conasauga Formation, and Knox Group consist of cavernous carbonate rocks on which a thick layer of residuum has formed (Scott, Harris, and Cobb 1987). The recharge area of Coldwater Spring, which includes the southeast corner of ANAD and possibly the southernmost part of the chemical agents and munitions storage area, is highly susceptible to contamination from the surface because of the numerous sinkholes and depressions that have formed in the residuum; the presence of cavernous carbonate rock beneath the residuum; and the thrust faulting along the Jacksonville Fault, which has hydraulically interconnected the strata that crop out in the area.

Groundwater quality in Calhoun County is generally good (Warman and Causey 1962). Values of pH vary from 6.7 to 8.1, within the range of most natural waters. Mineral content as indicated by the concentration of total dissolved solids is low (<200 mg/L), indicating that the groundwater is satisfactory for domestic, agricultural, and most industrial applications provided no single constituent is present in excessive amounts. Sulfate, chloride, fluoride, nitrate, and iron concentrations are below recommended drinking water limits. Bicarbonate concentrations exceed 100 mg/L because of the dissolution of limestone and dolomite present in many of the water-bearing geologic formations. Calcium-magnesium hardness, which varies between 100 and 150 mg/L, is in the moderately hard range. Some formations locally yield groundwater containing excessive amounts of iron or which is highly saline. The discharge from several small springs contains dissolved hydrogen sulfide gas.

Of the total water consumption in Calhoun County, 93% [55.37 m^3/min (21.06 Mgd)] is supplied by groundwater obtained from wells and springs (Baker and Mooty 1987). Agricultural withdrawals account for 0.92 m^3/min (0.35 Mgd) while self-supplied industrial and domestic use totals 2.1 m^3/min (0.80 Mgd). The remaining 52.34 m^3/min (19.91 Mgd) is used by public water systems. Most of this groundwater is obtained from Coldwater Spring, which supplies the cities of Anniston, Blue Mountain, and Oxford; several suburban areas; the Fort McClellan Military Reservation; and ANAD. Coldwater Spring has served as the municipal water supply for Anniston since 1890 (Scott, Harris, and Cobb 1987).

Sufficient groundwater is readily obtainable from Coldwater Spring to supply the proposed ANAD incineration facility. A reserve of 6.41 m^3/min (2.44 Mgd) is available for consumption from Coldwater Spring, even at its minimum yield of 61.8 m^3/min (23.5 Mgd) and the assumption that the total groundwater consumption in Calhoun County of 55.37 m^3/min (21.06 Mgd) is obtained from this source.

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APPENDIX D.

DESCRIPTION OF SITE-SPECIFIC LAND USE

The portion of Alabama within 100 km (62 miles) of Anniston Army Depot (ANAD) is a predominantly forested region having an average of 70% forest, 23% agricultural land (pasture and cropland), 3.5% urban and built-up land, and 3.0% other land (Table D-1). Calhoun County, in which ANAD is located, has a higher than average fraction of urban and built-up lands and a lower than average fraction of forest land compared to the other Alabama counties located mostly or wholly within the 100-km (62-mile) radius study area. Talladega County, which lies just southwest of ANAD, is about average. Compared to the entire state of Alabama, the study area has a slightly larger fraction of forest (70.0 vs 66.2%) and a slightly smaller fraction of farmland (23.3 vs 26.8%). Counties having relatively high fractions of farmland include DeKalb (51% farmland), Marshall (44%), Cullman (39%), and Blount (36%).

The predominant agricultural or land-use commodities in the state of Alabama, in order of decreasing cash receipts, are broilers, cattle and calves, nonfarm commercial timber, cotton, eggs, peanuts, soybeans, and greenhouse/nursery products (Table D-2). Livestock and poultry comprise 52% of the total cash receipts for the Alabama commodities listed in Table D-2, whereas plant products account for 34%.

The leading products in the Alabama counties within the study area are broilers, eggs, and cattle. Greenhouse/nursery products in Cherokee County comprise the only plant commodity listed as a leading product (Table D-3). Study-area counties that rank high in animal products include Cullman (broilers, eggs, cattle), DeKalb (broilers, eggs, cattle), Blount (broilers, eggs, cattle), and Marshall (broilers, eggs). The leading product in Calhoun County is broilers; in Talladega County, it is cattle (and calves). Although some counties rank high in beef cows, milk cows/dairy products, hogs/pigs, sorghum, and soybeans (Table D-3), these commodities are relatively minor products in the state (Table D-2).

In Georgia, animal commodities account for 53% of the total cash receipts for the plant and animal products listed in Table D-2. Broilers and peanuts are by far the principal commodities. Of the study-area counties in Georgia, only Carroll County ranks very high in an animal product (broilers) (Table D-4). Other counties producing greater than the average number of broilers include Floyd, Haralson, Heard, and Polk. Carroll, Chattooga, and Floyd counties produce greater than the average number of cattle and calves.

Many land parcels within the study area are occupied by national forests, state parks, a national military park, a national wilderness area, and a national wildlife refuge (Appendix B, Table B-4). The national forests provide for the greatest variety of land uses including forestry and various forms of recreation. In other areas, the designated land uses are restricted primarily to non- consumptive recreation and preservation of natural resources.

Table D-1. Land use in Alabama counties located mostly or wholly within 100 km (62 miles) of Anniston Army Depot

County[a]	Area (% of Alabama average)[b]	Urban and built-up (%)	Agri-culture (%)	Forest (%)	Other[c] (%)
Blount	84	0.8	36.4	60.7	2.1
Calhoun	80	11.7	22.4	64.9	1.1
Chambers	78	3.0	21.9	74.1	1.0
Cherokee	78	0.1	28.8	62.1	8.5
Clay	79	1.0	12.6	86.2	0.2
Cleburne	73	1.2	9.0	89.3	0.6
Coosa	87	0.4	7.7	87.9	4.0
Cullman	98	1.7	38.9	56.8	2.6
DeKalb	100	1.5	50.9	47.2	0.4
Etowah	72	6.6	30.8	59.5	3.0
Jefferson	146	17.6	7.4	71.2	3.8
Marshall	81	2.3	43.7	45.0	8.7
Randolph	76	0.8	18.8	79.9	0.3
Shelby	105	2.3	14.8	80.0	2.8
St Clair	84	2.0	16.6	77.7	3.5
Talladega	99	4.1	24.6	68.4	2.7
Tallapoosa	99	3.2	11.5	79.0	6.1
Study area average %	89	3.5	23.3	70.0	3.0
Average Alabama county	100	2.5	26.8	66.2	4.4

[a]Several counties located mostly outside the 100-km (62-mile) area are not included (Chilton, Jackson, Madison, Morgan, Walker).

[b]Average county size in Alabama is 199,583 ha (493,163 acres).

[c]Includes water, wetland, and barren.

Source: *Alabama County Data Book 1987*, Alabama Department of Economic and Community Affairs, Montgomery, Ala., 1988.

Table D-2. Agricultural cash receipts for Alabama (1985) and Georgia (1986)

Product	Alabama 1000s of dollars	Alabama Percent	Georgia 1000s of dollars	Georgia Percent
	Livestock and poultry			
Cattle and Calves	346,343	13.9	215,341	6.1
Hogs	50,941	2.0	193,637	5.5
Dairy	78,735	3.2	173,750	4.9
Broilers	629,168	25.2	951,902	27.0
Turkeys			31.926	0.9
Eggs	159,956	6.4	263,398	7.5
Other livestock and poultry	36,114	1.4	53,685	1.5
(Subtotal)	(1,301,247)	(52.1)	(1,883,639)	(53.4)
	Crops			
Corn			86,013	2.4
Cotton	168,659	6.8	53,384	1.5
Soybeans	129,919	5.2	95,073	2.7
Peanuts	133,930	5.4	475,079	13.5
Tobacco			107,522	3.0
Truck crops			160,637	4.6
Pecans			81,800	2.3
Greenhouse and Nursery	114,238	4.6		
Farm forest products	93,779	3.8	86,300	2.4
Other crops and vegetables	209,692	8.4	252,124	7.1
(Subtotal)	(850,217)	(34.1)	(1,397,932)	(39.6)
	Nonfarm			
Commercial timber	283,896	11.4		
Government payments	60,364	2.4	245,200	7.0
Total farm and forestry	2,495,724			

Sources: *Alabama Agricultural Statistics*, Service Bulletin 29, Montgomery, Ala., 1987. *Georgia Agricultural Statistics Service*, Athens, Ga., 1988.

Table D-3. Ranks[a] of study-area counties in Alabama for crops, poultry, and livestock

County[a]	Ranks within Alabama's total of 67 counties												Leading products[d]
	Cr[b]	Ct	P	Sg	Sy	Wh	CC	BC	MC	HP	BP	EP	
Blount	23	34	NL[c]	28	27	31	18	18	11	25	8	5	**BP,EP**,CC
Calhoun	40	35	NL	60	29	44	47	48	33	66	18	17	BP
Chambers	66	53	NL	19	66	66	50	51	36	55	NL	52	(CC)
Cherokee	47	13	NL	3	10	24	55	61	25	29	35	13	Nursery
Clay	64	62	NL	63	61	55	33	36	32	62	24	7	BP,EP
Cleburne	59	64	NL	58	53	47	65	65	NL	38	22	19	BP
Coosa	67	63	NL	47	57	58	67	64	NL	67	NL	41	(CC)
Cullman	14	28	NL	20	19	15	5	5	4	10	1	1	**BP,EP**,CC
DeKalb	5	42	NL	2	7	5	23	21	15	2	3	3	**BP,EP**,CC
Etowah	27	32	NL	8	30	34	35	32	13	35	12	37	BP
Jefferson	55	67	NL	55	64	57	62	67	28	51	NL	8	EP
Marshall	19	51	NL	11	23	33	57	53	26	11	2	2	BP,EP
Randolph	54	61	NL	43	65	62	37	33	NL	57	27	6	EP,BP
Shelby	63	17	NL	52	59	60	25	42	6	45	NL	34	CC
St Clair	56	65	NL	56	52	53	45	38	29	44	25	35	BP
Talladega	46	43	NL	66	17	38	22	23	12	50	30	63	CC
Tallapoosa	65	29	NL	51	67	64	51	55	NL	64	41	18	(CC)

[a]Several counties located mostly outside the 100-km (62-mile) area are not included (Chilton, Jackson, Madison, Morgan, Walker).

[b]Corn=Cr; cotton=Ct; peanuts=P; sorghum=Sg; soybeans=Sy; wheat=Wh; cattle and calves=CC; beef cows=BC; milk cows=MC; hogs and pigs=HP; broilers produced=BP; eggs produced=EP;

[c]NL = Not listed in top 32 counties for peanuts, top 40 counties for milk cows, or top 43 counties for broilers produced.

[d]Leading products: **>25 M dollars**; 10–25 M dollars; 5–10 M dollars; (<5 M dollars), 1986 cash receipts.

Sources: *Alabama Agricultural Statistics*, Service Bulletin 29, Montgomery, Ala., 1987. *Alabama County Data Book 1987*, Alabama Department of Economic and Community Affairs, Montgomery, Ala., 1987.

Table D-4. Ranks of study area counties in Georgia (159 total counties) for poultry and livestock.[a]

County[b]	Broilers (rank)	Hens and pullets (rank)	All cattle and calves (% of av)	Hogs and pigs (% of av)
Carroll	9	>70	270	55
Chattooga	53-68	>70	114	31
Floyd	19-53	>70	142	41
Haralson	19-53	>70	76	20
Heard	19-53	>70	67	<14
Polk	19-53	27-70	99	14

[a]Exact ranks were not available; therefore, the range of ranks that bound each county's rank is provided where available. The number of cattle and hogs is given as a percent of the average number in all Georgia counties.

[b]Several counties located mostly outside the 100-km (62-mile) area are not included (Bartow, Corveta, Douglas, Paulding, Troup).

Sources: *Alabama Agricultural Statistics*, Service Bulletin 29, Montgomery, Ala., 1987. *Alabama County Data Book 1987*, Alabama Department of Economic and Community Affairs, Montgomery, Ala., 1988. *Georgia Agricultural Facts*, Georgia Agricultural Statistics Service, Athens, Ga., 1988.

APPENDIX E.

DESCRIPTION OF SITE-SPECIFIC ECOLOGICAL RESOURCES

Ecological resources include all living organisms except humans as well as areas containing important terrestrial and/or aquatic resources (i.e., parklands, wilderness areas, Nature Conservancy areas, and wetlands). Terrestrial and aquatic species protected by the Endangered Species Act are identified in this appendix for the 20-, 50-, and 100-km (12.4-, 31- and 62-mi) zones around Anniston Army Depot (ANAD). Aspects of land use related to ecological resources are described in this appendix, while the human aspects of land use are addressed in Appendix D.

The maximum no-effects radius [100 km (62 miles) for GB and VX] includes 33 counties or parts of counties in Alabama and Georgia; 70% of the area is in Alabama. The no-deaths distance for mustard is 50 km (31 miles); mustard is carcinogenic and does not have a no-effects distance. The 50-km (31-mile) zone for mustard includes 10 counties within Alabama. Ecological data for resources of special concern are summarized in Table E-1. Additional site-specific information is found in the environmental analysis of on-site disposal of M55 rockets at ANAD (U.S. Army 1984) and in the Installation Assessment of Anniston Army Depot (U.S. Army 1978).

E.1 TERRESTRIAL RESOURCES

Of the land area within the 100-km (62-mile) zone, 70% is forested and 23% is pasture and cropland, with 7% of the area in two major rivers (Coosa and Alabama Rivers) and development (ADECA 1988). Major crops within this zone are soybeans, corn, and cotton.

The 100-km (62-mile) study area is within the gulf slope section of the oak-pine forest region (Harper 1943). The landscape is hilly to mountainous with relief ascending to 610 m (2000 ft) in the southeast quadrant of the 100-km (62-mile) zone (Talladega Mountains). The forest vegetation of the area is diverse, with three major forest types represented. Loblolly-shortleaf pine and oak-pine are the two dominant types. Approximately 15% of the area is represented by longleaf-slash pine. Commercial utilization of the forest resources is sporadic, with unmanaged harvesting for fuel and paper products the primary use. Game and furbearing species in the area consist of white-tailed deer, wild turkey, bobwhite, dove, woodcock, rabbit, squirrel, opossum, and raccoon. The area is within a flyway for two duck species: the blue-winged teal and the lesser scaup (Bellrose 1978).

E.2 AQUATIC RESOURCES

The major bodies of water within the 100-km (62-mile) zone around ANAD are shown in Fig. E-1. Under the proposed on-site incineration of agent, the only transportation will be from the storage area to the incinerator site; therefore, the only bodies of water in which aquatic resources could be adversely impacted by a spill would occur within the drainage area of Cane Creek and the downstream receiving bodies of

Table E-1. Summarized county-level information for ecological resources and land use within 20-, 50-, and 100-km radii zones around the existing storage and proposed on-site disposal facility sites for Anniston Army Depot

	National park units	Gross area (ha)	Wilder-ness area units	County area (ha)	Threatened and endangered species		Wild and scenic rivers (no.)	Nature Conservancy areas (no.)	Land use (%)			States/ counties
					Terrestrial	Aquatic			Forest	Crop	Grazing/ pasture	
20 km	0		0		1	0	0	0	81	6	7	1/5
50 km	0		0		4	0	0	1	77	8	8	2/12
100 km	1	830	0		6	7	0	5	77	7	8	2/28

Source: U.S. Department of the Army, 1988. *Chemical Stockpile Disposal Program Final Programmatic Environmental Impact Statement*, Vols. 1, 2, and 3, Program Manager for Chemical Demilitarization, Aberdeen Proving Ground, Md., January 1988.

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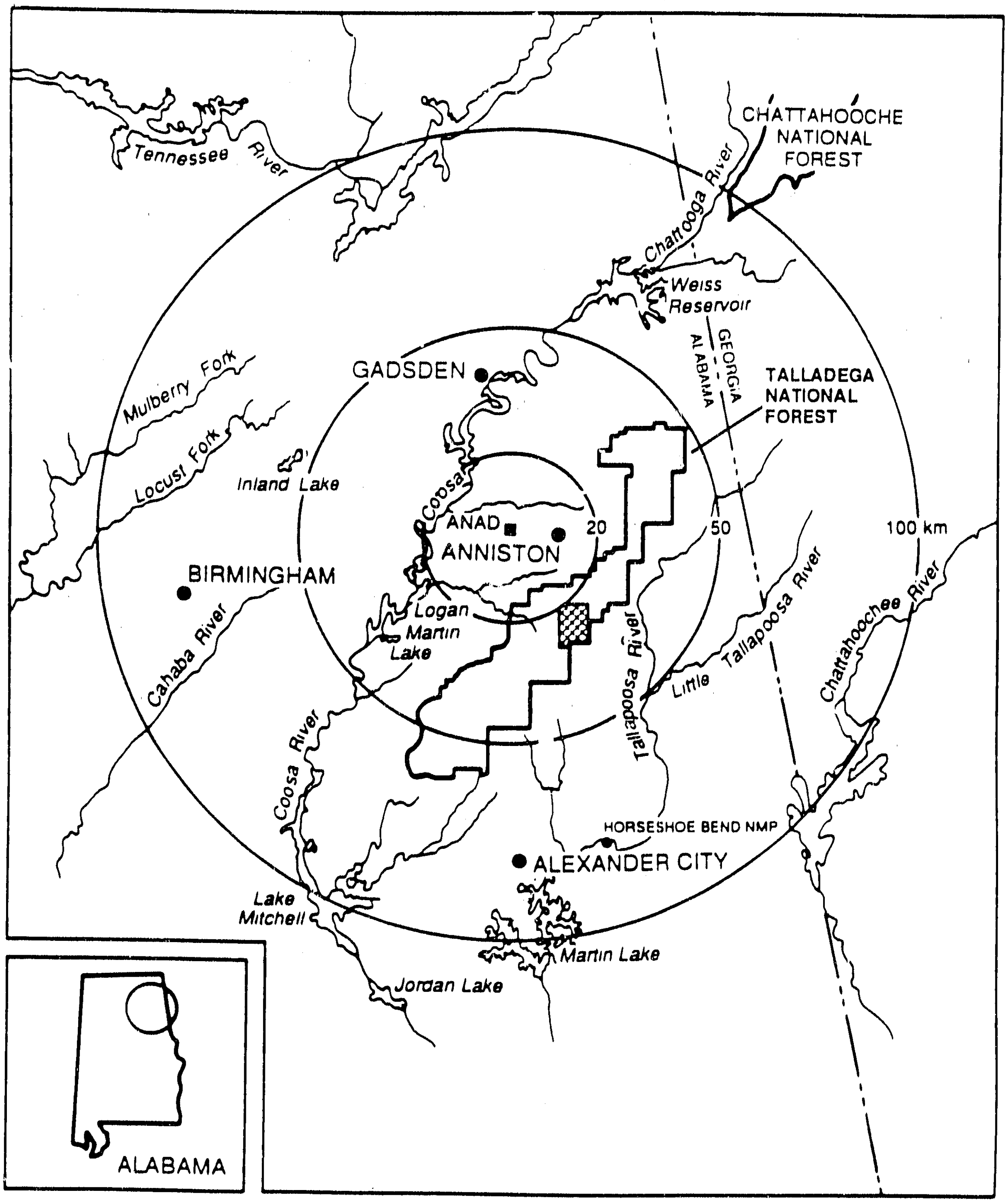

Fig. E-1. Water resources within the 100-km (62-mile) zone around Anniston Army Depot.

water. The additional water bodies shown (Fig. E-1) within the impact zone could be affected by atmospheric deposition from aerosolization of agent. Depending upon the type and amount of agent involved and the meteorological conditions at the time of the accident, effects could extend to the 100-km (62-mile) no-effects distance.

As discussed in Sect. 3.2.1 and Appendix C, the drainage at the proposed incineration site is to the northwest into a tributary of Cane Creek. Cane Creek ultimately flows into the Coosa River at Logan Martin Lake. Specific information on the aquatic resources of Cane Creek and Logan Martin Lake has been requested from the Alabama Department of Fish and Game [Dan Catchings, District Manager, personal communication to Virginia Tolbert, Oak Ridge National Laboratory (ORNL), Jan. 31, 1989] and the Alabama Geological Survey (Scott Mattee, personal communication to Virginia Tolbert, Jan. 31, 1989) for use in preparing the ANAD draft EIS.

Information in the final programmatic environmental impact statement (FPEIS) stated that bluegill, sunfish, and catfish are the most abundant panfish and smallmouth bass the most abundant game fish in the ANAD vicinity (Ramsey 1976). This information remains accurate. More detailed information obtained since the FPEIS shows that the fisheries resources of Logan Martin Lake in the site vicinity consist of recreational species of bass, bluegill, spotted bass, and black and white crappie. Additional species found in the reservoir include threadfin and gizzard shad, catfish, suckers, and minnows (Keith Floyd, Alabama Department of Game and Fish, personal communication to Virginia Tolbert, ORNL, Jan. 27, 1989). According to Dan Catchings of the Alabama Department of Game and Fish, the fisheries resources of Logan Martin Lake are similar in kind and number to those of other reservoirs on the Coosa main stem. Information on the densities of individual species for Logan Martin Reservoir has been requested from Dan Catchings of the Alabama Department of Game and Fish. This information will be used in the site-specific EIS to estimate the impacts of a spill of nerve agent entering and traveling downstream in the Coosa River system.

There are two lakes on the ANAD installation that are used for fishing; a 14.2-ha (35-acre) reservoir west of Gate C and a 5-acre lake near Gate B (U.S. Army 1978). The 14.2-ha (35-acre) reservoir was stocked by the state of Alabama in 1961 with largemouth bass and bluegill and subsequently has been managed by reduction of bluegill and restocking of largemouth bass (U.S. Army 1984). No information is available on the 2-ha (5-acre) lake.

Information has been requested from Federal Emergency Management Agency (FEMA) and the U.S. Fish and Wildlife Service (FWS) on wetlands. Any new information obtained from these and other agencies during preparation of the Phase I Report or the site-specific EIS will be included in the appropriate document.

E.3 THREATENED AND ENDANGERED SPECIES

Twelve federally listed endangered species were listed in the FPEIS as occurring within the 100-km (62-mile) zone: watercress darter, two species of clams (fine-rayed pigtoe and shiny pigtoe), three species of pearly mussels (pink mucket, Alabama lamp, and pale lilliput), gray bat, Indiana bat, eastern cougar, red-cockaded woodpecker, bald eagle, and green pitcher plant. In addition, the snail darter, a threatened species, is found in the Alabama part of the 100-km (62-mile) zone. Important caves for hibernating bats are found within 100 km (62 miles) of the site (R. M. Dawson and D. J. Wesley, U.S. FWS, R. Odom, Georgia Department of Natural Resources, personal communications to

L. L. Sigal, ORNL, June 26, 1986, June 19, 1986, and Aug. 6, 1986; see Appendix F, U.S. Army 1988). The approximate locations of the threatened and endangered species are shown in Fig. E-2.

The Indiana bat is a resident of caves in the area in the winter and nests under the bark of older trees during the spring and summer (Brack 1988). The gray bat is a year-round resident of caves throughout the region (Tuttle 1979). The red-cockaded woodpecker may nest in suitable old-growth pine stands throughout the region. Presently, both Cleborne and Coosa counties contain two active colonies. These are the only known colonies within the state. Both Weiss and Neely Henry Lakes (Cherokee and St. Clair counties, respectively) provide winter habitats for several pairs of Bald Eagles. The peregrine falcon is an occasional transient in the area (Bill Summerour, Department of Biology, Jacksonville State University, Jacksonville, Alabama, personal communications to D. C. West, ORNL, Feb. 8, 1989). The eastern cougar has not been reported in the area during this century.

The U.S. FWS has been contacted to update information appearing in the FPEIS. Conversation with Sandy Tucker, Alabama Field Office, U.S. FWS (personal communication to Virginia Tolbert, ORNL, Jan. 26, 1989) indicated that only the orange-footed pimpleback mussel occurs in the Tennessee River to the north within the 100-km (62-mile) zone. Additional information has been requested.

The pygmy sculpin, *Cottus pygamaeus*, a state-listed and candidate federal endangered species, is found in Coldwater Spring, which is located just to the southwest of the site, and in Coldwater Creek as far downstream as the confluence with Dry Creek. Historically, this species occurred further downstream, but water quality degradation in Dry Creek has restricted its range (U.S.Army 1984). The coldwater darter, *Etheostoma ditrema*, also occurs in Coldwater Spring and is listed as a Category 2 species (a species for which existing information indicates that listing may be warranted but for which substantial biological information to support a proposed rule is lacking) (Sandy Tucker, U.S. Fish and Wildlife Service, Alabama Field Supervisor, personal communication to Virginia Tolbert, ORNL, Jan. 25, 1989). As discussed in Sect. 3.2.1 and Appendix C, drainage at the proposed site is to the northwest and away from the Coldwater Spring recharge area; consequently, impacts to these species would not occur as a result of a spill of chemical agent. If atmospheric release of agent occurred and the wind direction was toward the south, deposition of agent into Coldwater Spring could occur, and both pygmy sculpins and coldwater darters could be impacted. Potential impacts will be examined in the site-specific EIS.

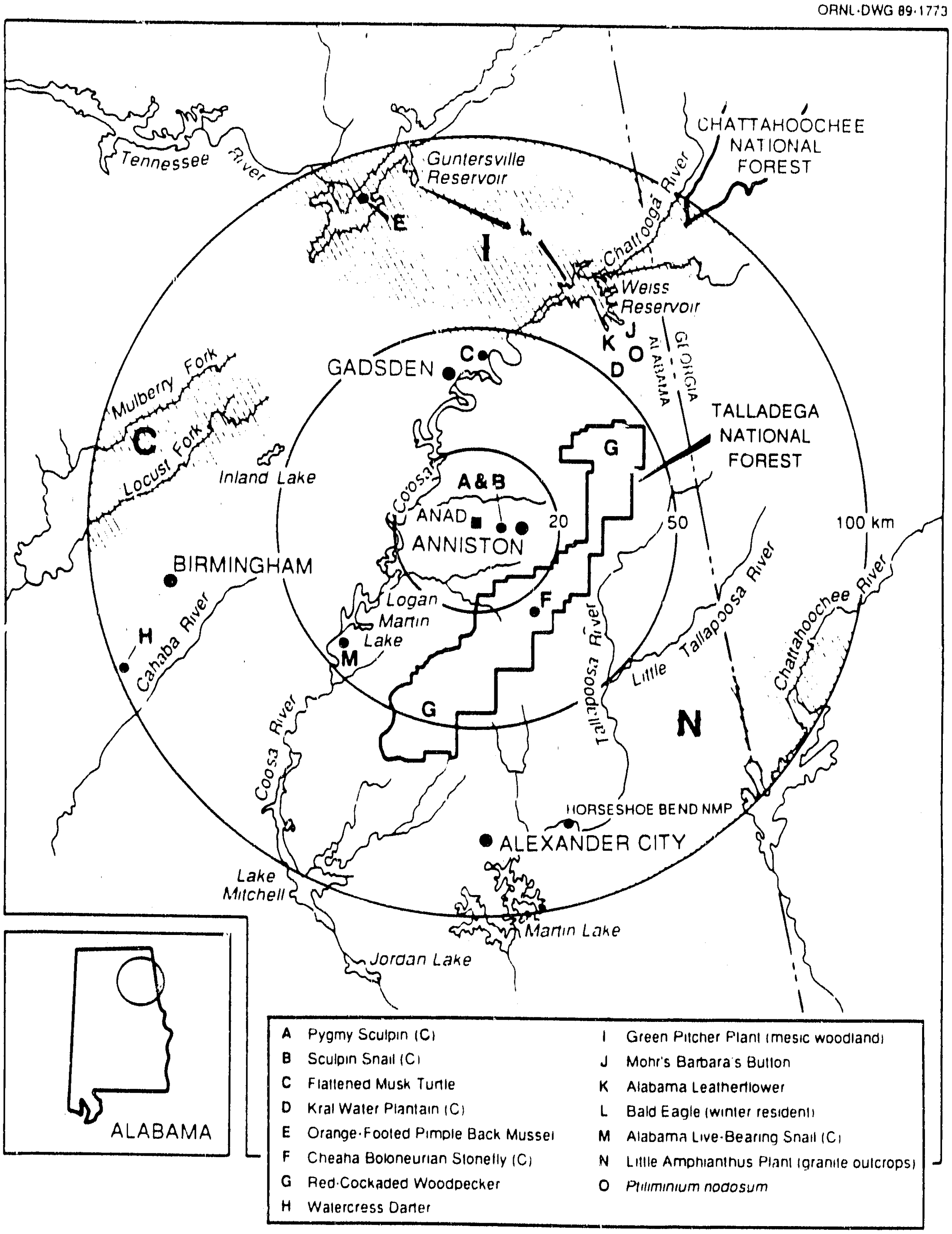

Fig. E-2. Approximate locations of threatened and endangered species within the 100-km (62-mile) zone. (c) denotes candidate species.

E.4 REFERENCES

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APPENDIX F

DESCRIPTION OF SITE-SPECIFIC SOCIAL, ECONOMIC, AND CULTURAL RESOURCES

It is assumed that Calhoun and Talladega counties will be the primary counties economically impacted by the development of the proposed disposal facilities. This assumption is based upon the observation that Calhoun County, in which ANAD is located, contains the largest infrastructure and possesses the greatest potential for growth. It is further assumed that Talladega County, because of its proximity to ANAD, will absorb the socioeconomic effects which overflow from Calhoun County.

F.1 HISTORY AND BACKGROUND

Settlements in the Anniston area before the American Civil War were dominated by agriculture (mainly cash crops such as cotton and tobacco). To the cash crop economic base was added an iron foundry, the Cane Creek Furnace. Fueled by charcoal obtained from the nearby forests, other foundries were established at Jenifer and Oxford (Ayers 1940).

After the destruction of the Cane Creek Furnace in the Civil War, the Samuel Noble and the Daniel Tyler families founded the Woodstock Iron Company in 1872. These leaders were aware of Anniston's ideal location for supplying the rapidly developing railroads that were linking the South to industrial centers of the North at that time. Anniston had ample supplies of hematite ore, limestone, and coal (Ayers 1940).

The Noble and Tyler families not only wanted the railroads to be successful, but wanted to be able to compete on a wider scope with the North in the development of iron and steel. As a result, they converted Anniston to a planned industrial community. With the Woodstock Foundry as its nucleus, the community added a cast iron and pipe foundry in 1887, and by the 1890s a railroad car wheel and wooden railroad car manufacturing plant. Thus, from 1883 to 1884 Anniston grew through an economic boom; from 1885 to 1886 the boom slowed down, and from 1887–1890 a second boom occurred, as Woodstock diversified. The Depression of 1891 was followed by only a partial recovery from 1895 to 1897, with the introduction of textiles and other industries. With the arrival of military camps there during the Spanish-American War of 1898–99, the economy revived.

By the 1940s, Anniston was a leading manufacturer of cast iron pipe. Its location near power lines, its industrial achievements, and other attributes were advertised to attract industry (Ayers 1940). Subsequently, gradual economic growth has been supported, and to a degree dominated, by the establishment of the Anniston Ordnance Depot in 1942. Known today as Anniston Army Depot (ANAD), its overall mission includes rebuilding and maintaining tanks and other heavy equipment, performing missile maintenance, repairing and rebuilding small arms and artillery, supplying material and services worldwide to the U.S. Army, and storing ammunition.

F.2 PUBLIC SERVICES/INFRASTRUCTURE

In general, the dominant economy of Calhoun County is defense related and centers at Anniston Army Depot (ANAD). Because of the massive influxes of transient populations both from ANAD training and the Talladega Speedway, the county has developed a general infrastructure and service system capable of handling these influxes, at least on a short-term basis.

F.2.1 Police and Fire Departments

Table F-1 summarizes the police and fire departments for Talladega and Calhoun Counties.

F.2.2 Schools

Two schools are located within 10 km (6.2 miles) of ANAD. Table F-2 provides a full listing of schools in the ANAD vicinity. These will be the schools most likely to be affected by a large accidental release of chemical agent.

Tables F-3 and F-4 depict the two- and four-year colleges, respectively, within the 100-km (62-mile) radius from ANAD.

F.2.3 Hospitals and Community Health

Table F-5 lists the hospitals available in Calhoun and Talladega counties. Specialized medical services within the 100-km (62-mile) radius include (1) University of Alabama Medical Center, Birmingham, Alabama, which has available specialized facilities for severe burn, head injury, and open heart surgery, and (2) Emory University Hospital, Atlanta, Georgia, which has similar specialized services available. Birmingham's facilities are accessible from the ANAD vicinity within 20 minutes by helicopter.

Also available is the Fort McClellan Hospital, with 100 beds usable and 48% occupancy.

Emergency medical services include the Fort McClellan Mobile Army Surgical Hospital unit, the Talladega Emergency Medical Services, and the Anniston City Rescue Squad.

Mental and community health services are served by the Calhoun-Cleburne Mental Health Board, Inc., a public nonprofit corporation (David Harvey, Executive Director, Calhoun-Cleburne Mental Health Board, Inc., personal communication with Mark Schoepfle, Nov. 17, 1988).

Table F-1. Police and fire department staffing in Calhoun and Talladega counties

Personnel description	Calhoun County	Talladega County
Rural fire department staff	23	15
Police	55	43
Total vehicles	20	22
Sheriff and deputies	25	28
Jailers		16
Cars and paddy wagons	15	32
Auxiliary		50

Sources: Elmer Wheatly, Calhoun County Chamber of Commerce, Inc., November 17, 1988. Personal communication with Mark Schoepfle, Oak Ridge National Laboratory; Buddy Holcomb, Director, Talladega County Emergency Management Agency, November 16, 1988. Personal communication with Mark Schoepfle, Oak Ridge National Laboratory; Skippy Smithwick, Directory, Talladega County Industrial Development Board, November 16, 1988. Personal communication with Mark Schoepfle, Oak Ridge National Laboratory.

Table F-2. Schools within Calhoun and Talladega Counties

	Students	Faculty	Support personnel
(a) Calhoun County			
Alexandria Elementary	376	16	9
Alexandria High	1,293	62	32
Bynum	286	16	9
Coldwater	484	22	11
De Armanville	364	21	9
Ohatchee	893	43	17
Pleasant Valley	1,100	52	19
Saks Elementary	823	39	18
Saks Middle School	533	28	8
Saks High School	867	46	17
Weaver Elementary	790	38	18
Weaver High	621	33	13
Wellborn Elementary	885	48	21
Wellborn High	1,113	58	18
White Plains	595	36	15
Vocational Center*	8		4
Central Office	—	—	13
Total[a]	11,031	558	251

*Students rotate from all high schools for brief periods of attendance.

	Students	Faculty	Support personnel
Anniston City			
Anniston High	1,117	79	38
Anniston Middle	989	67	35
Constantine Elementary	194	16	11
Cooper Elementary	170	17	15
Golden Springs Elementary	332	19	13
Johnston Elementary	865	53	32
Norwood Elementary	224	17	14
Randolph Park Elementary	236	16	8
Tenth Street Elementary	208	18	9
Administration	—	11	52
Total[b]	4,335	313	227

Table F-2. (Continued)

	Students	Faculty	Support personnel
Piedmont City			
Southside Elementary	389	*	*
Frances E. Willard Middle	503	*	*
Piedmont High School	356	*	*
Total[c]	1,248	80	25

*Individual school staffing figures were unavailable. Because of the relatively small size of the district, totals are provided.

	Students	Faculty	Support personnel
Jacksonville City Schools			
Kittystone Elementary	840	48	23
Jacksonville High School	785	50	17
Central Office	—	1	5
Total[d]	1,625	99	45
Oxford Public Schools			
C.E. Hanna Elementary	495	26	11
Oxford Middle School	758	41	17
Oxford High School	1,299	70	11
Central Administration	—	3	62
Total[e]	2,552	140	101
Pell City Schools			
Coosa Valley Elementary	262	16	9
Iola Roberts Elementary	581	32	13
Duran Junior High	806	40	13
Kennedy Elementary	683	33	16
Pell City High	863	50	17
Central Administration	—	4	5
Total[f]	3,195	175	73

Table F-2. (Continued)

	Students	Faculty	Support personnel
(b) Talladega County			
Childersburg Elementary	311	21	13
Childersburg High	618	34	22
Childersburg Middle	593	35	32
B.B. Palmer	1,362	68	43
C.R. Drew	437	23	18
Fayetteville	432	25	19
Hill Elementary	811	45	36
Idalia	103	8	8
Jonesview	167	10	10
Lincoln	830	47	29
Munford	669	43	25
Sycamore	469	29	26
Talladega County Training	529	35	28
Watwood	393	23	15
Winterboro	703	44	30
Childersburg Child Development Center	69		
Pittard Area Vocational School, Childersburg	—	14	2
Total[g]	8,496	504	356
City of Talladega			
Salter Elementary School	493	25	***
Houston Elementary School	488	26	***
Graham Elementary School	465	27	***
Henderson Elementary School	276	15	***
Young Elementary School	270	14	***
Dixon Middle School	294	16	***
Ellis Junior High School	665	36	***
Talladega High School	1,114	66	***
Central Office	—	10	***
Total[h]	4,065	235	***

*** Data were unavailable

Table F-2. (Continued)

	Students	Faculty	Support personnel
Syllacauga			
Indian Valley Elementary School	656		15
Mounvainview Elementary School	305		8
Pinecrest Elementary School	474	86	8
Syllacauga High School	705	47	19
East Highland Middle School	372	25	10
Central Office	3	3	20
Total[i]	2,515	161	80
Donoho School (Private)			
	500	34	9
Total[j]	500	34	9

[a]Letter from H. Harold Hobbs, Administrative Assistant County Board of Education to Mark Schoepfle, Jan 20, 1989.

[b]Helen Copeland, Anniston City Schools, Personal Communication with Mark Schoepfle, Oak Ridge National Laboratory, May 4, 1989.

[c]Charles Needham, Piedmont City Schools, Personal Communication with Mark Schoepfle, Oak Ridge National Laboratory, May 4, 1989.

[d]Glenda Gentry, Jacksonville City Schools, Personal Communication with Mark Schoepfle, Oak Ridge National Laboratory, May 4, 1989.

[e]Bill Cassidy, Superintendent, Oxford Public Schools, Personal Communication with Mark Schoepfle, Oak Ridge National Laboratory, May 4, 1989.

[f]Nan Strickland, Pell City Schools, Personal Communication with Mark Schoepfle, Oak Ridge National Laboratory, May 4, 1989.

[g]Sam Slone III, Calhoun County Emergency Management, Personal Communication with Mark Schoepfle, Oak Ridge National Laboratory, May 4, 1989.

[h]Peggy King, Talladega City Schools, Personal Communication with Mark Schoepfle, Oak Ridge National Laboratory, May 4, 1989.

[i]Joseph B. Morton, Superintendent, Syllacauga City School, Personal Communication with Mark Schoepfle, Oak Ridge National Laboratory, May 4, 1989.

[j]George Gorey, Principal, Donoho School, Anniston, Alabama, Personal Communication with Mark Schoepfle, Oak Ridge National Laboratory, May 4, 1989.

Table F-3. Two-year college attendance within 100 km (62 miles) of Anniston Army Depot[a]

College	City	Undergraduate enrollment	% Part-time	No. Part-time
Alabama Technical College	Gadsden	759	24	182
Alexander City State Junior College	Alexander City	1112	33	367
Bessemer State Technical College	Bessemer	1816	53	962
Booker T. Washington Junior College of Business	Birmingham	255	9	23
Gadsden State Junior College	Gadsden	3345	40	1338
Harry M. Ayers State Technical College	Anniston	684	0	0
Jefferson State Junior College	Birmingham	5844	51	2980
Lawson State Community College	Birmingham	1699	28	476
National Education Center/ National Institute of Technology Campus	Homewood	350	0	0
N.F. Nunnelly State Technical College	Childersburg	600	20	120
Northeast Alabama State Junior College	Rainsville	1162	41	476
RETS Electronic Institute	Birmingham	726	0	0
Snead State Junior College	Boaz	1146	34	390
Southern Institute	Birmingham	515	35	180
Southern Junior College of Business	Birmingham	694	0	0
Southern Union State Junior College	Wadley	1711	47	804
Wallace State Community College	Hanceville	2719	42	1142

[a]Presents Alabama counties only. Based on the data examined, no two-year colleges exist in Georgia within the 100-km (62-mile) zone.

Source: Lehman, A. E., and E. A. Suber, *Guide to Four-Year Colleges, 1987*, Seventeenth Edition. Princeton, New Jersey: Peterson's Guides.

Table F-4. Four-year college attendance within 100 km (62 miles) of Anniston Army Depot

College	City	Undergraduate enrollment
Alabama		
Jacksonville State University	Jacksonville	6,241
Miles College	Birmingham	517
Samford University	Birmingham	2,726
Southeastern Bible College	Birmingham	146
Talladega College	Talladega	559
University of Alabama	Birmingham	10,159
Georgia		
Berry College	Mount Berry	1,187
Shorter College	Romer	736
West Georgia College	Carrollton	4,800

Source: Lehman, A. E., and E. A. Suber, *Guide to Four-Year Colleges, 1987*, Seventeenth Edition. Princeton, New Jersey: Peterson's Guides.

Table F-5. Hospital use for Calhoun and Talladega counties

Name of hospital/facility	No. of licensed beds	No. of beds available	No. of patients accommodated	Average daily census	Percent occupancy (ADC[a] No. beds avail.)
Anniston/Northeast	372	269	250	181	67.29
Stringfellow	120	92	50	42	45.65
Jacksonville	100	56		29	51.79
Piedmont Hospital	49	30	78[b]	N/A[c]	
Talladega County Hospital	122	187		52	27.86
Average occupancy percentage					32.10

[a]ADC = average daily census.

[b]A nursing home is also attached to the Piedmont Hospital. Hence, the higher average daily census would not describe the same domain as would the other listings.

[c]N/A = Not available.

Source: Jan Munroe, Administrative Vice President, Anniston/Northeast Hospital, personal communication to Mark Schoepfle, Nov. 17, 1988.

F.2.4 Utilities

Water is supplied through the Anniston Water and Sewer Board. Electricity is supplied through the Alabama Power Company, as well as the Cherokee Electric and Coosa Valley Electric Cooperative. Alabama Power Company, the major supplier of industrial electricity, maintains two 230-kV and five 115-kV transmission feeds into Calhoun County. Its electric power distribution is supported by a 44-kV sub-transmission system (Elmer Wheatly, Calhoun County Chamber of Commerce, Inc., personal communication with Mark Schoepfle, Nov. 16, 1988).

Interruptible gas is supplied through the Alabama Gas Corporation (Alasgo), except for Piedmont and Jacksonville (Elmer Wheatly, Calhoun County Chamber of Commerce, Inc., personal communication with Mark Schoepfle, Nov. 16, 1988).

F.2.5 Transportation

Anniston is the most important confluence for transportation in the region. It is accessible by automobile through

(1) Interstate 20 from the east and west, which links it to both Birmingham, Alabama, and Atlanta, Georgia;

(2) U.S. Highway 431/21, the north/south corridor, which links it to Jacksonville, Gadsden, and Chattanooga, Tennessee;

(3) State Highway 21 South, which links it to Talladega.

The airport at Anniston provides commercial air transportation to Atlanta and Birmingham on a regular basis through the Anniston/Calhoun County Metropolitan Airport, which has a 2134-m (7000-ft) paved and lighted runway. The airport is also the location of the Federal Aviation Administration Flight Service Center for the State of Alabama (Elmer Wheatly, Calhoun County Chamber of Commerce, Inc., personal communication with Mark Schoepfle, Nov. 16, 1988).

Rail services are provided by Norfolk Southern and CSX railways for freight and by AMTRAK for passenger service. CSX includes the Seaboard Coast Line, the Louisville and Nashville, and the Chesapeake and Ohio railroads. All railroads have reciprocal switching agreements in the Anniston-Oxford area. The Norfolk Southern is the dominant rail carrier, handling about 43,000 carloads inbound and 43,000 carloads outbound per year and switching on a 7-d per week basis. The CSX system accounts for an average of 10,000 carloads annually and switches on a 5-d/week basis. Main lines for both systems pass through Birmingham and Atlanta (Elmer Wheatly, Calhoun County Chamber of Commerce, Inc., personal communication with Mark Schoepfle, Nov. 16, 1988).

Water transportation is occasionally utilized through Birmingham on the Tennessee/Tom Bigbee Waterway. Situated about 121 km (75 miles) west, via Interstate 20, access is available to the Alabama State Docks at Mobile, Alabama.

F.2.6 Waste Management

Present sewer capacity is 20 Mgd. Normal use capacity varies from 10 Mgd in summer to 14 Mgd in the winter. Waste water is routed through Choccolocco Creek and nearby tributaries as needed (Elmer Wheatly, Calhoun County Chamber of Commerce, Inc., personal communication to Mark Schoepfle, Nov. 17, 1988).

F.2.7 Water Supplies

Municipal and industrial water supply comes from Coldwater Springs and the nearby reservoir. Coldwater Springs operates at a peak capacity of 91 million L/d (24 Mgd); the reservoir operates at 30.3 million L/d (8 Mgd). Peak usage for water in Calhoun and Talladega counties is 72 million L/d (19 Mgd); normal usage ranges from 64 to 68 million L/d (17 to 18 Mgd).

Also planned is White Plains Reservoir, which will operate at a 19 to 34 million L/d (5 to 9 Mgd) capacity.

F.3 ECONOMIC RESOURCES

F.3.1 Employment

Employment data for Calhoun and Talladega counties are shown in Table F-6. Data for other counties within the 100-km (62-mile) radius of the proposed disposal facility are provided in Table F-6 for regional comparison with Calhoun and Talladega counties.

F.3.2 Housing

Housing is available in Calhoun County in a variety of districts. Most of this housing is established north and south along U.S. Highway 21. To the east it is bounded by Choccolocco Mountain and Fort McClellan, and to the west by ANAD. The average sale price is $47,535, with $24,027 for two bedrooms or less, $47,788 for three bedrooms (constituting 63% of the total home sales), $62,258 for four bedrooms (21% of the total sales), and $68,583 for five or more bedrooms. The average list prices were $51,606 for a three-bedroom home, $66,434 for a four-bedroom residence, and $106,023 for a home with five or more bedrooms. Purchase prices are below the national average (Elmer Wheatly, Calhoun County Chamber of Commerce, Inc., personal communication with Mark Schoepfle, Nov. 16, 1988).

Table F-6. Employment for counties within 100 km (62 miles) of Anniston Army Depot

County	Civil. labor force 1986	Civil. labor force unemployment	Civil. labor unemployment rate (%)
Blount, Ala.	16,681	1,508	9.0
Calhoun, Ala.	51,893	5,004	9.6
Chambers, Ala.	17,241	1,484	8.6
Cherokee, Ala.	7,767	1,049	13.5
Chilton, Ala.	15,723	1,668	10.6
Clay, Ala.	6,358	960	15.1
Cleburne, Ala.	5,720	501	8.8
Coosa, Ala.	4,762	381	8.0
Cullman, Ala.	31,391	2,951	9.4
De Kalb, Ala.	28,748	2,872	10.0
Etowah, Ala.	43,953	5,735	13.0
Jackson, Ala.	20,967	3,088	14.7
Jefferson, Ala.	335,633	25,995	7.7
Madison, Ala.	126,254	9,093	7.2
Marshall, Ala.	37,012	4,387	11.9
Morgan, Ala.	45,825	4,574	10.0
Randolph, Ala.	9,422	870	9.2
St. Clair, Ala.	20,609	1,726	8.4
Shelby, Ala.	37,154	2,522	6.8
Talladega, Ala.	32,144	3,982	12.4
Tallapoosa, Ala.	19,102	1,521	8.0
Bartow, Ga.	20,662	1,802	8.7
Carroll, Ga.	29,966	1,875	6.3
Chattooga, Ga.	8,744	806	9.2
Coweta, Ga.	22,718	1,151	5.1
Douglas, Ga.	34,432	1,334	3.9
Floyd, Ga.	38,307	2,692	7.0
Haralson, Ga.	8,613	674	7.8
Heard, Ga.	3,330	242	7.3
Paulding, Ga.	14,995	689	4.6
Polk, Ga.	13,466	1,195	8.9
Troup, Ga.	28,413	2,172	7.6
Total	1,138,005	96,503	

Source: U.S. Department of Commerce, *County and City Data Book, 1988*. Files on Diskette (1986 Data). Bureau of the Census, Washington, D.C.

Table F-7 provides a summary of housing vacancy information for all the counties within the 100-km (62-mile) range of ANAD.

Calhoun and Talladega counties have vacancies numbering well over the average for the 100-km (62-mile) range. These figures tend to support assertions by local planners that rental housing availability tends to be directed toward serving transient participants in periodical training at ANAD and Fort McClellan. With influxes numbering as high as 900 people, 100 often seek off-base rentals, while 800 remain in the barracks (Elmer Wheatly, Calhoun County Chamber of Commerce, Inc., personal communication to Mark Schoepfle, Nov. 17, 1988).

During the November survey 1200 homes were available on the market (Elmer Wheatly, Calhoun County Chamber of Commerce, Inc., personal communication to Mark Schoepfle, Nov. 17, 1988).

There are nine hotels and motels, totaling approximately 775 hotel/motel rooms within Calhoun County. A total of 993 rooms are anticipated. These figures tend to support the assertion by planners that the county has accustomed itself to serving large transient population influxes from short-term training exercises at ANAD, as well as from the Talladega Race Track (Elmer Wheatly, Calhoun County Chamber of Commerce, Inc., personal communication to Mark Schoepfle, Nov. 17, 1988).

F.3.3 Agriculture and Land Use

Since the end of the Civil War, agriculture in Calhoun and Talladega counties has maintained a secondary status to developing industry. In general, agriculture appears to be declining relative to manufacturing and services. It is nevertheless a major economic influence in the two counties as well as in the wider area included within the 100-km radius.

Table F-8 provides an overall summary of agricultural land use within 100 km (62 miles) of ANAD. Table F-9 provides information on the status of irrigated farming with respect to overall farming.

F.4 ARCHAEOLOGICAL/HISTORICAL RESOURCES

Table F-10 includes the federal data base for historical sites within the 100-km (62-mile) area located within Alabama. The Alabama State Historical Preservation Officer reported no further information from other sources.

F.5 EMERGENCY RESPONSE

The current Calhoun County budget for emergency management is approximately $61,000. The Calhoun County Emergency Management Agency (EMA) was designated in 1984 by the seven communities in the county to be the lead agency for local emergency response. In addition, Talladega County has agreed that Calhoun County is to take the lead in planning and managing potential emergencies involving the releases of chemical agent [Sam B. Slone III, Director of Emergency Management, Calhoun County, personal communication with G. Rogers, Oak Ridge National Laboratory (ORNL), Feb. 8, 1989].

Table F-7. Housing vacancy information for the area within 100 km (62 miles) of Anniston Army Depot

County	Housing unit % change, 1970–80	Total housing units, 1980	Occupied housing units, 1980	Estimated total housing vacancies, 1980	New auth. housing units, 1980–86	Estimated total housing units, 1986
Blount, Ala.	50.3	13,846	12,682	1,164	0	13,846
Calhoun, Ala.	30.8	42,582	39,651	2,931	0	42,582
Chambers, Ala.	20.5	14,428	13,520	908	164	14,592
Cherokee, Ala.	50.3	8,197	6,505	1,692	66	8,263
Chilton, Ala.	41.3	12,869	10,742	0	203	13,072
Clay, Ala.	22.9	5,328	4,767	561	35	5,363
Cleburne, Ala.	32.0	4,798	4,373	425	0	4,798
Coosa, Ala.	25.7	4,933	3,899	1,034	10	4,943
Cullman, Ala.	41.5	24,729	21,758	2,971	535	25,264
De Kalb, Ala.	41.8	20,888	19,247	1,641	0	20,888
Etowah, Ala.	24.7	39,891	36,864	3,027	0	39,891
Jackson, Ala.	51.3	19,620	17,689	1,931	592	20,212
Jefferson, Ala.	22.0	259,843	244,215	15,628	19,746	279,589
Madison, Ala.	25.2	71,123	67,082	4,041	19,348	90,471
Marshall, Ala.	43.7	26,669	23,489	3,180	1,657	28,326
Morgan, Ala.	36.2	33,811	31,369	2,442	3,224	37,035
Randolph, Ala.	21.8	7,847	7,045	802	0	7,847
St. Clair, Ala.	65.2	15,613	13,850	1,763	470	16,083
Shelby, Ala.	102.9	24,644	21,817	2,827	2,289	26,933
Talladega, Ala.	27.2	26,059	24,061	1,998	793	26,852
Tallapoosa, Ala.	25.6	15,343	13,275	2,068	636	15,979
Bartow, Ga.	41.0	14,836	13,804	1,032	402	15,238
Carroll, Ga.	38.9	20,321	19,002	1,319	3,811	24,132
Chattooga, Ga.	21.6	8,287	7,733	554	0	8,287
Coweta, Ga.	38.3	14,119	13,307	812	2,988	17,107
Douglas, Ga.	104.7	17,758	16,911	847	5,375	23,133
Floyd, Ga.	25.5	30,246	28,477	1,769	2,283	32,529
Haralson, Ga.	28.6	6,990	6,504	486	664	7,654
Heard, Ga.	34.9	2,459	2,204	255	44	2,503
Paulding, Ga.	69.5	9,167	8,745	422	3,541	12,708
Polk, Ga.	21.7	12,062	11,413	649	1,205	13,267
Troup, Ga.	22.9	18,346	17,455	891	3,227	21,573
Total		847,652	783,455	77,896	73,308	920,960

Source: U.S. Department of Commerce, *County and City Data Book, 1988*. Files on Diskette (1986 Data). Bureau of the Census, Washington, D.C.

Table F-8. Agricultural population and land use within 100 km (62 miles) of Anniston Army Depot

County	Number of farms	Percent of farms <20 ha[a]	Percent of farms ≥200 ha
Blount, Ala.	1,338	37.4	3.8
Calhoun, Ala.	733	41.3	3.5
Chambers, Ala.	409	20.0	15.9
Cherokee, Ala.	588	30.6	11.7
Chilton, Ala.	793	35.4	4.9
Clay, Ala.	466	21.5	5.6
Cleburne, Ala.	380	31.6	2.6
Coosa, Ala.	299	26.1	9.0
Cullman, Ala.	2,303	51.9	1.9
De Kalb, Ala.	2,228	47.3	2.1
Etowah, Ala.	998	46.6	3.4
Jackson, Ala.	1,295	40.1	9.0
Jefferson, Ala.	556	53.6	2.2
Madison, Ala.	1,101	38.1	15.0
Marshall, Ala.	1,664	52.8	2.0
Morgan, Ala.	1,353	45.3	4.4
Randolph, Ala.	695	25.9	3.5
St. Clair, Ala.	661	33.4	3.8
Shelby, Ala.	516	34.7	7.9
Talladega, Ala.	630	30.5	9.0
Tallapoosa, Ala.	391	19.2	7.9
Bartow, Ga.	463	32.2	9.9
Carroll, Ga.	868	31.5	2.5
Chattooga, Ga.	292	22.3	9.2
Coweta, Ga.	376	30.1	7.7
Douglas, Ga.	151	50.3	2.6
Floyd, Ga.	504	28.6	7.5
Haralson, Ga.	321	36.8	4.4
Heard, Ga.	190	22.6	6.8
Paulding, Ga.	296	46.3	1.7
Polk, Ga.	327	31.8	4.0
Troup, Ga.	291	30.6	10.3
Total	22,457		

[a]20 hectares = 50 acres; 200 ha = 500 acres.

Source: U.S. Department of Commerce, *County and City Data Book, 1988*. Files on Diskette (1986 Data). Bureau of the Census, Washington, D.C.

Table F-9. Farm area (hectares) for counties within 100 km (62 miles) of Anniston Army Depot

County	Area (thousands of hectares)	Percent change in area 1978–82	Average size of farm (ha)[a]	Total irrigated	Total crop land area(thousands of hectares)
Blount, Ala.	66	-7.3	49	0	32
Calhoun, Ala.	38	-12.2	51	0	19
Chambers, Ala.	49	-5.9	120	0	15
Cherokee, Ala.	58	7.4	99	0.8	34
Chilton, Ala.	47	-7.3	59	0	22
Clay, Ala.	32	-1.1	69	0	13
Cleburne, Ala.	20	0.8	52	0	7
Coosa, Ala.	25	1.3	84	0	7
Cullman, Ala.	83	-7.4	36	0.4	45
De Kalb, Ala.	90	-4.9	40	0.4	53
Etowah, Ala.	48	6.1	48	0	26
Jackson, Ala.	92	-10.5	71	0	54
Jefferson, Ala.	20	3.4	36	0	9
Madison, Ala.	119	-5.9	108	0.4	81
Marshall, Ala.	62	-7.0	37	0	36
Morgan, Ala.	68	-7.8	50	0	42
Randolph, Ala.	40	-6.0	58	0	13
St. Clair, Ala.	38	3.2	58	0.4	15
Shelby, Ala.	35	-7.4	68	0	18
Talladega, Ala.	52	-7.0	83	0	31
Tallapoosa, Ala.	36	4.9	92	0	10
Bartow, Ga.	42	11.2	91	0	21
Carroll, Ga.	39	8.7	45	0	17
Chattooga, Ga.	25	-8.0	86	0	10
Coweta, Ga.	27	0.9	72	0	13
Douglas, Ga.	6	36.9	39	0	2
Floyd, Ga.	38	-25.8	75	0.4	17
Haralson, Ga.	15	3.7	49	0	6
Heard, Ga.	15	-6.0	76	0	6
Paulding, Ga.	12	-6.8	39	0	4
Polk, Ga.	19	-13.7	59	0	9
Troup, Ga.	22	-2.7	77	0	9
Total	1377			3.0	636

[a]Multiply hectares by 2.471 to obtain acres.

Source: U.S. Department of Commerce, *County and City Data Book, 1988*. Files on Diskette (1986 Data). Bureau of the Census, Washington, D.C.

Table F-10. National Register listings by identification number as of June 13, 1988
[Within 50 km (62 miles) of site of proposed on-site disposal facility
of Anniston Army Depot

ID #, site name city, county	Approximate distance from proposed facility (km)[a]
76000356, Kymulga Mill And Covered Bridge, Childersburg, Talladega	49
83002982, Presley Store, Springville, St. Clair	48
73000334, Hugo Black House, Ashland, Clay	47
76000316, Clay County Courthouse, Ashland, Clay	46
84000599, Southern Railway Depot, Piedmont, Calhoun	42
86001157, Lawler--Whiting House, Talladega, Talladega	41
83002968, U.S. Post Office, Attalla, Etowah	40
74000410, Alabama City Library, Gadsden, Etowah	39
84000616, Eleventh Street School, Gadsden, Etowah	37
76000325, U.S. Post Office, Gadsden, Etowah	37
83002967, Gadsden Times-News Building, Gadsden, Etowah	37
74000404, Shoal Creek Church, Edwardsville, Cleburne	37
86001000, Colonel O. R. Hood House, Gadsden, Etowah	36
76000317, Cleburne County Courthouse, Heflin, Cleburne	34
73002127, Inzer House, Ashville, St. Clair	32

Table F-10. (Continued)

ID #, site name city, county		Approximate distance from proposed facility (km)[a]
74002223, Swayne Hall, Talladega,	Talladega	31
79000403, Silk Stocking District, Talladega,	Talladega	30
72000181, Talladega Courthouse Square Historic District, Talladega,	Talladega	30
88000471, Talladega Courthouse Square Historic District (Boundary Increase), Talladega,	Talladega	30
83003489, First Presbyterian Church, Talladega,	Talladega	30
3002983, Boxwood, Talladega,	Talladega	28
74002179, Looney House, Ashville,	St. Clair	27
80004238, Jacob Green House, Ashville,	St. Clair	27
66000154, J. L. M. Curry House, Talladega,	Talladega	27
86001044, Downtown Jacksonville Historic District, Jacksonville,	Calhoun	23
87001651, Alexander Woods House, Jacksonville,	Calhoun	23
70000100, Dr. J. C., Francis, Office, Jacksonville,	Calhoun	23
82001999, First Presbyterian Church, Jacksonville,	Calhoun	22
76000357, Elston House, Talladega,	Talladega	15
82002000, Dudley Snow House, Oxford,	Calhoun	14

Table F-10. (Continued)

ID #, site name city, county		Approximate distance from proposed facility (km)[a]
85002864, Bagley--Cater Building, Anniston,	Calhoun	14
76000315, Janney Furnace, Ohatchee,	Calhoun	14
72001440, Fort Strother Site, Ohatchee,	St. Clair	14
85002867, Glenwood Terrace Residential Historic District, Anniston,	Calhoun	13
85002880, Oak Tree Cottage, Anniston,	Calhoun	13
85002870, Hillside Cemetery, Anniston,	Calhoun	13
85002888, Tyler Hill Residential Historic District, Anniston,	Calhoun	12
85002868, Henry Burt Glover House, Anniston,	Calhoun	12
84000597, McKleroy-Wilson-Kirby House, Anniston,	Calhoun	12
75000307, Crowan Cottage, Anniston,	Calhoun	12
85002876, Samuel Noble Monument, Anniston,	Calhoun	12
85002887, Temple Beth-El, Anniston,	Calhoun	12
85002872, Kilby House, Anniston,	Calhoun	12
85002881, Parker Memorial Baptist Church, Anniston,	Calhoun	12
85002740, Anniston Transfer Company, Anniston,	Calhoun	12

Table F-10. (Continued)

ID #, site name city, county		Approximate distance from proposed facility (km)[a]
85002877, Noble-McCaa-Butler House,		
Anniston,	Calhoun	12
85002869, Grace Episcopal Church,		
Anniston,	Calhoun	12
85002884, Saint Paul's Methodist Episcopal Church,		
Anniston,	Calhoun	12
76000313, Noble Cottage,		
Anniston,	Calhoun	12
85002875, Mount Zion Baptist Church,		
Anniston,	Calhoun	11
85002739, Anniston Cotton Manufacturing Company,		
Anniston,	Calhoun	11
85002873, Kress Building,		
Anniston,	Calhoun	11
85002883, Rollstone Machinery Company,		
Anniston,	Calhoun	11
85002885, Security Bank Building,		
Anniston,	Calhoun	11
85002874, Montgomery Ward--Alabama Power Company Building,		
Anniston,	Calhoun	11
85002879, Nonnenmacher House,		
Anniston,	Calhoun	11
85002878, Nonnenmacher Bakery,		
Anniston,	Calhoun	11
85002890, Wikle Drug Company,		
Anniston,	Calhoun	11
82001997, Caldwell Building,		
Anniston,	Calhoun	11
80000681, Lyric Theatre,		
Anniston,	Calhoun	11

Table F-10. (Continued)

ID #, site name city, county		Approximate distance from proposed facility (km)[a]
85002738, Glen Addie Volunteer Hose Company Fire Hall, Anniston,	Calhoun	11
85002866, Calhoun County Courthouse, Anniston,	Calhoun	11
76000314, U.S. Post Office, Anniston,	Calhoun	11
85002871, Richard P. Huger House, Anniston,	Calhoun	11
85002739, Anniston Cotton Manufacturing Company, Anniston,	Calhoun	11
85002882, Peerless Saloon, Anniston,	Calhoun	11
73000332, Anniston Inn Kitchen, Anniston,	Calhoun	11
85002865, Bank of Anniston, Anniston,	Calhoun	11
85002886, Lansing T. Smith House, Anniston,	Calhoun	11
85002889, Union Depot and Freight House, Anniston,	Calhoun	11
78000483, St. Michael and All Angels Episcopal Church, Anniston,	Calhoun	10
73000333, Coldwater Creek Covered Bridge, Coldwater,	Calhoun	10

[a]Multiply km by 0.6214 to obtain miles.
Source: J. Byrne of the National Register, personal communication to G. Rogers, ORNL, July 27, 1988.

The final draft of the first comprehensive county-wide emergency plan for Calhoun County was distributed to appropriate organizations in the area in January 1989. Within the county, only Anniston has a written disaster plan, which is loosely coordinated with county plans. Talladega County's draft emergency operations plan was completed in April 1989. All other municipalities in the county have designated the county as the lead agency for emergency management (Sam B. Slone III, Director of Emergency Management, Calhoun County, personal communication with G. Rogers, ORNL, Feb. 8, 1989).

Calhoun County has limited recent disaster experience. Local emergency management officials responded to a tornado that touched down in Oxford on December 3, 1983, where 50 people were injured and two people were killed. Another smaller tornado touched down in the county in 1984 and resulted in fewer injuries and no fatalities. However, because the comprehensive county emergency plan did not exist at that time, the plan has never been put into effect in the county (Sam B. Slone III, Director of Emergency Management, Calhoun County, personal communication with G. Rogers, ORNL, Feb. 8, 1989).

County participation in ANAD exercises has been limited to communications roles to date, with the most recent being in the first quarter of 1989. A series of tabletop training, and full-field exercises is envisioned by local officials to help provide adequate emergency preparedness (Sam B. Slone III, Director of Emergency Management, Calhoun County, personal communication with G. Rogers, ORNL, Feb. 8, 1989). The most important weaknesses in the current emergency capabilities deal with warning the public and notifying them concerning appropriate actions. Another recognized weakness involves the communications system among community response organizations, county organizations, and local municipality responders.

The county emergency operations center (EOC) is located in the basement of the county courthouse. Comprising approximately 325 m^2 (3500 ft^2), the facility is currently being remodeled to better suit the needs of EMA staff and off-duty EMA staff and volunteers. The EOC is normally used for office space for EMA staff (Sam B. Slone III, Director of Emergency Management, Calhoun County, personal communication with G. Rogers, ORNL, Feb. 8, 1989).

F.6 REFERENCES FOR APPENDIX F

Ayers, Harry M. 1940. "A Thumb-nail Sketch of Calhoun County," from the Calhoun County Library, Anniston, Ala.

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